SL Paper 1

The first term of a geometric sequence is 2 and the third term is 2.205.

a. Calculate the common ratio of the sequence; [2]

b. Calculate the eleventh term of the sequence; [2]

c. Calculate the sum of the first 23 terms of the sequence. [2]

Markscheme

a. $2r^2 = 2.205$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in geometric sequence formula.

$r = 1.05$ ***(A1)*** ***(C2)***

[2 marks]

b. $2(1.05)^{10}$ ***(M1)***

Note: Award ***(M1)*** for the correct substitution, using their answer to part (a), in geometric sequence formula.

$= 3.26$ (3.25778…) ***(A1)*****(ft)** ***(C2)***

Note: Follow through from their part (a).

[2 marks]

c. $\frac{2(1.05^{23}-1)}{(1.05-1)}$ ***(M1)***

Note: Award ***(M1)*** for their correct substitution in geometric sum formula.

$= 82.9$ (82.8609…) ***(A1)*****(ft)** ***(C2)***

Notes: Accept an answer of 3.97221...if $r = -1.05$ is found in part (a) and used again in part (c). Follow through from their part (a).

[2 marks]

Examiners report

a. In part (a), 1.1025 proved to be a popular, but erroneous, answer. Similarly to question 4, such candidates failed to find a square root. Whilst this accuracy mark was lost for such candidates, much good work was seen in this question reflecting how well drilled the majority of candidates were in both arithmetic and geometric sequence techniques.

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a. **In this question give all answers correct to two decimal places.** [3]

Diogo deposited 8000 Argentine pesos, ARS, in a bank account which pays a nominal annual interest rate of 15%, **compounded monthly**. Find how much **interest** Diogo has earned after 2 years.

b. Carmen also deposited ARS in a bank account. Her account pays a nominal annual interest rate of 17%, **compounded yearly**. After three years, the total amount in Carmen's account is $10\,000\ \text{ARS}$. [3]

Find the amount that Carmen deposited in the bank account.

Markscheme

a. **The first time an answer is not given to two decimal places the final *(A1)* is not awarded.**

$FV = 8000 \times \left(1 + \frac{15}{100 \times 12}\right)^{2 \times 12} \quad \left(FV = 8000 \times (1.0125)^{2 \times 12}\right)$ ***(M1)(A1)***

OR

$I = 8000 \times \left(1 + \frac{15}{100 \times 12}\right)^{2 \times 12} - 8000$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution into compound interest formula, ***(A1)*** for correct substitutions.

OR

$N = 24$

$I\% = 15$

$PV = -8000$

$PMT = 0$

$(FV = 10778.8084)$

$P/Y = 12$

$C/Y = 12$ ***(A1)(M1)***

Note: Award ***(A1)*** for $C/Y = 12$ seen, ***(M1)*** for **all** other correct entries. $FV = 10778.8084$ need not be seen.

OR

$N = 2$

$I\% = 15$

$PV = -8000$

$PMT = 0$

$(FV = 10778.8084)$

$P/Y = 1$

$C/Y = 12$ ***(A1)(M1)***

Note: Award ***(A1)*** for $C/Y = 12$ seen, ***(M1)*** for **all** other correct entries. $FV = 10778.8084$ need not be seen.

interest $= 2778.81$ ***(A1)*** ***(C3)***

Note: Final answer must be to two decimal places for the ***(A1)*** to be awarded.

b. $N = 3$

$I\% = 17$

$(PV = \pm 6243.705564)$

$PMT = 0$

$(FV = \mp 10\,000)$

$P/Y = 1$

$C/Y = 1$ ***(A1)(M1)***

Note: Award ***(A1)*** for $FV = \mp 10\,000$, ***(M1)*** for **all** other correct entries. $PV = \pm 6243.705564$ need not be seen.

OR

$10\,000 = PV \times \left(1 + \frac{17}{100}\right)^3$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituting into compound interest formula, ***(A1)*** for equating $10\,000$ to the correctly substituted compounded interest formula.

$(PV =)\ 6243.71$ ***(A1)*** ***(C3)***

Note: Answer must be to two decimal places.

Examiners report

a. **Question 12: Compound Interest**

The use of the TVM solver, with lack of working, remains a source of concern, though many more are writing down the calculator display; candidates are advised still to write down substituted formulas prior to using the TVM solver. Compounding periods remain a source of confusion

The use of the 0.15 and 0.17 was a common error, as was the computation of the amount in part (a).

b. Question 12: Compound Interest

The use of the TVM solver, with lack of working, remains a source of concern, though many more are writing down the calculator display; candidates are advised still to write down substituted formulas prior to using the TVM solver. Compounding periods remain a source of confusion

The use of the 0.15 and 0.17 was a common error, as was the computation of the amount in part (a).

The exchange rate between Indian rupees (INR) and Singapore dollars (S$) is $100\ \text{INR} = \text{S\$}\ 3.684$

a. Kwai Fan changes $\text{S\$}\ 500$ to Indian rupees. [2]

Calculate the number of Indian rupees she will receive using this exchange rate. **Give your answer correct to the nearest rupee.**

b. On her return to Singapore, Kwai Fan has 2500 Indian rupees left from her trip. She wishes to exchange these rupees back to Singapore dollars. There is a 3% commission charge for this transaction and the exchange rate is $100 \text{ INR} = \text{S\$}3.672$. [2]

Calculate the commission in Indian rupees that she is charged for this exchange.

c. On her return to Singapore, Kwai Fan has 2500 Indian rupees left from her trip. She wishes to exchange these rupees back to Singapore dollars. There is a 3% commission charge for this transaction and the exchange rate is $100 \text{ INR} = \text{S\$}3.672$. [2]

Calculate the amount of money she receives in Singapore dollars, **correct to two decimal places**.

Markscheme

a. *Financial penalty **(FP)** applies in this question.*

$500 \times \frac{100}{3.684}$ ***(M1)***

FP $= 13572$ ***(A1)*** ***(C2)***

Note: ***(M1)*** for multiplication by $\frac{100}{3.684}$

[2 marks]

b. 2500×0.03 ***(M1)***

$= 75 \ (75.0, 75.00)$ ***(A1)*** ***(C2)***

If $2500 \times 0.03 \times \frac{3.672}{100}$

$= 2.75$

*Award **(M1)(A0)***

[2 marks]

c. *Financial penalty **(FP)** applies in this question.*

$2425 \times \frac{3.672}{100}$ ***(M1)*****(ft)**

FP $= 89.05$ ***(A1)*****(ft)**

OR

$\frac{3.672}{100} \times 0.97 \times 2500$ ***(M1)*****(ft)**

FP $= 89.05$ ***(A1)*****(ft)**

OR

$3\% \text{ of } 91.8 = 2.754$

$91.8 - 2.754$ ***(M1)*****(ft)**

FP $= 89.05$ ***(A1)*****(ft)*** ***(C2)***

Note: (ft) in **(c)** if the conversion process is reversed consistently through the question, i.e. multiplication in **(a)** followed by division in **(c)**.

[2 marks]

Examiners report

a. This caused problems for many candidates. The form of the exchange rate proved difficult.

b. Most candidates managed to answer this correctly.

c. This part also proved problematic for many candidates.

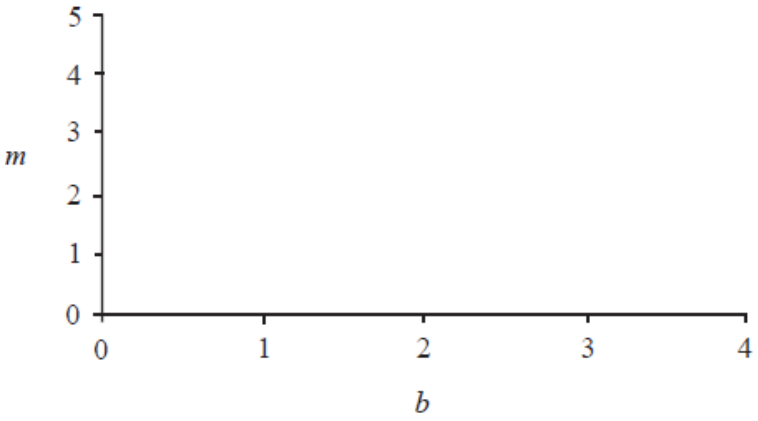
A store sells bread and milk. On Tuesday, 8 loaves of bread and 5 litres of milk were sold for \$21.40. On Thursday, 6 loaves of bread and 9 litres of milk were sold for \$23.40.

If $b =$ the price of a loaf of bread and $m =$ the price of one litre of milk, Tuesday's sales can be written as $8b + 5m = 21.40$.

a. Using simplest terms, write an equation in *b* and *m* for Thursday's sales. [2]

b. Find *b* and *m*. [2]

c. Draw a sketch, in the space provided, to show how the prices can be found graphically. [2]



Markscheme

a. Thursday's sales, $6b + 9m = 23.40$ ***(A1)***

$2b + 3m = 7.80$ ***(A1)*** ***(C2)***

[2 marks]

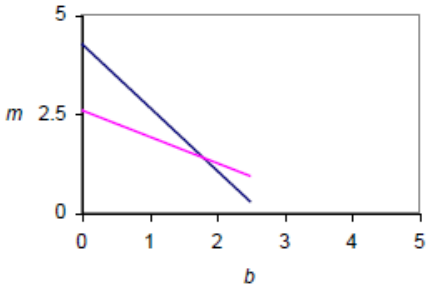
b. $m = 1.40$ *(accept 1.4)* ***(A1)*****(ft)**

$b = 1.80$ *(accept 1.8)* ***(A1)*****(ft)**

Award ***(A1)****(d) for a reasonable attempt to solve by hand and answer incorrect.* ***(C2)***

[2 marks]

c.



(A1)(A1)**(ft)**

(A1) *each for two reasonable straight lines. The intersection point must be approximately correct to earn both marks, otherwise penalise at least one line.*

Note: The follow through mark is for candidate's line from (a). ***(C2)***

[2 marks]

Examiners report

a. a) Nearly all the candidates were able to write the equation but very few simplified it.

b. b) A majority of candidates were able to find the values of b and m. Some used the right method but made arithmetical errors, many of which were due to them using the method of substitution which involved fractions. GDC use was expected.

c. c) A majority of candidates did not attempt this part. For those who did, very few were able to sketch the graph correctly. Common errors were to plot the point (1.4, 1.8) or draw a straight line through that point and the origin.

The annual fees paid to a school for the school years 2000, 2001 and 2002 increase as a geometric progression. The table below shows the fee structure.

Year	Fees (USD)
2000	8000.00
2001	8320.00
2002	8652.80

a. Calculate the common ratio for the increasing sequence of fees. [2]

b. **Give your answer correct to 2 decimal places.** [2]

The fees continue to increase in the same ratio.

Find the fees paid for 2006.

c. **Give your answer correct to 2 decimal places.** [2]

The fees continue to increase in the same ratio.

A student attends the school for eight years, starting in 2000.

Find the **total** fees paid for these eight years.

Markscheme

a. $r = \frac{8320}{8000}$ (or equivalent) ***(M1)***

Note: Award ***(M1)*** for dividing correct terms.

$r = 1.04$ ***(A1)*** ***(C2)***

Notes: In (b) and (c) **(ft)** from candidate's r.

Allow lists, graphs *etc.* as working in (b) and (c).

[2 marks]

b. ***Financial penalty (FP) applies in this part***

Fees = $8000\ (1.04)^6$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into correct formula.

(FP) Fees = 10122.55 USD (USD not required) ***(A1)*(ft)*** ***(C2)***

Note: Special exception to the note above.

Award maximum of ***(M1)(A0)*** if 5 is used as the power.

[2 marks]

c. ***Financial penalty (FP) applies in this part***

$\text{Total} = \frac{8000(1.04^8-1)}{1.04-1}$ ***(M1)***

Notes: Award ***(M1)*** for correct substitution into correct formula.

Give full credit for solution by lists.

(FP) Total = 73713.81 USD (USD not required) ***(A1)*(ft)*** ***(C2)***

[2 marks]

Examiners report

a. Many marks were lost through incorrect rounding or premature rounding (if a year by year approach was used).

This part was well attempted, errors being the use of 4% as the common ratio.

b. Many marks were lost through incorrect rounding or premature rounding (if a year by year approach was used).

The common error here was the use of the incorrect index in the formula.

c. Many marks were lost through incorrect rounding or premature rounding (if a year by year approach was used).

Attempts at calculation without use of the formula were largely unsuccessful.

An amount, C, of Australian Dollars (AUD) is invested for 5 years at 2.5 % yearly simple interest. The interest earned on this investment is 446.25 AUD.

5000 AUD is invested at a nominal annual interest rate of 2.5 % **compounded half yearly**.

Calculate the length of time in years for the interest on this investment to exceed 446.25 AUD.

Markscheme

$446.25 = 5000\left(1 + \frac{2.5}{2(100)}\right)^{2n} - 5000$ ***(M1)(A1)***

Notes: Award ***(M1)*** for substitution into compound interest formula. Award ***(A1)*** for correct values.

$5446.25 = 5000\left(1 + \frac{2.5}{2(100)}\right)^{2n}$ ***(A1)***

n = 3.44

n = 3.5 ***(A1)***

OR

$5446.25 = 5000(1.0125)^{2n}$ ***(A1)(M1)(A1)***

Notes: Award ***(A1)*** for 5446.25 seen.

Award ***(M1)*** for substitution into compound interest formula.

Award ***(A1)*** for correct values.

n = 3.44 years

3.5 years required ***(A1)*** ***(C4)***

Notes: For incorrect substitution into compound interest formula award at most ***(M1)(A0)(A1)(A0)***.

Award ***(A3)*** for 3.44 seen without working.

Allow solution by lists. In this case

Award ***(A1)*** for half year rate 1.25 % seen.

(A1) for 5446.25 seen.

(M1) for at least 2 correct uses of multiplication by 1.0125

5000 × 1.0125 = 5062.5 and 5062.5 × 1.0125 = 5125.78125

(A1) *n* = 3.5

If yearly rate used then award ***(A0)(A1)(M1)(A0)***

[4 marks]

Examiners report

This question was poorly answered by many of the candidates. Candidates confuse interest with principal in the formulas.

The idea of compounding periods and the implication for determining the level of interest is poorly understood. The correct answer is 3.5 years. Interpretation of compounding periods is expected.

In this question give all answers correct to two decimal places.

Chiara is an Italian tourist visiting Sweden. The exchange rate for changing euros (€) into Swedish Krona (SEK) is 1€ = 10.275 SEK. She converts 350 euros into Swedish Krona at a bank which charges 2 % commission.

a. Calculate the amount of commission charged in **SEK**. [3]

b. Write down the amount of money she receives from the bank after commission. [1]

c. Chiara returns to Italy with 296 SEK. She changes this money back into euros at a bank and receives 32€. The bank does not charge commission. [2]

Calculate the value in SEK of 1€.

Markscheme

a. 350 × 10.275 × 0.02 ***(M1)(M1)***

Note: Award ***(M1)*** for ×10.275, ***(M1)*** for ×0.02.

71.93 (SEK) ***(A1)*** ***(C3)***

[3 marks]

b. 3524.33(SEK) ***(A1)*(ft)** ***(C1)***

Note: Accept 3524.32. Follow through from their answer to part (a).

[1 mark]

c. $\frac{296}{32}$ ***(M1)***

9.25 ***(A1)*** ***(C2)***

[2 marks]

Examiners report

a. A common error in Question 9 was finding the amount of money received for part (a) rather than just the commission. Some candidates had difficulties giving the appropriate number of decimal places.

b. A common error in Question 9 was finding the amount of money received for part (a) rather than just the commission. Some candidates had difficulties giving the appropriate number of decimal places.

c. A common error in Question 9 was finding the amount of money received for part (a) rather than just the commission. Some candidates had difficulties giving the appropriate number of decimal places.

Consider the function $f(x) = ax^3 - 3x + 5$, where $a \neq 0$.

a. Find $f'(x)$. [2]

b. Write down the value of $f'(0)$. [1]

c. The function has a local maximum at $x = -2$. [3]

Calculate the value of a.

Markscheme

a. $f'(x) = 3ax^2 - 3$ ***(A1)(A1)*** ***(C2)***

Note: Award a maximum of ***(A1)(A0)*** if any extra terms are seen.

b. –3 ***(A1)*****(ft)** ***(C1)***

Note: Follow through from their part (a).

c. $f'(x) = 0$ ***(M1)***

Note: This may be implied from line below.

$3a(-2)^2 - 3 = 0$ ***(M1)***

$(a =) \frac{1}{4}$ ***(A1)*****(ft)** ***(C3)***

Note: Follow through from their part (a).

Examiners report

a. Many candidates could find the derivative of the cubic function and find the value of the derivative at $x = 0$. For part (c) many candidates calculated the value of the function rather than the derivative at $x = -2$.

b. Many candidates could find the derivative of the cubic function and find the value of the derivative at $x = 0$.

c. Many candidates could find the derivative of the cubic function and find the value of the derivative at $x = 0$. For part (c) many candidates calculated the value of the function rather than the derivative at $x = -2$. However only the best realized that the derivative is zero at the maximum and so calculated the value of a.

Given that $z = \frac{12\cos(A)}{4q+r}$ and that $A = 60^\circ$, $q = 8$ and $r = 32$;

a. Find the **exact** value of z. [2]

b.i. Write your answer to part (a) correct to 2 decimal places. [1]

b.ii. Write your answer to part (a) correct to three significant figures. [1]

b.iii. Write your answer to part (a) in the form $a \times 10^k$, where $1 \leq a < 10$, $k \in \mathbb{Z}$. [2]

Markscheme

a. $z = \frac{12\cos(60^\circ)}{(4(8)+32)}$ ***(M1)***

Note: Award ***(M1)*** for correct substituted formula seen.

$= 0.09375\left(\frac{3}{32}\right)$ ***(A1)(C2)***

[2 marks]

b.i. 0.09 ***(A1)*(ft)** ***(C1)***

[1 mark]

b.ii. 0.0938 ***(A1)*(ft)** ***(C1)***

[1 mark]

b.iii. 9.375×10^{-2} (9.38×10^{-2}) ***(A1)*(ft)*(A1)*(ft)** ***(C2)***

Note: Award ***(A1)*(ft)*** for 9.375, ***(A1)*(ft)*** for $\times 10^{-2}$. Follow through from their part (a).

[2 marks]

Examiners report

a. Although the use of radians leading to an incorrect answer of -0.1785774388 was seen on a minority of scripts, many candidates produced correct answers for parts (a) and (b)(i). The requirement for an answer to 3 significant figures led many to count the first zero after the decimal point and as a consequence gave an incorrect answer of 0.094. Despite any previous incorrect working, it was pleasing to see that most candidates were able to express their answer to part (a) in standard form.

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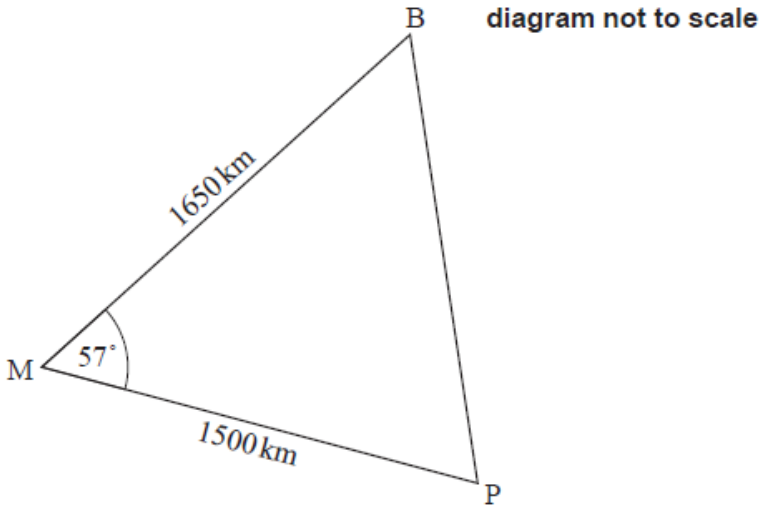
a. When Bermuda (B), Puerto Rico (P), and Miami (M) are joined on a map using straight lines, a triangle is formed. This triangle is known as the Bermuda triangle. [3]

According to the map, the distance MB is $1650\,\mathrm{km}$, the distance MP is $1500\,\mathrm{km}$ and angle BMP is 57°.



Calculate the distance from Bermuda to Puerto Rico, BP.

b. Calculate the area of the Bermuda triangle. [3]

Markscheme

a. $\mathrm{BP}^2 = 1650^2 + 1500^2 - 2 \times 1650 \times 1500 \cos(57^\circ)$ ***(M1)(A1)***

$1510\,(\mathrm{km})$ $(1508.81...\,(\mathrm{km}))$ ***(A1)*** ***(C3)***

Notes: Award ***(M1)*** for substitution in the cosine rule formula, ***(A1)*** for correct substitution.

b. $\frac{1}{2} \times 1650 \times 1500 \times \sin 57^\circ$ ***(M1)(A1)***

$= 1\,040\,000\,(\mathrm{km}^2)$ $\left(1\,037\,854.82...\,(\mathrm{km}^2)\right)$ ***(A1)*** ***(C3)***

Note: Award ***(M1)*** for substitution in the area of triangle formula, ***(A1)*** for correct substitution.

Examiners report

a. Question 6: Non-right angle trigonometry.

Instead of using the law of cosines weaker candidates substituted into Pythagoras' theorem and likewise used $A = \frac{1}{2}bh$ instead of $A = \frac{1}{2}ab\sin C$. Those that did select the correct formula almost always made correct substitutions but were not always able to calculate the correct answer.

b. Question 6: Non-right angle trigonometry. Instead of using the law of cosines weaker candidates substituted into Pythagoras' theorem and likewise used $A = \frac{1}{2}bh$ instead of $A = \frac{1}{2}ab\sin C$. Those that did select the correct formula almost always made correct substitutions but were not always able to calculate the correct answer.

The fifth term of an arithmetic sequence is 20 and the twelfth term is 41.

a. (i) Find the common difference. [3]

(ii) Find the first term of the sequence.

b. Calculate the eighty-fourth term. [1]

c. Calculate the sum of the first 200 terms. [2]

Markscheme

a. (i) $u_5 = u_1 + 4d = 20$

$u_{12} = u_1 + 11d = 41$ ***(M1)***

(M1) *for both equations correct* (or ***(M1)*** for $20 + 7d = 41$)

$7d = 21$

$d = 3$ ***(A1)*** ***(C2)***

(ii) $u_1 + 12 = 20$

$u_1 = 8$ ***(A1)*****(ft)** ***(C1)***

[3 marks]

b. $u_{84} = 8 + (84 - 1)3$

$= 257$ ***(A1)*****(ft)** ***(C1)***

[1 mark]

c. $S_{200} = 100(16 + 199 \times 3)$ ***(M1)***

$= 61300$ ***(A1)*****(ft)** ***(C2)***

[2 marks]

Examiners report

a. This question was generally answered well. Most of the candidates had a good understanding of how to use the formulae for an arithmetic sequence.

b. This question was generally answered well. Most of the candidates had a good understanding of how to use the formulae for an arithmetic sequence.

c. This question was generally answered well. Most of the candidates had a good understanding of how to use the formulae for an arithmetic sequence.

The second term of an arithmetic sequence is 30. The fifth term is 90.

a. Calculate [3]

(i) the common difference of the sequence;

(ii) the first term of the sequence.

b. The first, second and fifth terms of this arithmetic sequence are the first three terms of a geometric sequence. [3]

Calculate the seventh term of the **geometric** sequence.

Markscheme

a. (i) $u_1 + d = 30,\ u_1 + 4d = 90,\ 3d = 90 - 30$ (or equivalent) ***(M1)***

Note: Award ***(M1)*** for **one** correct equation. Accept a list of at least 5 correct terms.

$(d =)\ 20$ ***(A1)***

(ii) $(u_1 =)\ 10$ ***(A1)*****(ft)** ***(C3)***

Note: Follow through from (a)(i), irrespective of working shown if $u_1 = 30 - (\text{their } d)$ **OR** $u_1 = 90 - 4 \times (\text{their } d)$

b. $(u_7 =)\ 10(3^{(7-1)}$ **OR** $(u_7 =)\ 10 \times 3^6$ ***(M1)(A1)*****(ft)**

Note: Award ***(M1)*** for substituted geometric sequence formula, ***(A1)*****(ft)** for their correct substitutions.

OR

$10;\ 30;\ 90;\ 270;\ 810;\ 2430;\ 7290$ ***(M1)(A1)*****(ft)**

Note: Award ***(M1)*** for a list of at least 5 consecutive terms of a geometric sequence, ***(A1)*****(ft)** for terms corresponding to their answers in part (a).

$= 7290$ ***(A1)*****(ft)** ***(C3)***

Note: Follow through from part (a).

Examiners report

a. Part (a) was answered correctly by many candidates, but working using equations was rarely seen. A “trial and error” method, based upon a list of terms was the most seen method.

b. In part (b) many found the correct answer, but many others did not. Some gave the seventh term of the arithmetic sequence, some gave a term of an incorrect order and some a completely incorrect answer. Finding the correct ratio was the most common problem. Often repeated multiplication was used to find the answer, but also the formula for the nth term of a geometric sequence was used. Several did not use the correct three terms from the question.

The length of a square garden is $(x + 1)$ m. In one of the corners a square of 1 m length is used only for grass. The rest of the garden is only for planting roses and is shaded in the diagram below.

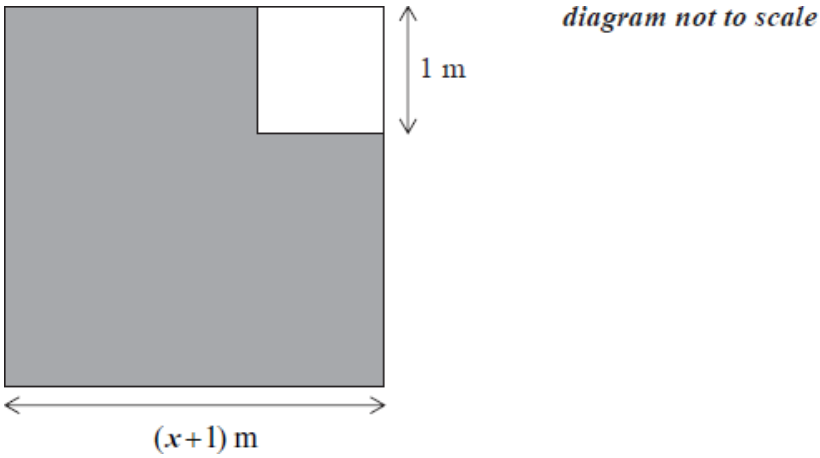


diagram not to scale

The area of the shaded region is A .

a. Write down an expression for A in terms of x. [1]

b. Find the value of x given that $A = 109.25$ m^2. [3]

c. The owner of the garden puts a fence around the shaded region. Find the length of this fence. [2]

Markscheme

a. $(x + 1)^2 - 1$ ***or*** $x^2 + 2x$ ***(A1)*** ***(C1)***

[1 mark]

b. $(x + 1)^2 - 1 = 109.25$ ***(M1)***

$x^2 + 2x - 109.25 = 0$ ***(M1)***

Notes: Award ***(M1)*** for writing an equation consistent with their expression in (a) (accept equivalent forms), ***(M1)*** for correctly removing the brackets.

OR

$(x + 1)^2 - 1 = 109.25$ ***(M1)***

$x + 1 = \sqrt{110.25}$ ***(M1)***

Note: Award ***(M1)*** for writing an equation consistent with their expression in (a) (accept equivalent forms), ***(M1)*** for taking the square root of both sides.

OR

$(x + 1)^2 - 10.5^2 = 0$ ***(M1)***

$(x - 9.5)(x + 11.5) = 0$ ***(M1)***

Note: Award ***(M1)*** for writing an equation consistent with their expression in (a) (accept equivalent forms), ***(M1)*** for factorised left side of the equation.

$x = 9.5$ ***(A1)*****(ft)** ***(C3)***

Note: Follow through from their expression in part (a).

The last mark is lost if x is non positive.

If the follow through equation is not quadratic award at most ***(M1)(M0)(A1)*****(ft)**.

[3 marks]

c. $4 \times (9.5 + 1) = 42$ m ***(M1)(A1)*****(ft)** ***(C2)***

Notes: Award ***(M1)*** for correct method for finding the length of the fence. Accept equivalent methods.

[2 marks]

Examiners report

a. Some candidates were able to answer this question correctly, but the majority experienced difficulty in finding the correct expression for the area of the shaded region. Those who showed working could then be awarded follow through marks for correctly equating their expressions to the given area and for their found value of x. Many candidates also could not find the perimeter of the shaded region in part c) even though they had found the value of x correctly.

b. Some candidates were able to answer this question correctly, but the majority experienced difficulty in finding the correct expression for the area of the shaded region. Those who showed working could then be awarded follow through marks for correctly equating their expressions to the given area and for their found value of x. Many candidates also could not find the perimeter of the shaded region in part c) even though they had found the value of x correctly.

c. Some candidates were able to answer this question correctly, but the majority experienced difficulty in finding the correct expression for the area of the shaded region. Those who showed working could then be awarded follow through marks for correctly equating their expressions to the given area and for their found value of x. Many candidates also could not find the perimeter of the shaded region in part c) even though

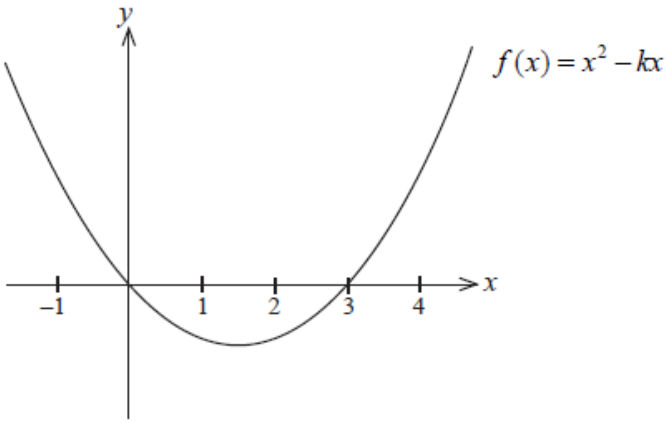
they had found the value of x correctly.

---

a. Factorise the expression $x^2 - kx$. [1]

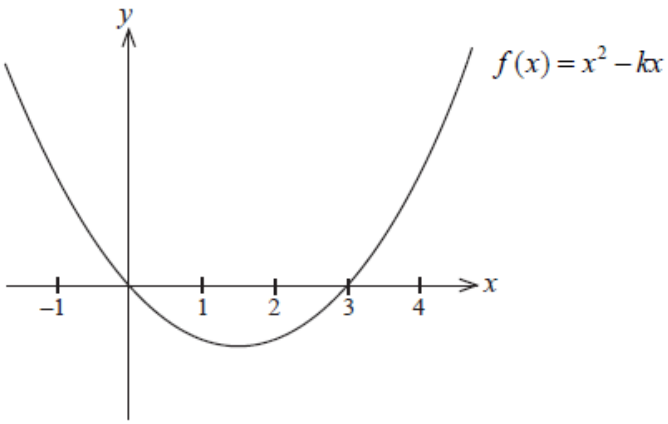
b. Hence solve the equation $x^2 - kx = 0$. [1]

c. The diagram below shows the graph of the function $f(x) = x^2 - kx$ for a particular value of k. [1]



Write down the value of k for this function.

d. The diagram below shows the graph of the function $f(x) = x^2 - kx$ for a particular value of k. [3]



Find the minimum value of the function $y = f(x)$.

Markscheme

a. $x(x - k)$ ***(A1)*** ***(C1)***

[1 mark]

b. $x = 0$ **or** $x = k$ ***(A1)*** ***(C1)***

Note: Both correct answers only.

[1 mark]

c. $k = 3$ ***(A1)*** ***(C1)***

[1 mark]

d. $\text{Vertex at } x = \frac{-(-3)}{2(1)}$ ***(M1)***

Note: ***(M1)*** for correct substitution in formula.

$x = 1.5$ ***(A1)*****(ft)**

$y = -2.25$ ***(A1)*****(ft)**

OR

$f'(x) = 2x - 3$ ***(M1)***

Note: ***(M1)*** for correct differentiation.

$x = 1.5$ ***(A1)*****(ft)**
$y = -2.25$ ***(A1)*****(ft)**

OR

for finding the midpoint of their 0 and 3 ***(M1)***
$x = 1.5$ ***(A1)*****(ft)**
$y = -2.25$ ***(A1)*****(ft)**

Note: If final answer is given as $(1.5, -2.25)$ award a maximum of ***(M1)(A1)(A0)***

[3 marks]

Examiners report

a. This question was poorly answered by all but the best candidates. The links between the parts were not made. The idea of the line of symmetry for the graph was seldom investigated. The “minimum value of the function” was often incorrectly given as a coordinate pair.

b. This question was poorly answered by all but the best candidates. The links between the parts were not made. The idea of the line of symmetry for the graph was seldom investigated. The “minimum value of the function” was often incorrectly given as a coordinate pair.

c. This question was poorly answered by all but the best candidates. The links between the parts were not made. The idea of the line of symmetry for the graph was seldom investigated. The “minimum value of the function” was often incorrectly given as a coordinate pair.

d. This question was poorly answered by all but the best candidates. The links between the parts were not made. The idea of the line of symmetry for the graph was seldom investigated. The “minimum value of the function” was often incorrectly given as a coordinate pair.

Minta deposits 1000 euros in a bank account. The bank pays a nominal annual interest rate of 5%, **compounded quarterly**.

a. Find the amount of money that Minta will have in the bank after 3 years. Give your answer correct to two decimal places. [3]

b. Minta will withdraw the money from her bank account when the interest earned is 300 euros. [3]

Find the time, in years, until Minta withdraws the money from her bank account.

Markscheme

a. $1000\left(1+\frac{5}{4\times100}\right)^{4\times3}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution into compound interest formula, ***(A1)*** for correct substitution.

OR

$\mathrm{N}=3$

$\mathrm{I}\%=5$

$\mathrm{PV}=-1000$

$\mathrm{P/Y}=1$

$\mathrm{C/Y}=4$ ***(A1)(M1)***

Note: Award ***(A1)*** for $\mathrm{C/Y}=4$ seen, ***(M1)*** for other correct entries.

OR

$\mathrm{N}=12$

$\mathrm{I}\%=5$

$\mathrm{PV}=-1000$

$\mathrm{P/Y}=4$

$\mathrm{C/Y}=4$ ***(A1)(M1)***

Note: Award ***(A1)*** for $\mathrm{C/Y}=4$ seen, ***(M1)*** for other correct entries.

$=1160.75$ (€) ***(A1)*** ***(C3)***

b. $1000\left(1+\frac{5}{4\times100}\right)^{4\times t}=1300$ ***(M1)(A1)***

Note: Award ***(M1)*** for using the compound interest formula with a variable for time, ***(A1)*** for substituting correct values and equating to 1300.

OR

$\mathrm{I}\%=5$

$\mathrm{PV}=\pm1000$

$\mathrm{FV}=\mp1300$

$\mathrm{P/Y}=1$

$\mathrm{C/Y}=4$ ***(A1)(M1)***

Note: Award ***(A1)*** for 1300 seen, ***(M1)*** for the other correct entries.

OR

$\mathrm{I}\%=5$

$\mathrm{PV}=\pm1000$

$\mathrm{FV}=\mp1300$

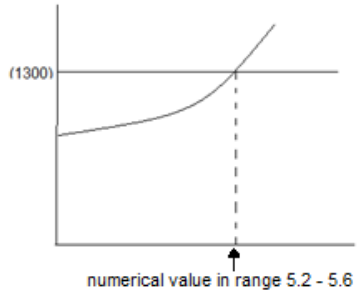
$\mathrm{P}/\mathrm{Y} = 4$

$\mathrm{C}/\mathrm{Y} = 4$ ***(A1)(M1)***

Note: Award ***(A1)*** for 1300 seen, ***(M1)*** for the other correct entries.

OR

Sketch drawn of two appropriate lines which intersect at a point



Note: Award ***(M1)*** for a sketch with a straight line intercepted by appropriate curve, ***(A1)*** for a numerical answer in the range $5.2 - 5.6$.

$t = 5.28\ (\text{years})\quad (5.28001\ldots)$ ***(A1) (C3)***

Examiners report

a. [N/A]
b. [N/A]

The tenth term of an arithmetic sequence is 32 and the common difference is –6.

a. Find the first term of the sequence. [2]

b. Find the 21st term of the sequence. [2]

c. Find the sum of the first 30 terms of the sequence. [2]

Markscheme

a. $32 = u_1 + (10 - 1) \times (-6)$ ***(M1)***

Notes: Award ***(M1)*** for correct substitution in correct formula. Accept correct alternative methods.

$u_1 = 86$ ***(A1)*** ***(C2)***

[2 marks]

b. $u_{21} = 86 + (21 - 1) \times (-6)$ ***(M1)***

$u_{21} = -34$ ***(A1)*(ft)**

Notes: Award ***(M1)*** for correct substitution in correct formula. Accept correct alternative methods. Award ***(M1)*** for a list of at least 5 correct terms seen. Follow through from their answer to part (a).

OR

$u_{21} = 32 + 11 \times (-6)$ ***(M1)***

$u_{21} = -34$ ***(A1)*** ***(C2)***

[2 marks]

c. $S_{30} = \frac{30}{2}(2 \times 86 + (30-1) \times (-6))$ ***(M1)***

Notes: Award ***(M1)*** for their correct substitution in correct formula. Accept correct alternative methods. For a list award ***(M1)*** for the correct addition of at least 10 terms.

$S_{30} = -30$ ***(A1)*****(ft)** ***(C2)***

Notes: Follow through from their answer to part (a).

[2 marks]

Examiners report

a. This question was very well answered by most candidates. Correct working was clearly shown. Many candidates used 32 as their first term and many others subtracted 6 rather than multiplied by -6, indicating a lack of attention in their algebraic notation and manipulation.

b. This question was very well answered by most candidates. Correct working was clearly shown. Many candidates used 32 as their first term and many others subtracted 6 rather than multiplied by -6, indicating a lack of attention in their algebraic notation and manipulation.

c. This question was very well answered by most candidates. Correct working was clearly shown. Many candidates used 32 as their first term and many others subtracted 6 rather than multiplied by -6, indicating a lack of attention in their algebraic notation and manipulation.

The first three terms of a geometric sequence are $u_1 = 486,\ u_2 = 162,\ u_3 = 54$.

a. Find the value of r, the common ratio of the sequence. [2]

b. Find the value of n for which $u_n = 2$. [2]

c. Find the sum of the first 30 terms of the sequence. [2]

Markscheme

a. $\frac{162}{486}$ **OR** $\frac{54}{162}$ ***(M1)***

Note: Award ***(M1)*** for dividing any u_{n+1} by u_n.

$= \frac{1}{3}\ (0.333,\ 0.333333\ldots)$ ***(A1)*** ***(C2)***

[2 marks]

b. $486\left(\frac{1}{3}\right)^{n-1} = 2$ ***(M1)***

Note: Award ***(M1)*** for their correct substitution into geometric sequence formula.

$n = 6$ ***(A1)*(ft)** ***(C2)***

Note: Follow through from part (a).

Award ***(A1)(A0)*** for $u_6 = 2$ or u_6 with or without working.

[2 marks]

c. $S_{30} = \frac{486\left(1-\frac{1}{3}^{30}\right)}{1-\frac{1}{3}}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into geometric series formula.

$= 729$ ***(A1)*(ft)** ***(C2)***

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

Javier starts training for a running race.

On the first day he runs 1.5 km. Every day he runs 10 % more than the day before.

a. Write down the distance he runs on the second day of training. [1]

b. Calculate the **total** distance Javier runs in the first seven days of training. [2]

c. Javier stops training on the day his total distance exceeds 100 km. [3]

Calculate the number of days Javier has trained for the running race.

Markscheme

a. 1.65 (km) or 1650 (m) ***(A1)*** ***(C1)***

[1 mark]

b. $\frac{1.5(1.1^7-1)}{1.1-1}$ ***(M1)***

Notes: Award ***(M1)*** for correct substitution of candidate's 10 % into the correct formula. Accept a list.

14.2 (km) ***(A1)*****(ft)** ***(C2)***

[2 marks]

c. $\frac{1.5(1.1^n-1)}{1.1-1} > 100$ ***(M1)***

Note: Award ***(M1)*** for setting up their inequality/equation. Accept a list.

n = 21.371... ***(A1)*****(ft)**

n = 22 ***(A1)*****(ft)** ***(C3)***

Notes: Follow through from their values of 1.1 and 1.5 in part (b). The final ***(A1)*****(ft)** is for rounding up their answer for *n* to a whole number of days.

[3 marks]

Examiners report

a. Most candidates could answer the first part of this question, although a number found it difficult to find the total distance run after 7 days.

Many gave the correct answer of 1.65 km or 1650 m for part (a).

b. In part (b), stronger candidates answered correctly, however many used a list or the incorrect arithmetic formula.

c. In part (c), the most common mistake was to use the arithmetic formula. Many candidates rounded their answer down rather than up.

Claudia travels from Buenos Aires to Barcelona. She exchanges 8000 Argentine Pesos (ARS) into Euros (EUR).

The exchange rate is 1 ARS = 0.09819 EUR. The bank charges a 2% commission on the exchange.

When Claudia returns to Buenos Aires she has 85 EUR left and exchanges this money back into ARS. The exchange rate is 1 ARS = 0.08753 EUR.

The bank charges r% commission. The commission charged on this exchange is 14.57 ARS.

a. Find the amount of Euros that Claudia receives. Give your answer correct to two decimal places. [3]

b. Find the value of r. [3]

Markscheme

a. $8000 \times 0.09819 \times 0.98$ ***(M1)(M1)***

Note: Award ***(M1)*** for multiplying 8000 by 0.09819, ***(M1)*** for multiplying by 0.98 (or equivalent).

769.81 (EUR) ***(A1)*** ***(C3)***

[3 marks]

b. $r\% \times \frac{85}{0.08753} = 14.57$ ***(M1)(M1)***

Note: Award ***(M1)*** for dividing 85 by 0.08753, and ***(M1)*** for multiplying their $\frac{85}{0.08753}$ by $r\%$ and equating to 14.57.

OR

$\frac{85}{0.08753} = 971.095\ldots$ ***(M1)***

Note: Award ***(M1)*** for dividing 85 by 0.08753.

$\frac{14.57}{9.71095\ldots}$ **OR** $\frac{14.57}{971.095\ldots} \times 100$ ***(M1)***

Note: Award ***(M1)*** for dividing 14.57 by 9.71095… or equivalent.

$r = 1.50\ (1.50036\ldots)$ ***(A1)*** ***(C3)***

[3 marks]

Examiners report

a. [N/A]
b. [N/A]

The first term of an arithmetic sequence is 3 and the sum of the first two terms is 11.

a. Write down the second term of this sequence. [1]

b. Write down the common difference of this sequence. [1]

c. Write down the fourth term of this sequence. [1]

d. The n^{th} term is the first term in this sequence which is greater than 1000. Find the value of n. [3]

Markscheme

a. 8 ***(A1)*** ***(C1)***

[1 mark]

b. 5 ***(A1)*(ft)** ***(C1)***

[1 mark]

c. 18 ***(A1)*(ft)** ***(C1)***

[1 mark]

d. $3 + 5 \times (n - 1) > 1000$ ***(M1)***

Note: Allow equality sign and equal to 1001

$n > 200.4$ ***(A1)***

Note: Accept $n = 200.4$ or $5n = 1002$

OR

(M1) for attempt at listing, ***(A1)*** for 998 and 1003 seen. ***(M1)(A1)***

$n = 201$ ***(A1)*(ft)** ***(C3)***

Note: Follow through from their answer to (b).

[3 marks]

Examiners report

a. Most candidates achieved at least the first three marks on this question and a significant number gained full marks. Up to five marks could be awarded even to students who did not find correctly the value of the *n*th term, but showed correct method and attempted to find the value of *n*. Some candidates lost the last mark for giving a non integer value.

b. Most candidates achieved at least the first three marks on this question and a significant number gained full marks. Up to five marks could be awarded even to students who did not find correctly the value of the *n*th term, but showed correct method and attempted to find the value of *n*. Some candidates lost the last mark for giving a non integer value.

c. Most candidates achieved at least the first three marks on this question and a significant number gained full marks. Up to five marks could be awarded even to students who did not find correctly the value of the *n*th term, but showed correct method and attempted to find the value of *n*. Some candidates lost the last mark for giving a non integer value.

d. Most candidates achieved at least the first three marks on this question and a significant number gained full marks. Up to five marks could be awarded even to students who did not find correctly the value of the *n*th term, but showed correct method and attempted to find the value of *n*. Some candidates lost the last mark for giving a non integer value.

In a television show there is a transparent box completely filled with identical cubes. Participants have to estimate the number of cubes in the box. The box is 50 cm wide, 100 cm long and 40 cm tall.

a. Find the volume of the box. [2]

b. Joaquin estimates the volume of one cube to be 500 cm^3. He uses this value to estimate the number of cubes in the box. [2]

Find Joaquin's estimated number of cubes in the box.

c. The actual number of cubes in the box is 350. [2]

Find the percentage error in Joaquin's estimated number of cubes in the box.

Markscheme

a. $50 \times 100 \times 40 = 200\,000\ \text{cm}^3$ ***(M1)(A1)*** ***(C2)***

Note: Award ***(M1)*** for correct substitution in the volume formula.

[2 marks]

b. $\frac{200\,000}{500} = 400$ ***(M1)(A1)*****(ft)** ***(C2)***

Note: Award ***(M1)*** for dividing their answer to part (a) by 500.

[2 marks]

c. $\frac{400-350}{350} \times 100 = 14.3\ \%$ ***(M1)(A1)*****(ft)** ***(C2)***

Notes: Award ***(M1)*** for correct substitution in the percentage error formula.

Award ***(A1)*** for answer, follow through from part (b).

Accept –14.3 %.

% sign not necessary.

[2 marks]

Examiners report

a. This question proved to be the one that most candidates answered correctly. Many received full marks and the only error seen was incorrect substitution in the percentage error formula.

b. This question proved to be the one that most candidates answered correctly. Many received full marks and the only error seen was incorrect substitution in the percentage error formula.

c. This question proved to be the one that most candidates answered correctly. Many received full marks and the only error seen was incorrect substitution in the percentage error formula.

Pietro arrives in Singapore and, at the airport, changes 800 euros (EUR) to Singapore dollars (SGD).

The bank rates quoted at the airport for exchanging EUR with SGD are given in the following table. Also given are the rates for exchanging SGD with British pounds (GBP) and US dollars (USD). There is no commission charged on exchanges.

Bank Buys	Bank Sells
1 EUR = 1.55 SGD	1 EUR = 1.75 SGD
1 GBP = 1.92 SGD	1 GBP = 2.05 SGD
1 USD = 1.15 SGD	1 USD = 1.28 SGD

a. Calculate the number of SGD Pietro receives. [2]

b. Pietro also has 100 GBP that he wishes to change to USD for a trip to Cambodia. [4]

To perform this transaction, the GBP must first be converted to SGD and then to USD.

Calculate the number of USD Pietro receives.

Markscheme

a. 800×1.55 ***(M1)***

Note: Award ***(M1)*** for multiplication by 1.55.

$= 1240$ ***(A1)*** ***(C2)***

b. $\frac{100 \times 1.92}{1.28}$ ***(A1)(M1)(M1)***

Notes: Award ***(M1)*** for multiplication by a GBP rate (1.92 or 2.05), ***(M1)*** for division by a USD rate (1.28 or 1.15), ***(A1)*** for two correct rates used.

$= 150$ ***(A1) (C4)***

Note: Award a maximum of ***(A1)*****(ft)*****(M1)(M1)(A1)*****(ft)** for $\frac{100 \times 2.05}{1.15}$, if in part (a) a rate of 1.75 is used.

Award a maximum of ***(A1)*****(ft)*****(M1)(M1)(A1)*****(ft)** if division by an EUR rate is seen in part (a) and multiplication by 1.28 and division by 1.92 is seen in (b).

Examiners report

a. Many candidates lost at least two marks on this question for using an incorrect rate. The difference between “Bank buys” and “Bank sells” was not understood by many candidates. Their use of the table was often not consistent, leading to the candidates losing 4 marks, 2 in part (a) and 2 in part (b). Only very few candidates were confused on when to multiply and when to divide by a conversion rate. It was disappointing to see that so many candidates were not able to apply their knowledge of currency conversion in the real world context where both rates are given and the candidate had to decide which one to use. Methods marks were given out frequently, showing candidates were confident to calculate currency conversion with given rates.

b. Many candidates lost at least two marks on this question for using an incorrect rate. The difference between “Bank buys” and “Bank sells” was not understood by many candidates. Their use of the table was often not consistent, leading to the candidates losing 4 marks, 2 in part (a) and 2 in part (b). Only very few candidates were confused on when to multiply and when to divide by a conversion rate. It was disappointing to see that so

many candidates were not able to apply their knowledge of currency conversion in the real world context where both rates are given and the candidate had to decide which one to use. Methods marks were given out frequently, showing candidates were confident to calculate currency conversion with given rates.

The number of apartments in a housing development has been increasing by a constant amount every year.

At the end of the first year the number of apartments was 150, and at the end of the sixth year the number of apartments was 600.

The number of apartments, y, can be determined by the equation $y = mt + n$, where t is the time, in years.

a. Find the value of m. [2]

b. State what m represents **in this context**. [1]

c. Find the value of n. [2]

d. State what n represents **in this context**. [1]

Markscheme

a. $\frac{600-150}{6-1}$ ***(M1)***

OR

$600 = 150 + (6-1)m$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into gradient formula or arithmetic sequence formula.

$= 90$ ***(A1)*** ***(C2)***

b. the annual rate of growth of the number of apartments ***(A1)*** ***(C1)***

Note: Do not accept common difference.

c. $150 = 90 \times (1) + n$ ***(M1)***

Note: Award ***(M1)*** for correct substitution of their gradient and one of the given points into the equation of a straight line.

$n = 60$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (a).

d. the initial number of apartments ***(A1)*** ***(C1)***

Note: Do not accept “first number in the sequence”.

Examiners report

a. [N/A]

b. [N/A]
c. [N/A]
d. [N/A]

---

a. Calculate exactly $\frac{(3\times 2.1)^3}{7\times 1.2}$. [1]

b. Write the answer to part (a) correct to 2 significant figures. [1]

c. Calculate the percentage error when the answer to part (a) is written correct to 2 significant figures. [2]

d. Write your answer to **part (c)** in the form $a \times 10^k$ where $1 \leqslant a < 10 \text{ and } k \in \mathbb{Z}$. [2]

Markscheme

a. 29.7675 ***(A1)*** ***(C1)***

Note: Accept exact answer only.

[1 mark]

b. 30 ***(A1)*****(ft)** ***(C1)***

[1 mark]

c. $\frac{30-29.7675}{29.7675} \times 100\%$ ***(M1)***

For correct formula with correct substitution.

$= 0.781\%$ *accept* 0.78% *only if formula seen with* 29.7675 *as denominator* ***(A1)*****(ft)** ***(C2)***

[2 marks]

d. $7.81 \times 10^{-1}\%$ (7.81×10^{-3} with no percentage sign) ***(A1)*****(ft)*****(A1)*****(ft)** ***(C2)***

[2 marks]

Examiners report

a. Many candidates gained maximum marks. The common errors were in the initial calculation due to forgetting to use brackets when entering the denominator into the GDC; using 2 decimal places instead of 2 significant figures in part (b); and using the wrong value as the denominator in part (c). Some candidates were still using the old Information booklet with the wrong formula for percentage error. Because examiners believed that the wording was ambiguous the correct answer given to 2 significant figures was awarded full marks for this part.

b. Many candidates gained maximum marks. The common errors were in the initial calculation due to forgetting to use brackets when entering the denominator into the GDC; using 2 decimal places instead of 2 significant figures in part (b); and using the wrong value as the denominator in part (c). Some candidates were still using the old Information booklet with the wrong formula for percentage error. Because examiners believed that the wording was ambiguous the correct answer given to 2 significant figures was awarded full marks for this part.

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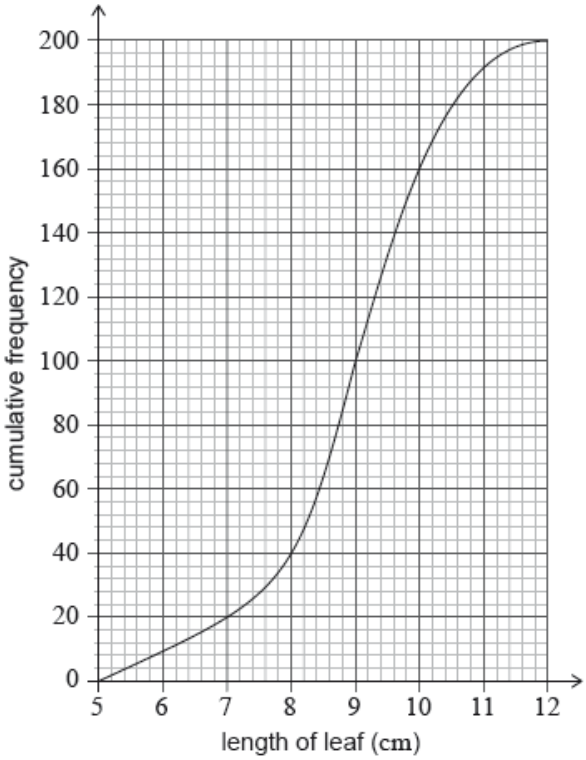
For a study, a researcher collected 200 leaves from oak trees. After measuring the lengths of the leaves, in cm, she produced the following cumulative frequency graph.



The researcher finds that 10% of the leaves have a length greater than k cm.

a. Write down the median length of these leaves. [1]

b. Write down the number of leaves with a length less than or equal to 8 cm. [1]

c.i. Use the graph to find the value of k. [2]

c.ii. Before measuring, the researcher estimated k to be approximately 9.5 cm. Find the percentage error in her estimate. [2]

Markscheme

a. 9 (cm) ***(A1)*** ***(C1)***

[1 mark]

b. 40 (leaves) ***(A1)*** ***(C1)***

[1 mark]

c.i. $(200 \times 0.90 =)\ 180$ or equivalent ***(M1)***

Note: Award ***(M1)*** for a horizontal line drawn through the cumulative frequency value of 180 and meeting the curve (or the corresponding vertical line from 10.5 cm).

$(k =)\ 10.5\ (\text{cm})$ ***(A1)*** ***(C2)***

Note: Accept an error of ±0.1.

[2 marks]

c.ii. $\left|\frac{9.5-10.5}{10.5}\right| \times 100\%$ ***(M1)***

Notes: Award ***(M1)*** for their correct substitution into the percentage error formula.

$9.52\ (\%)\ (9.52380\ldots\ (\%))$ ***(A1)*****(ft)** ***(C2)***

Notes: Follow through from their answer to part (c)(i).

Award ***(A1)(A0)*** for an answer of -9.52 with or without working.

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c.i. [N/A]
c.ii. [N/A]

Shiyun bought a car in 1999. The value of the car V , in USD, is depreciating according to the exponential model

$$V = 25000 \times 1.5^{-0.2t},\ t \geqslant 0$$

where t is the time, in years, that Shiyun has owned the car.

a. Write down the value of the car when Shiyun bought it. [1]

b. Calculate the value of the car three years after Shiyun bought it. Give your answer correct to **two decimal places**. [2]

c. Calculate the time for the car to depreciate to half of its value since Shiyun bought it. [3]

Markscheme

a. 25000 USD ***(A1)*** ***(C1)***

[1 mark]

b. $25000 \times 1.5^{-0.6}$ ***(M1)***

19601.32 USD ***(A1)*** ***(C2)***

[2 marks]

c. $12500 = 25000 \times 1.5^{-0.2t}$ ***(A1)*****(ft)*****(M1)***

Notes: Award ***(A1)*****(ft)** for 12500 seen. Follow through from their answer to part (a). Award ***(M1)*** for equating their half value to $25000 \times 1.5^{-0.2t}$. Allow the use of an inequality.

OR

Graphical method (sketch):

(A1)**(ft)** for $y = 12500$ seen on the sketch. Follow through from their answer to part (a). ***(A1)*****(ft)**

(M1) for the exponent model and an indication of their intersection with their horizontal line. ***(M1)***

8.55 ***(A1)*****(ft)** ***(C3)***

[3 marks]

Examiners report

a. A substituted value of $t = 1$ in part (a) saw many incorrect answers of 23052.70 for this part of the question. Part (b) was better attempted with many correct answers seen. Many candidates picked up the first two marks of part (c) equating a correct expression to half their answer found in part (a). Many though did not seem to know the correct process of using their GDC to find the required answer. Much *trial and improvement* was seen here with varying degrees of success.

b. A substituted value of $t = 1$ in part (a) saw many incorrect answers of 23052.70 for this part of the question. Part (b) was better attempted with many correct answers seen. Many candidates picked up the first two marks of part (c) equating a correct expression to half their answer found in part (a). Many though did not seem to know the correct process of using their GDC to find the required answer. Much *trial and improvement* was seen here with varying degrees of success.

c. A substituted value of $t = 1$ in part (a) saw many incorrect answers of 23052.70 for this part of the question. Part (b) was better attempted with many correct answers seen. Many candidates picked up the first two marks of part (c) equating a correct expression to half their answer found in part (a). Many though did not seem to know the correct process of using their GDC to find the required answer. Much *trial and improvement* was seen here with varying degrees of success.

The fourth term, u_4, of a geometric sequence is 135. The fifth term, u_5, is 101.25 .

a. Find the common ratio of the sequence. [2]

b. Find u_1, the first term of the sequence. [2]

c. Calculate the sum of the first 10 terms of the sequence. [2]

Markscheme

a. $\frac{101.25}{135}$ ***(M1)***

$= \frac{3}{4}(0.75)$ ***(A1)*** ***(C2)***

b. $u_1\left(\frac{3}{4}\right)^4 = 101.25$ ***(M1)***

OR

$u_1\left(\frac{3}{4}\right)^3 = 135$ ***(M1)***

OR

(by list)

$u_3 = 180,\ u_2 = 240$ ***(M1)***

Notes: Award ***(M1)*** for their correct substitution in geometric sequence formula, or stating explicitly u_3 and u_2.

$(u_1 =)320$ ***(A1)*(ft)** ***(C2)***

Note: Follow through from their answer to part (a).

c. $S_{10} = \frac{320\left(1-\left(\frac{3}{4}\right)^{10}\right)}{1-\left(\frac{3}{4}\right)}$ ***(M1)***

Notes: Award ***(M1)*** for their correct substitution in geometric series formula.

Accept a list of all their ten geometric terms.

= 1210 (1207.918...) ***(A1)*(ft)** ***(C2)***

Note: Follow through from their parts (a) and (b).

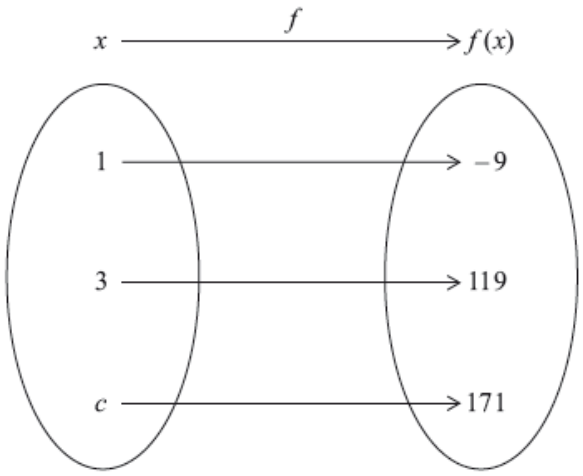
Examiners report

a. The weakest candidates erroneously used an arithmetic sequence rather than a geometric sequence as specified in the question.

b. The weakest candidates erroneously used an arithmetic sequence rather than a geometric sequence as specified in the question.

c. The weakest candidates erroneously used an arithmetic sequence rather than a geometric sequence as specified in the question.

A quadratic function $f : x \mapsto ax^2 + b$, where a and $b \in \mathbb{R}$ and $x \geqslant 0$, is represented by the mapping diagram.



a. Using the mapping diagram, write down two equations in terms of a and b. [2]

b. Solve the equations to find the value of [2]

(i) a;

(ii) b.

c. Find the value of c. [2]

Markscheme

a. $a(1)^2 + b = -9$ ***(A1)***

$a(3)^2 + b = 119$ ***(A1)*** ***(C2)***

Note: Accept equivalent forms of the equations.

[2 marks]

b. (i) $a = 16$ ***(A1)*****(ft)**

(ii) $b = -25$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (a) irrespective of whether working is seen.

If working is seen follow through from part (i) to part (ii).

[2 marks]

c. $16c^2 - 25 = 171$ ***(M1)***

Note: Award ***(M1)*** for correct quadratic with their a and b substituted.

$c = 3.5$ ***(A1)*****(ft)** ***(C2)***

Note: Accept x instead of c.

Follow through from part (b).

Award ***(A1)*** only, for an answer of ± 3.5 with or without working.

[2 marks]

Examiners report

a. This question was answered reasonably well with many candidates able to write down the two equations and solve them for a and b. Errors such as mistaking the equation given for $3a^2 + b = 119$ meant that marks were lost even though the candidates appeared to know what they needed to do. Most candidates who were able to set up the equation in part (c) solved it correctly. Follow through marks were awarded to many candidates for correct working with their substituted values from part (b).

b. This question was answered reasonably well with many candidates able to write down the two equations and solve them for a and b. Errors such as mistaking the equation given for $3a^2 + b = 119$ meant that marks were lost even though the candidates appeared to know what they needed to do. Most candidates who were able to set up the equation in part (c) solved it correctly. Follow through marks were awarded to many candidates for correct working with their substituted values from part (b).

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The planet Earth takes one year to revolve around the Sun. Assume that a year is 365 days and the path of the Earth around the Sun is the circumference of a circle of radius $150000000\ \text{km}$.

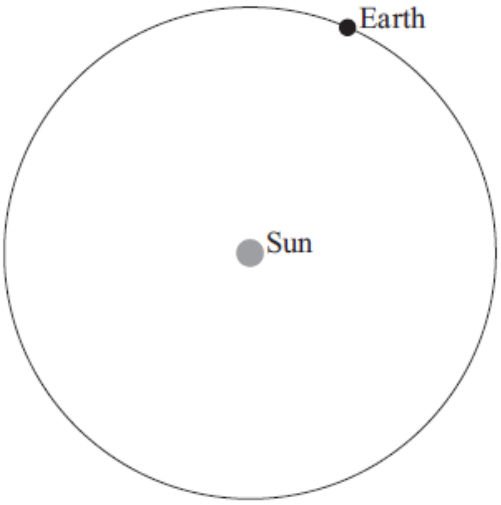


diagram not to scale

a. Calculate the distance travelled by the Earth in **one day**. [4]

b. Give your answer to part (a) in the form $a \times 10^k$ where $1 \leqslant a \leqslant 10$ and $k \in \mathbb{Z}$. [2]

Markscheme

a. $2\pi\frac{150000000}{365}$ ***(M1)(A1)(M1)***

Notes: Award ***(M1)*** for substitution in correct formula for circumference of circle.

Award ***(A1)*** for correct substitution.

Award ***(M1)*** for dividing their perimeter by 365.

Award ***(M0)(A0)(M1)*** for $\frac{150000000}{365}$.

$2580000\ \text{km}$ ***(A1)*** ***(C4)***

[4 marks]

b. 2.58×10^6 ***(A1)*(ft)*(A1)*(ft)** ***(C2)***

Notes: Award ***(A1)*(ft)** for 2.58, ***(A1)*(ft)** for 10^6. Follow through from their answer to part (a). The follow through for the index should be dependent not only on the answer to part (a), but also on the value of their mantissa. No ***(AP)*** penalty for first ***(A1)*** provided their value is to 3 sf or is all their digits from part (a).

[2 marks]

Examiners report

a. A significant number of candidates simply divided 150000000 by 365 and consequently lost all but one method mark in part (a). Presumably these candidates assumed that the given value was the circumference rather than the radius.

b. A significant number of candidates simply divided 150000000 by 365 and consequently lost all but one method mark in part (a). Presumably these candidates assumed that the given value was the circumference rather than the radius. Recovery in part (b) did, however, result in many getting both marks here. It was noted on some answers to part (b) that the index power was negative rather than positive suggesting a misunderstanding by candidates of standard form.

Albena travels to Bulgaria on a business trip. She is paid 3550 Bulgarian levs (BGN) at the end of her trip. She converts all her BGN into euros (EUR), at an exchange bureau that sells 1 EUR for 1.95 BGN and charges 3 % commission.

a. Calculate the amount that Albena receives in EUR. [4]

b. At the airport shop, Albena buys chocolates that cost 34.50 BGN. She uses 20 EUR to pay for the chocolates but receives her change in BGN. [2]

The shop's exchange rate is 1 EUR = 1.90 BGN.

Find how many BGN she receives as change.

Markscheme

a. $\frac{0.97\times3550}{1.95}$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for 0.97 seen, ***(M1)*** for 0.97×3550, ***(M1)*** for division by 1.95.

OR

$(3550 - 0.03 \times 3550) \times \frac{1}{1.95}$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for 0.03×3550 seen, ***(M1)*** for subtracting 0.03×3550 from 3550, ***(M1)*** for division by 1.95.

$= 1765.90\ (\text{EUR})$ ***(A1)*** ***(C4)***

b. $20 \times 1.90 - 34.50$ ***(M1)***

Note: Award ***(M1)*** for subtraction of 34.50 from their product of 20×1.90.

$= 3.50\ \ (\text{BGN})$ ***(A1)*** ***(C2)***

Notes: Award at most ***(M1)(A0)*** for an answer of 4, but only if working seen.

Examiners report

a. [N/A]
b. [N/A]

A concert choir is arranged, per row, according to an arithmetic sequence. There are 20 singers in the fourth row and 32 singers in the eighth row.

a. Find the common difference of this arithmetic sequence. [3]

b. There are 10 rows in the choir and 11 singers in the first row. [3]

Find the **total** number of singers in the choir.

Markscheme

a. $20 = u_1 + 3d$ ***(A1)***

$32 = u_1 + 7d$ ***(A1)***

Note: Award ***(A1)*** for each equation, ***(A1)*** for correct answer.

OR

$d = \frac{32-20}{4}$ ***(A1)(A1)***

Note: Award ***(A1)*** for numerator, ***(A1)*** for denominator.

$d = 3$ ***(A1)*** ***(C3)***

[3 marks]

b. $\frac{10}{2}(2 \times 11 + 9 \times 3)$ ***or*** $\frac{10}{2}(11 + 38)$ ***(M1)(A1)*****(ft)**

Note: Award ***(M1)*** for correct substituted formula, ***(A1)*** for correct substitution, follow through from their answer to part (a).

OR

11 + 14 + ... + 38 ***(M1)(A1)*****(ft)**

Note: Award ***(M1)*** for attempt at the sum of a list, ***(A1)*****(ft)** for all correct numbers, follow through from their answer to part (a).

= 245 ***(A1)*****(ft)** ***(C3)***

[3 marks]

Examiners report

a. This question was very well answered with most candidates finding the common difference and the total number of singers. Most candidates used the given formulae, rather than making lists. A common mistake was to find the number of singers in the back row, rather than find the total number of singers in the choir.

b. This question was very well answered with most candidates finding the common difference and the total number of singers. Most candidates used the given formulae, rather than making lists. A common mistake was to find the number of singers in the back row, rather than find the total number of singers in the choir.

A building company has many rectangular construction sites, of varying widths, along a road.

The area, A, of each site is given by the function

$$A(x) = x(200 - x)$$

where x is the **width** of the site in metres and $20 \leqslant x \leqslant 180$.

a. Site S has a width of 20 m. Write down the area of S. [1]

b. Site T has the same area as site S, but a different width. Find the width of T. [2]

c. When the width of the construction site is b metres, the site has a maximum area. [2]

(i) Write down the value of b.

(ii) Write down the maximum area.

d. The range of $A(x)$ is $m \leqslant A(x) \leqslant n$. [1]

Hence write down the value of m and of n.

Markscheme

a. $3600\ (\text{m}^2)$ ***(A1)(C1)***

b. $x(200 - x) = 3600$ ***(M1)***

Note: Award ***(M1)*** for setting up an equation, equating to their 3600.

$180\ (\text{m})$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from their answer to part (a).

c. (i) $100\ (\text{m})$ ***(A1)*** ***(C1)***

(ii) $10\,000\ (\text{m}^2)$ ***(A1)*****(ft)*****(C1)***

Note: Follow through from their answer to part (c)(i).

d. $m = 3600$ **and** $n = 10\,000$ ***(A1)*****(ft)** ***(C1)***

Notes: Follow through from part (a) and part (c)(ii), but only if their m is less than their n. Accept the answer $3600 \leqslant A \leqslant 10\,000$.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]
d. [N/A]

The exchange rates between the British pound (GBP) and the United States dollar (USD) and between the USD and the Euro (EUR) are given below.

1 GBP	2.034 USD
1 USD	0.632 EUR

a. Find the exchange rate between GBP and EUR in the form 1 GBP = k EUR, where k is a constant. Give your answer correct to **two decimal places**. [2]

b. Isabella changes 400 USD into Euros and is charged 2 % commission. [4]

Calculate how many Euros she receives. Give your answer correct to **two decimal places**.

Markscheme

a. $k = 2.034 \times 0.632$ ***(M1)***

= 1.29 (1 GBP = 1.29 EUR) ***(A1)*** ***(C2)***

Note: Accept 1.29 only

[2 marks]

b. ***Financial penalty (FP) applies in part (b).***

400×0.632 ***(M1)***

= 252.80 EUR ***(A1)***

2 % of 252.80 = 5.06 EUR ***(A1)***

(FP) She receives 247.74 EUR ***(A1)***

OR

(FP) $0.98 \times 252.80 = 247.74$ EUR ***(A1)(A1)*** ***(C4)***

Note: Accept ***(A1)*** for 0.98 seen.

[4 marks]

Examiners report

a. Most students gained full marks on this question. However, some students found the required format of the answer in part (a) confusing.

b. Most students gained full marks on this question. However, some students found the required format of the answer in part (a) confusing.

Consider $c = 5200$ and $d = 0.0000037$.

a. Write down the value of $r = c \times d$. [1]

b. Write down your value of r in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [2]

c. Consider the following statements about c, d and r. Only **three** of these statements are true. [3]

Circle the true statements.

$c \in \mathbb{N}$
$d \in \mathbb{Z}$
$d \in \mathbb{Q}$
$r < d$
$c + d \in \mathbb{R}$
$\frac{1}{r} > c$

Markscheme

a. $r = 0.01924$ ***(A1)*** ***(C1)***

Note: Accept 0.0192 and 0.019

[1 mark]

b. $r = 1.924 \times 10^{-2}$ ***(A1)*(ft)*(A1)*(ft)** ***(C2)***

Notes: Award ***(A1)*** for 1.924, ***(A1)*** for 10^{-2}. Accept 1.92 and 1.9. Follow through from their part (a).

[2 marks]

c.

(circled) $c \in \mathbb{N}$
$d \in \mathbb{Z}$
(circled) $d \in \mathbb{Q}$
$r < d$
(circled) $c + d \in \mathbb{R}$
$\frac{1}{r} > c$

(A1)(A1)(A1) ***(C3)***

Notes: Award ***(A1)*** for each true statement circled. Do not follow through from part (a). Award ***(A1)(A1)(A0)*** if 1 extra term seen. Award ***(A1)(A0)(A0)*** if 2 extra terms seen. Award ***(A0)(A0)(A0)*** if all terms circled. Accept other indications of the correct statements i.e. highlighted or ticks.

[3 marks]

Examiners report

a. Most candidates could find the value of *r* and give it in standard form, although some did not give it to the correct degree of accuracy. Some candidates gave a positive index and others used calculator notation rather than standard form.

b. Most candidates could find the value of *r* and give it in standard form, although some did not give it to the correct degree of accuracy. Some candidates gave a positive index and others used calculator notation rather than standard form.

c. There were a number of candidates who were unable to find the three true statements about set notation.

The average radius of the orbit of the Earth around the Sun is 150 million kilometres.

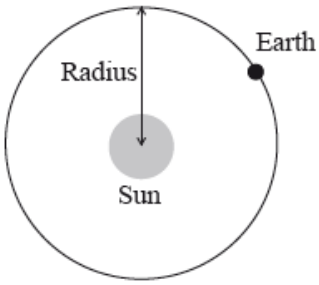


diagram not to scale

The average radius of the orbit of the Earth around the Sun is 150 million kilometres.

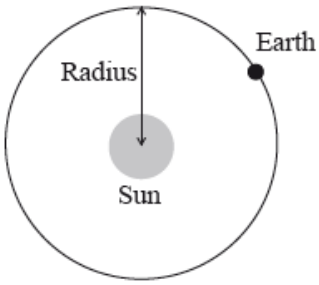


diagram not to scale

a. Write down this radius, in kilometres, in the form $a \times 10^k$, where $1 \leqslant a < 10,\ k \in \mathbb{Z}$. [2]

b. The Earth travels around the Sun in one orbit. It takes one year for the Earth to complete one orbit. [2]

Calculate the distance, in kilometres, the Earth travels around the Sun in one orbit, assuming that the orbit is a circle.

c. Today is Anna's 17th birthday. [2]

Calculate the total distance that Anna has travelled around the Sun, since she was born.

Markscheme

a. $1.5 \times 10^8\ (\text{km})$ ***(A2)*** ***(C2)***

Notes: Award ***(A2)*** for the correct answer.

Award ***(A1)(A0)*** for 1.5 and an incorrect index.

Award ***(A0)(A0)*** for answers of the form 15×10^7.

[2 marks]

b. $2\pi 1.5 \times 10^8$ ***(M1)***

$= 942\,000\,000\ (\text{km})$ $(942\,477\,796.1\ldots, 3 \times 10^8\pi,\ 9.42 \times 10^8)$ ***(A1)*****(ft)** ***(C2)***

Notes: Award ***(M1)*** for correct substitution into correct formula. Follow through from part (a).

Do not accept calculator notation $9.42\text{E}8$.

Do not accept use of $\frac{22}{7}$ or3.14 for π.

[2 marks]

c. $17 \times 942\,000\,000$ ***(M1)***

$= 1.60 \times 10^{10}\ (\text{km})$ $\left(1.60221\ldots \times 10^{10}, 1.6014 \times 10^{10},\ 16\,022\,122\,530, (5.1 \times 10^9)\pi\right)$ ***(A1)*****(ft)** ***(C2)***

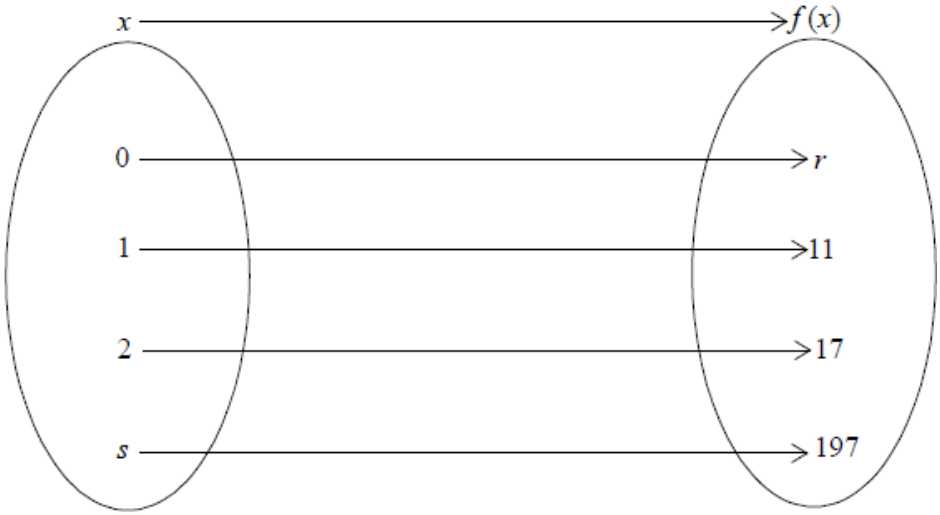
Note: Follow through from part (b).

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

A function $f(x) = p \times 2^x + q$ is defined by the mapping diagram below.



a. Find the value of [3]

(i) p ;

(ii) q .

b. Write down the value of r . [1]

c. Find the value of s . [2]

Markscheme

a. (i) $2p + q = 11$ and $4p + q = 17$ ***(M1)***

Note: Award ***(M1)*** for either two correct equations or a correct equation in one unknown equivalent to $2p = 6$.

$p = 3$ ***(A1)***

(ii) $q = 5$ ***(A1)*** ***(C3)***

Notes: If only one value of p and q is correct and no working shown, award ***(M0)(A1)(A0)***.

[3 marks]

b. $r = 8$ ***(A1)*(ft)** ***(C1)***

Note: Follow through from their answers for p and q irrespective of whether working is seen.

[1 mark]

c. $3 \times 2^s + 5 = 197$ ***(M1)***

Note: Award ***(M1)*** for setting the correct equation.

$s = 6$ ***(A1)*(ft)** ***(C2)***

Note: Follow through from their values of p and q.

[2 marks]

Examiners report

a. Candidates both understood how to interpret a mapping diagram correctly and did very well on this question or the question was very poorly answered or not answered at all. Writing down two simultaneous equations in part (a) proved to be elusive to many and this prevented further work on this question. Candidates who were able to find values of p and q (correct or otherwise) invariably made a good attempt at finding the value of s in part (c).

b. Candidates both understood how to interpret a mapping diagram correctly and did very well on this question or the question was very poorly answered or not answered at all. Writing down two simultaneous equations in part (a) proved to be elusive to many and this prevented further work on this question. Candidates who were able to find values of p and q (correct or otherwise) invariably made a good attempt at finding the value of s in part (c).

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Given the arithmetic sequence: $u_1 = 124$, $u_2 = 117$, $u_3 = 110$, $u_4 = 103, \ldots$

a. Write down the common difference of the sequence. [1]

b. Calculate the sum of the first 50 terms of the sequence. [2]

c. u_k is the first term in the sequence which is negative. [3]

Find the value of k.

Markscheme

a. $d = -7$ ***(A1)*** ***(C1)***

[1 mark]

b. $S_{50} = \frac{50}{2}(2(124) + 49(-7))$ ***(M1)***

Note: ***(M1)*** for correct substitution.

$= -2375$ ***(A1)*****(ft)** ***(C2)***

[2 marks]

c. $124 - 7(k-1) < 0$ ***(M1)***

$k > 18.7$ *or* 18.7 *seen* ***(A1)*****(ft)**

$k = 19$ ***(A1)*****(ft)** ***(C3)***

Note: ***(M1)*** for correct inequality or equation seen or for list of values seen or for use of trial and error.

[3 marks]

Examiners report

a. (a) Again, the omission of the negative sign was a too common fault.

b. This was generally well attempted.

c. The common misconception was confusion between k and the value of the k^{th} term. Close reading of this part was required from the candidates.

a. A ladder is standing on horizontal ground and leaning against a vertical wall. The length of the ladder is 4.5 metres. The distance between the bottom of the ladder and the base of the wall is 2.2 metres. [1]

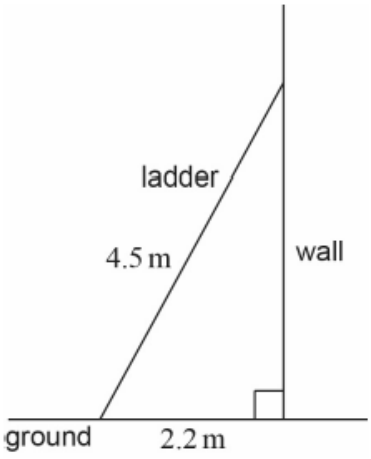
Use the above information to sketch a labelled diagram showing the ground, the ladder and the wall.

b. Calculate the distance between the top of the ladder and the base of the wall. [2]

c. Calculate the **obtuse** angle made by the ladder with the ground. [3]

Markscheme

a.



(A1) ***(C1)***

Notes: Award ***(A1)*** for drawing an approximately right angled triangle, with correct labelling of the distances $4.5\,(\text{m})$ and $2.2\,(\text{m})$.

b. $\sqrt{4.5^2 - 2.2^2}$ (accept eqivalent $eg\ d^2 + 2.2^2 = 4.5^2$) ***(M1)***

$= 3.93\,(\text{m})$ $\left(\sqrt{15.41}\,(\text{m}),\ 3.92555...\,(\text{m})\right)$ ***(A1)*** ***(C2)***

Note: Award ***(M1)*** for a correct substitution in the Pythagoras formula.

c. $180^\circ - \cos^{-1}\left(\frac{2.2}{4.5}\right)$ ***(M1)(M1)***

OR

$180^\circ - \tan^{-1}\left(\frac{3.92555...}{2.2}\right)$ ***(M1)(M1)***

OR

$180^\circ - \sin^{-1}\left(\frac{3.92555...}{4.5}\right)$ ***(M1)(M1)***

Note: Award ***(M1)*** for a correct substitution in the correct trigonometric ratio.
Award ***(M1)*** for subtraction from 180° (this may be implied if the sum of their inverse of the trigonometric ratio and their final answer equals 180).

$= 119^\circ$ $(119.267...^\circ)$ ***(A1)*****(ft)** ***(C3)***

Note: Follow through from their part (b) if cosine is not used. Accept $119.239...$ or $119.151...$ from use of 3 sf values.

Examiners report

a. Question 3: Right angle trigonometry.

Candidates sketched the ladder leaning against the wall and recognized that Pythagoras' theorem was needed to find the distance between the top of the ladder and the base of the wall (but not always correctly). Although it was a right triangle a number of the candidates used the law of sines (instead of Pythagoras' theorem) and law of cosines (instead of a trigonometry ratio). Many candidates failed to find the obtuse angle made by the ladder with the ground even though the word obtuse was in bold type in the question.

b. Question 3: Right angle trigonometry.

Candidates sketched the ladder leaning against the wall and recognized that Pythagoras' theorem was needed to find the distance between the top of the ladder and the base of the wall (but not always correctly). Although it was a right triangle a number of the candidates used the law of sines (instead of Pythagoras' theorem) and law of cosines (instead of a trigonometry ratio). Many candidates failed to find the obtuse angle made by the ladder with the ground even though the word obtuse was in bold type in the question.

c. Question 3: Right angle trigonometry.

Candidates sketched the ladder leaning against the wall and recognized that Pythagoras' theorem was needed to find the distance between the top of the ladder and the base of the wall (but not always correctly). Although it was a right triangle a number of the candidates used the law of sines (instead of Pythagoras' theorem) and law of cosines (instead of a trigonometry ratio). Many candidates failed to find the obtuse angle made by the ladder with the ground even though the word obtuse was in bold type in the question.

Gabriella purchases a new car.

The car's value in dollars, V, is modelled by the function

$$V(t) = 12870 - k(1.1)^t,\ t \geqslant 0$$

where t is the number of years since the car was purchased and k is a constant.

After two years, the car's value is $9143.20.

This model is defined for $0 \leqslant t \leqslant n$. At n years the car's value will be zero dollars.

a. Write down, and simplify, an expression for the car's value when Gabriella purchased it. [2]

b. Find the value of k. [2]

c. Find the value of n. [2]

Markscheme

a. $12870 - k(1.1)^0$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into $V(t)$.

$= 12870 - k$ ***(A1)*** ***(C2)***

Note: Accept $12870 - 3080$ **OR** 9790 for a final answer.

[2 marks]

b. $9143.20 = 12870 - k(1.1)^2$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into $V(t)$.

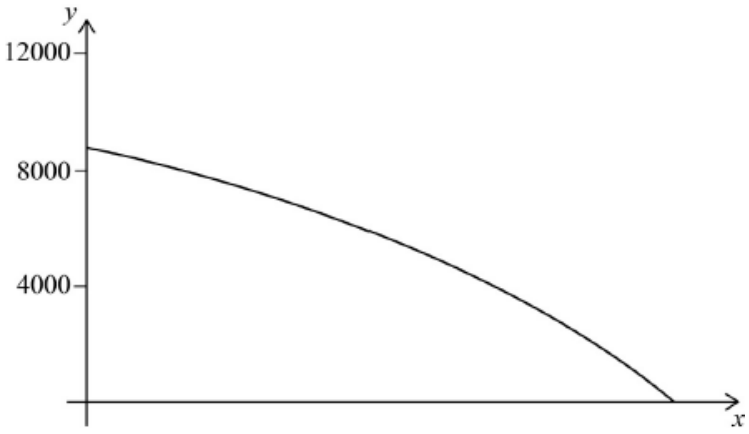
$(k =)\ 3080$ ***(A1)*** ***(C2)***

[2 marks]

c. $12870 - 3080(1.1)^n = 0$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into $V(t)$.

OR



(M1)

Note: Award ***(M1)*** for a correctly shaped curve with some indication of scale on the vertical axis.

$(n =)\ 15.0\ (15.0033\ldots)$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (b).

[2 marks]

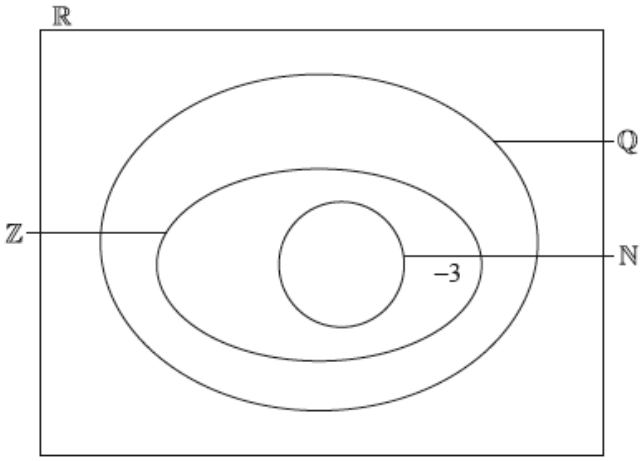
Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

The following Venn diagram shows the relationship between the sets of numbers

$$\mathbb{N},\ \mathbb{Z},\ \mathbb{Q} \text{ and } \mathbb{R}.$$

The number –3 belongs to the set of $\mathbb{Z}$, $\mathbb{Q}$ and $\mathbb{R}$, but not $\mathbb{N}$, and is placed in the appropriate position on the Venn diagram as an example.



Write down the following numbers in the appropriate place in the Venn diagram.

a. 4 [1]

b. $\frac{1}{3}$ [1]

c. π [1]

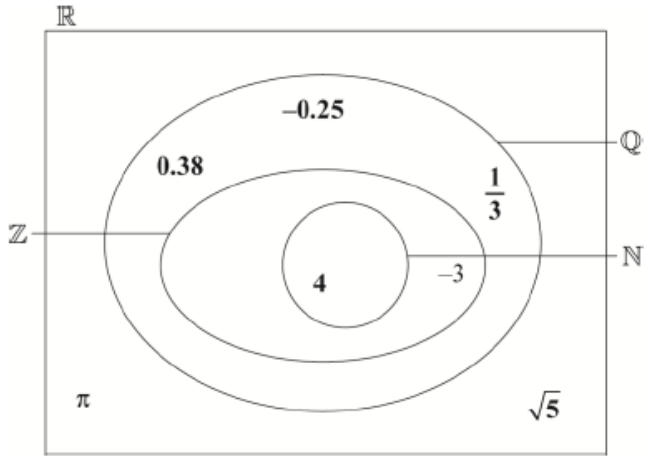
d. 0.38 [1]

e. $\sqrt{5}$ [1]

f. -0.25 [1]

Markscheme

a.



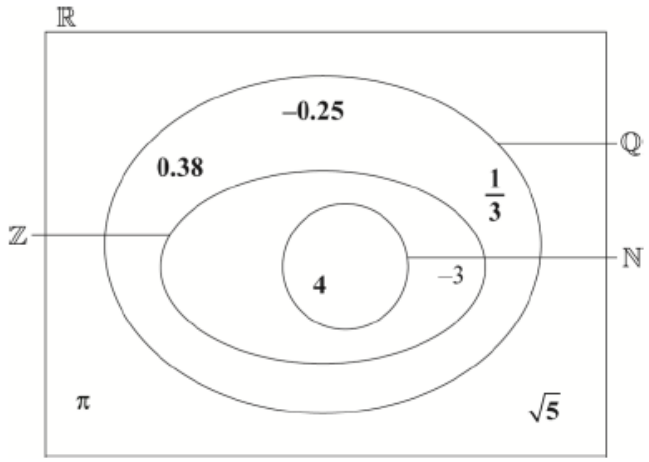
(A1)(A1)(A1)(A1)(A1)(A1) ***(C6)***

Note: Award ***(A1)*** for each number correctly placed.

Award ***(A0)*** for any entry in more than one region.

[1 mark]

b.



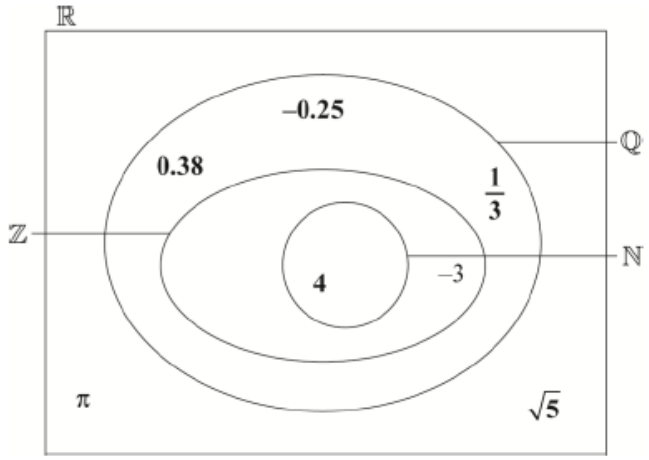
(A1)(A1)(A1)(A1)(A1)(A1) ***(C6)***

Note: Award ***(A1)*** for each number correctly placed.

Award ***(A0)*** for any entry in more than one region.

[1 mark]

c.



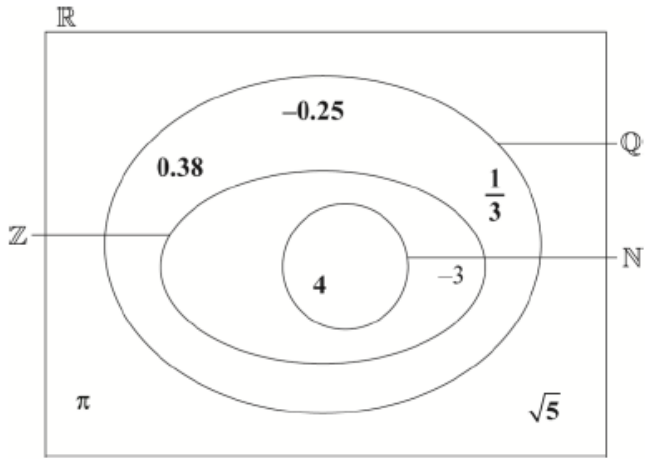
(A1)(A1)(A1)(A1)(A1)(A1) ***(C6)***

Note: Award ***(A1)*** for each number correctly placed.

Award ***(A0)*** for any entry in more than one region.

[1 mark]

d.



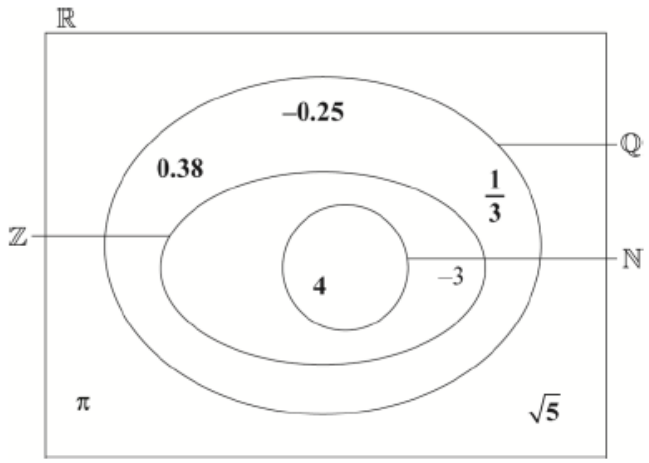
(A1)(A1)(A1)(A1)(A1)(A1) ***(C6)***

Note: Award ***(A1)*** for each number correctly placed.

Award ***(A0)*** for any entry in more than one region.

[1 mark]

e.



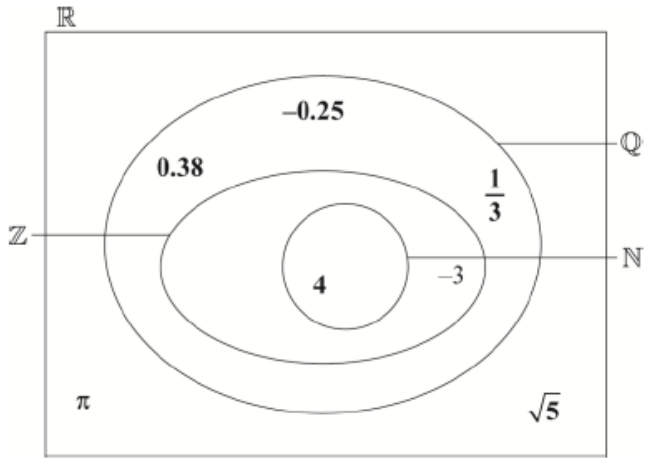
(A1)(A1)(A1)(A1)(A1)(A1) ***(C6)***

Note: Award ***(A1)*** for each number correctly placed.

Award ***(A0)*** for any entry in more than one region.

[1 mark]

f.



(A1)(A1)(A1)(A1)(A1)(A1) ***(C6)***

Note: Award ***(A1)*** for each number correctly placed.

Award ***(A0)*** for any entry in more than one region.

[1 mark]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]
d. [N/A]
e. [N/A]
f. [N/A]

A satellite travels around the Earth in a circular orbit 500 kilometres above the Earth's surface. The radius of the Earth is taken as 6400 kilometres.

a. Write down the radius of the satellite's orbit. [1]

b. Calculate the distance travelled by the satellite in one orbit of the Earth. Give your answer correct to the nearest km. [3]

c. Write down your answer to (b) in the form $a \times 10^k$, where $1 \leqslant a < 10, k \in \mathbb{Z}$. [2]

Markscheme

a. 6900 km ***(A1)*** ***(C1)***

[1 mark]

b. $2\pi(6900)$ ***(M1)(A1)*****(ft)**

Notes: Award ***(M1)*** for substitution into circumference formula, ***(A1)*****(ft)** for correct substitution. Follow through from part (a).

$= 43354$ ***(A1)*****(ft)** ***(C3)***

Notes: Follow through from part (a). The final ***(A1)*** is awarded for rounding their answer correct to the nearest km. Award ***(A2)*** for 43400 shown with no working.

[3 marks]

c. 4.3354×10^4 ***(A1)*****(ft)*****(A1)*****(ft)** ***(C2)***

Notes: Award ***(A1)*****(ft)** for 4.3354, ***(A1)*****(ft)** for $\times 10^4$. Follow through from part (b). Accept 4.34×10^4 .

[2 marks]

Examiners report

a. Candidates appeared to be confused by the context in this question. They had difficulty identifying the radius and many used the formula for the area of a circle, rather than the circumference.

b. Candidates appeared to be confused by the context in this question. They had difficulty identifying the radius and many used the formula for the area of a circle, rather than the circumference. A large number of candidates misread the final sentence in part b and did not write their answer to the nearest kilometre.

c. Candidates appeared to be confused by the context in this question. They had difficulty identifying the radius and many used the formula for the area of a circle, rather than the circumference.

U is the set of **positive** integers less than or equal to 10.

A, B and C are subsets of U.

$A = \{\text{even integers}\}$

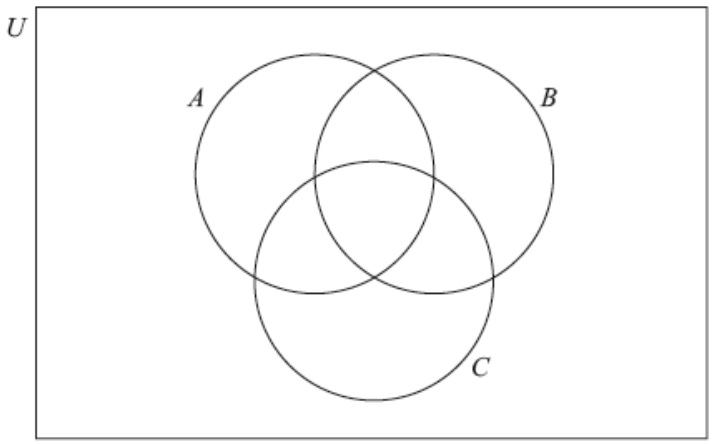
$B = \{\text{multiples of } 3\}$

$C = \{6,\ 7,\ 8,\ 9\}$

a. List the elements of A. [1]

b. List the elements of B. [1]

c. Complete the Venn diagram with **all** the elements of U. [4]



Markscheme

a. $2, 4, 6, 8, 10$ ***(A1)*** ***(C1)***

Note: Do not penalize the use of $\{\ \}$.

[1 mark]

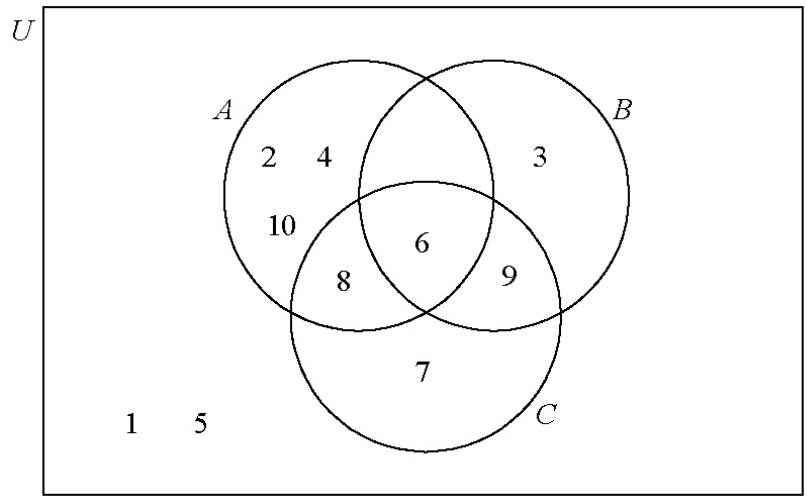
b. $3, 6, 9$ ***(A1)*** ***(C1)***

Note: Do not penalize the use of $\{\ \}$.

Follow through from part (a) only if their U is listed.

[1 mark]

c.



(A1)**(ft)*****(A1)*****(ft)*****(A1)*****(ft)*****(A1)*****(ft)** ***(C4)***

Notes: Award ***(A1)*****(ft)** for the correct placement of 6.

Award ***(A1)*****(ft)** for the correct placement of 8 and 9 and the empty region.

Award ***(A1)*****(ft)** for the correct placement of 2, 4, 3, 7, and 10.

Award ***(A1)*****(ft)** for the correct placement of 1 and 5.

If an element is in more than one region, award ***(A0)*** for that element.

Follow through from their answers to parts (a) and (b).

[4 marks]

Examiners report

a. This question was done well by most candidates. The most frequent error was to omit the placement of 1 and 5 or to include 0 in the set of even integers.

b. This question was done well by most candidates. The most frequent error was to omit the placement of 1 and 5 or to include 0 in the set of even integers.

c. This question was done well by most candidates. The most frequent error was to omit the placement of 1 and 5 or to include 0 in the set of even integers.

Consider the universal set $U = \{x \in \mathbb{N} | 3 < x < 13\}$, and the subsets $A = \{\text{multiples of } 3\}$ and $B = \{4,\ 6,\ 12\}$.

a.i. List the elements of the following set. [1]

A

a.ii. List the elements of the following set. [1]

$A \cap B'$

b. Write down one element of $(A \cup B)'$. [2]

c. One of the statements in the table below is false. Indicate with an **X** which statement is false. Give a reason for your answer. [2]

$n(A \cup B) = 4$	
$15 \in A'$	
$A \subset A \cup B$	

Markscheme

a.i. 6, 9, 12 ***(A1)*** ***(C1)***

[1 mark]

a.ii. 9 ***(A1)*****(ft)** ***(C1)***

Note: Follow through from their part (a)(i).

[1 mark]

b. any element from {5, 7, 8, 10, 11} ***(A1)(A1)*(ft)** ***(C2)***

Note: Award ***(A1)*(ft)** for finding $(A \cup B)$, follow through from their *A*.

Award full marks if all correct elements of $(A \cup B)'$ are listed.

[2 marks]

c.

$n(A \cup B) = 4$	
$15 \in A'$	**X**
$A \subset A \cup B$	

$15 \notin U$ ***(R1)(A1)*** ***(C2)***

Notes: Accept correct reason in words.

If the reason is incorrect, both marks are lost.

Do not award ***(R0)(A1)***.

[2 marks]

Examiners report

a.i. The question was not well answered by the majority of the candidates. Many did not identify the universal set correctly and so took 3 to be a member of this set. This affected their answers in a)(i) and a)(ii).

a.ii. The question was not well answered by the majority of the candidates. Many did not identify the universal set correctly and so took 3 to be a member of this set. This affected their answers in a)(i) and a)(ii).

b. Not many students answered (b) correctly. Some listed all correct elements of the given set instead of just one, which shows that they did not read the question carefully.

c. Although many candidates could indicate which statement in the table in c) was false, often they were unable either to identify or articulate a correct reason for it.

A manufacturer in England makes 16000 garden statues. 12% are defective and cannot be sold.

a. Find the number of statues that are non-defective. [2]

b. The manufacturer sells each non-defective statue for 5.25 British pounds (GBP) to an American company. The exchange rate from GBP to US dollars (USD) is $1 \text{ GBP} = 1.6407 \text{ USD}$. [2]

Calculate the amount in USD paid by the American company for all the non-defective statues. Give your answer correct to **two decimal places**.

c. The American company sells one of the statues to an Australian customer for $12\ \text{USD}$. The exchange rate from Australian dollars (AUD) to USD is $1\ \text{AUD} = 0.8739\ \text{USD}$. [2]

Calculate the amount that the Australian customer pays, in AUD, for this statue. Give your answer correct to **two decimal places**.

Markscheme

a. 0.88×16000 **OR** $16000 - 0.12 \times 16000$ ***(M1)***

14080 ***(A1)*** ***(C2)***

[2 marks]

b. $1.6407 \times 5.25 \times 14080$ ***(M1)***

$121280.54\ \text{USD}$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from their answer to part (a).

[2 marks]

c. $12 \times \frac{1}{0.8739}$ ***(M1)***

$13.73\ \text{AUD}$ ***(A1)*** ***(C2)***

Note: If division used in part (b) and multiplication used in part (c), award ***(M0)(A0)*** for part (b) and ***(M1)(A1)*****(ft)** for part (c).

[2 marks]

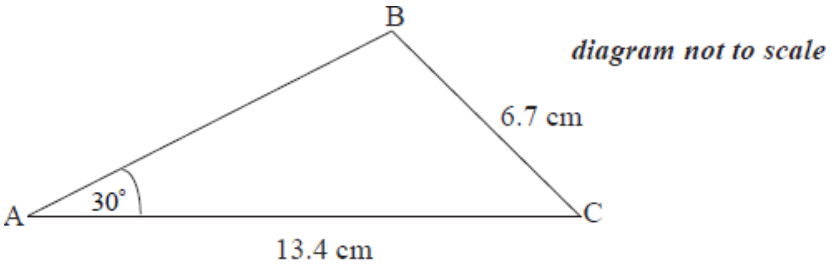
Examiners report

a. This question was generally well answered with much correct working seen in parts (a) and (b). The most popular incorrect answer in part (a) was 1920 – candidates simply stating the number of defective items rather than the number of non-defective items. Unfortunately in part (c) many candidates multiplied by 0.8739 rather than divided and 10.49 proved a popular, but erroneous, answer.

b. This question was generally well answered with much correct working seen in parts (a) and (b). The most popular incorrect answer in part (a) was 1920 – candidates simply stating the number of defective items rather than the number of non-defective items. Unfortunately in part (c) many candidates multiplied by 0.8739 rather than divided and 10.49 proved a popular, but erroneous, answer.

c. This question was generally well answered with much correct working seen in parts (a) and (b). The most popular incorrect answer in part (a) was 1920 – candidates simply stating the number of defective items rather than the number of non-defective items. Unfortunately in part (c) many candidates multiplied by 0.8739 rather than divided and 10.49 proved a popular, but erroneous, answer.

The diagram shows triangle ABC in which angle BAC $= 30°$, BC $= 6.7$ cm and AC $= 13.4$ cm.



a. Calculate the size of angle ACB. [4]

b. Nadia makes an accurate drawing of triangle ABC. She measures angle BAC and finds it to be 29°. [2]

Calculate the percentage error in Nadia's measurement of angle BAC.

Markscheme

a. $\frac{\sin A\hat{B}C}{13.4} = \frac{\sin 30^\circ}{6.7}$ ***(M1)(A1)***

Note: Award ***(M1)*** for correct substituted formula, ***(A1)*** for correct substitution.

$A\hat{B}C = 90°$ ***(A1)***

$A\hat{C}B = 60°$ ***(A1)*(ft)** ***(C4)***

Note: Radians give no solution, award maximum ***(M1)(A1)(A0)***.

[4 marks]

b. $\frac{29-30}{30} \times 100$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into correct formula.

% error = –33.3 % ***(A1)*** ***(C2)***

Notes: Percentage symbol not required. Accept positive answer.

[2 marks]

Examiners report

a. Use of cosine rule was common. The assumption of a right angle in the given diagram was minimal.

b. The incorrect denominator was often seen in the error formula.

Passengers of Flyaway Airlines can purchase tickets for either Business Class or Economy Class.

On one particular flight there were 154 passengers.

Let x be the number of Business Class passengers and y be the number of Economy Class passengers on this flight.

On this flight, the cost of a ticket for each Business Class passenger was 320 euros and the cost of a ticket for each Economy Class passenger was 85 euros. The total amount that Flyaway Airlines received for these tickets was $14\,970\ \text{euros}$.

The airline's finance officer wrote down the total amount received by the airline for these tickets as $14\,270\ \text{euros}$.

a. Use the above information to write down an equation in x and y. [1]

b. Use the information about the cost of tickets to write down a second equation in x and y. [1]

c. Find the value of x and the value of y. [2]

d. Find the percentage error. [2]

Markscheme

a. $x + y = 154$ ***(A1)*** ***(C1)***

[1 mark]

b. $320x + 85y = 14\,970$ ***(A1)*** ***(C1)***

[1 mark]

c. $x = 8,\ y = 146$ ***(A1)*****(ft)*****(A1)*****(ft)*** ***(C2)***

Note: Follow through from parts (a) and (b) irrespective of working seen, **but only** if both values are positive integers.

Award ***(M1)(A0)*** for a reasonable attempt to solve simultaneous equations algebraically, leading to at least one incorrect or missing value.

[2 marks]

d. $\left|\frac{14270-14970}{14970}\right| \times\ 100$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into percentage error formula.

$= 4.68(\%)\ (4.67601\ldots)$ ***(A1)*** ***(C2)***

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]
d. [N/A]

Let $f(x) = x^2 - 6x + 8$.

a. Factorise $x^2 - 6x + 8$. [2]

b. Hence, or otherwise, solve the equation $x^2 - 6x + 8 = 0$. [2]

c. Let $g(x) = x + 3$. [2]

Write down the solutions to the equation $f(x) = g(x)$.

Markscheme

a. $(x - 2)(x - 4)$ ***(A1)(A1)*** ***(C2)***

[2 marks]

b. $x = 2$, $x = 4$ ***(A1)*****(ft)*****(A1)*****(ft)*** ***(C2)***

[2 marks]

c. $x = 0.807$, $x = 6.19$ ***(A1)(A1)*** ***(C2)***

Note: Award maximum of ***(A0)(A1)*** if coordinate pairs given.

OR

(M1) for an attempt to solve $x^2 - 7x + 5 = 0$ via formula with correct values substituted. ***(M1)***

$x = \frac{7 \pm \sqrt{29}}{2}$ ***(A1)*** ***(C2)***

[2 marks]

Examiners report

a. This was generally well answered, but a number seemed not to know the term “factorise”.

b. This was generally well answered.

c. This part proved problematic for many candidates. It was expected that the GDC was used, though many attempted an algebraic solution.

Given that $h = \sqrt{\ell^2 - \frac{d^2}{4}}$,

a. Calculate the **exact** value of h when $\ell = 0.03625$ and $d = 0.05$. [2]

b. Write down the answer to part (a) correct to three decimal places. [1]

c. Write down the answer to part (a) correct to three significant figures. [1]

d. Write down the answer to part (a) in the form $a \times 10^k$, where $1 \leqslant a < 10$, $k \in \mathbb{Z}$. [2]

Markscheme

a. $h = \sqrt{0.03625^2 - \frac{0.05^2}{4}}$ ***(M1)***

$= 0.02625$ ***(A1)*** ***(C2)***

Note: Award ***(A1)*** only for 0.0263 seen without working

[2 marks]

b. 0.026 ***(A1)*****(ft)** ***(C1)***

[1 mark]

c. 0.0263 ***(A1)*****(ft)** ***(C1)***

[1 mark]

d. 2.625×10^{-2}

for 2.625 **(ft)** from unrounded (a) only ***(A1)*****(ft)**

for $\times 10^{-2}$ ***(A1)*****(ft)** ***(C2)***

[2 marks]

Examiners report

a. This was answered correctly by the majority of the candidates however some candidates entered the numbers incorrectly and arrived at the wrong answer.

b. Correction to decimal places was less well attempted than to significant figures.

c. Correction to decimal places was less well attempted than to significant figures.

d. Most made a successful attempt to change their answer to part (a) into scientific notation. Some were penalised for not using their answer to (a).

The following table gives the exchange rate from US dollars to euros and from US dollars to Japanese Yen. **Give all answers in this question correct to two decimal places**.

1 USD	0.6337 EUROS
1 USD	99.7469 YEN

a, iEnrico has 475 USD. [2]

How many euros is this worth?

a, ii. Enrico has 475 USD. [2]

Enrico goes to a bank to exchange his dollars. The bank charges 3 % commission.

How many euros does Enrico receive?

b. Find the exchange rate from euros to yen. [2]

Markscheme

a, i. ***Note: Financial penalty (FP) applies in this part***

(FP) $475 \times 0.6337 = 301.01$ ***(M1)(A1)***

Note: Award ***(M1)*** for multiplication by 0.6337.

[2 marks]

a, ii. ***Note: Financial penalty (FP) applies in this part*** $\frac{3}{100} \times 301.01 = 9.03$ ***(M1)***

Note: Award ***(M1)*** for multiplication by 3/100.

(FP) $301.01 - 9.03 = 291.98$ ***(A1)*****(ft)**

OR

0.97×301.01 ***(M1)***

(FP) $= 291.98$ ***(A1)*****(ft)** ***(C4)***

[2 marks]

b.

Note: Financial penalty (FP) applies in this part

(FP) $\frac{99.7469}{0.6337} = 157.40$ ***(M1)(A1)*** ***(C2)***

Notes: Award ***(M1)*** for dividing by 0.6337.

[2 marks]

Examiners report

a, i. This question was well answered by many candidates, particularly part (a), however a significant number lost the financial penalty mark for not giving an answer correct to two decimal places, as stated in the question.

a, ii. This question was well answered by many candidates, particularly part (a), however a significant number lost the financial penalty mark for not giving an answer correct to two decimal places, as stated in the question.

b. This question was well answered by many candidates, particularly part (a), however a significant number lost the financial penalty mark for not giving an answer correct to two decimal places, as stated in the question.

Astrid invests 1200 Euros for five years at a nominal annual interest rate of 7.2 %, **compounded monthly**.

Find the interest Astrid has earned during the five years of her investment. **Give your answer correct to two decimal places.**

Markscheme

$I = 1200\left(1 + \frac{7.2}{600}\right)^{5\times 12} - 1200$ ***(M1)(A1)***

I = 518.15 Euros ***(A1)*** ***(C3)***

Notes: Award ***(M1)*** for substitution in the compound interest formula, ***(A1)*** for correct substitutions, ***(A1)*** for correct answer.

If final amount found is 1718.15 and working shown award ***(M1) (A1)(A0)***.

[3 marks]

Examiners report

Part (a) of this question was incorrectly answered by many candidates not noticing that the rate of interest was compounded monthly rather than annually. A number of candidates gave the final amount as the answer, rather than the interest.

Neung is going home to Vietnam after working in Singapore.

She has 5000 Singapore dollars (SGD) and changes these into American dollars (USD) to take home.

The exchange rate between Singapore dollars (SGD) and American dollars (USD) is

1 USD = 1.2945 SGD.

There is also a 2.4 % commission on the exchange.

a. Calculate the amount of commission on the exchange **in SGD**. [2]

b. Calculate the number of American dollars (USD) Neung takes home. **Give your answer correct to 2 decimal places.** [2]

c. At the airport in Vietnam, Neung changes 150 USD into Vietnamese dong (VND) to pay for her transport home. [2]

The exchange rate between American dollars (USD) and Vietnamese dong (VND) is

1 USD = 19 495 VND.

There is no commission.

Calculate the number of Vietnamese dong that Neung receives. **Give your answer correct to the nearest thousand dong.**

Markscheme

a. 5000 × 0.024 ***(M1)***

Note: Award ***(M1)*** for multiplication by 0.024.

=120 ***(A1)*** ***(C2)***

b. $4880 \times \frac{1}{1.2945}$ ***(M1)***

Note: Award ***(M1)*** for multiplication by $\frac{1}{1.2945}$.

= 3769.80 ***(A1)*****(ft)** ***(C2)***

Note: Correct answer to 2 dp only. Follow through from their part (a).

c. 150×19495 ***(M1)***

Note: Award ***(M1)*** for $\times 19495$.

$= 2924000$ ***(A1)*** ***(C2)***

Notes: Correct answer to nearest 1000 only. Do not penalize incorrect accuracy in (c) if this has already been penalized in part (b).

Examiners report

a. Marks were awarded in part (a) for multiplication by 0.024 in part (b) for division by 1.2945 and in part (c) for multiplication by 19495. Candidates did not follow specified levels of accuracy. Candidates were able to answer later parts of the question even if they did not answer the first parts correctly.

b. Marks were awarded in part (a) for multiplication by 0.024 in part (b) for division by 1.2945 and in part (c) for multiplication by 19495. Candidates did not follow specified levels of accuracy. Candidates were able to answer later parts of the question even if they did not answer the first parts correctly.

c. Marks were awarded in part (a) for multiplication by 0.024 in part (b) for division by 1.2945 and in part (c) for multiplication by 19495. Candidates did not follow specified levels of accuracy. Candidates were able to answer later parts of the question even if they did not answer the first parts correctly.

Consider the sequence

$$512, 128, 32, 8, \ldots$$

a. Calculate the exact value of the ninth term of the sequence. [3]

b. Calculate the least number of terms required for the sum of the sequence to be greater than 682.6 [3]

Markscheme

a. $u_9 = 512\left(\frac{1}{4}\right)^8$ ***(M1)(A1)***

Notes: Award ***(M1)*** for substituted geometric sequence formula, ***(A1)*** for correct substitution.

OR

If a list is used, award ***(M1)*** for a list of 9 terms, ***(A1)*** for all 9 terms correct. ***(M1)(A1)***

$= \frac{1}{128}\ (0.0078125)$ ***(A1)*** ***(C3)***

Note: Award ***(A1)*** for exact answer only.

[3 marks]

b. $\frac{512\left(1-\left(\frac{1}{4}\right)^n\right)}{1-\left(\frac{1}{4}\right)} > 682.6$ ***(M1)(A1)*****(ft)**

Notes: Award ***(M1)*** for setting substituted geometric sum formula > 682.6 ***(A1)*****(ft)** for correct substitution into geometric sum formula. Follow through from their common ratio.

OR

If list is used, award ***(M1)*** for S(6) and S(7) seen, values don't have to be correct.

(A1) for correct S(6) and S(7). (S(6) $= 682.5$ and S(7) $= 682.625$). ***(M1)(A1)***

$n = 7$ ***(A1)*****(ft)** ***(C3)***

Notes: Follow through from their common ratio. Do not award the final ***(A1)*****(ft)** if n is less than 5 or if n is not an integer.

[3 marks]

Examiners report

a. The upper quartile of candidates scored well on this question with the vast majority scoring more than 4 marks. However, the lower quartile did very badly with the majority scoring less than 2 marks. A fundamental error in part (a) resulted in many less able candidates using a common ratio of 4 instead of $^1/_4$. Where lists were used in either part of the question, they were either invariably incomplete or contained numerical errors. Indeed, using lists seem to be as problematic in this question as they were in Q6 on arithmetic sequences. Correctly quoted and substituted formula in a correct inequality (= sign was allowed) did earn many candidates two marks here. The required answer of 7 however did not always follow.

b. The upper quartile of candidates scored well on this question with the vast majority scoring more than 4 marks. However, the lower quartile did very badly with the majority scoring less than 2 marks. A fundamental error in part (a) resulted in many less able candidates using a common ratio of 4 instead of $^1/_4$. Where lists were used in either part of the question, they were either invariably incomplete or contained numerical errors. Indeed, using lists seem to be as problematic in this question as they were in Q6 on arithmetic sequences. Correctly quoted and substituted formula in a correct inequality (= sign was allowed) did earn many candidates two marks here. The required answer of 7 however did not always follow.

A tree begins losing its leaves in October. The number of leaves that the tree loses each day increases by the same number on each successive day.

Date in October	1	2	3	4	.....
Number of leaves lost	24	40	56	72	.....

a. Calculate the number of leaves that the tree loses on the 21st October. [3]

b. Find the total number of leaves that the tree loses in the 31 days of the month of October. [3]

Markscheme

a. $u_{21} = 24 + (21 - 1)(16)$ ***(M1)(A1)***

Note: Award ***(M1)*** for correct substituted formula, ***(A1)*** for correct substitutions.

$u_{21} = 344$ ***(A1)*** ***(C3)***

[3 marks]

b. $S_{31} = \frac{31}{2}[2(24) + (31 - 1)(16)]$ ***(M1)(A1)*****(ft)**

Note: Award ***(M1)*** for correct substituted formula, ***(A1)*****(ft)** for correct substitutions. **(ft)** from their value for *d*.

$S_{31} = 8184$ ***(A1)*****(ft)** ***(C3)***

[3 marks]

Examiners report

a. This was generally well attempted, often by listing.

b. The common misconception was the use of the “term by term” formula. Listing the values in this part was usually not a successful strategy. The incorrect substitution of the answer to (a) also led to errors.

A cuboid has the following dimensions: length = 8.7 cm, width = 5.6 cm and height = 3.4 cm.

a. Calculate the **exact** value of the volume of the cuboid, in cm^3. [2]

b. Write your answer to part (a) correct to [2]

(i) one decimal place;

(ii) three significant figures.

c. Write your answer to **part (b)(ii)** in the form $a \times 10^k$, where $1 \leqslant a < 10, k \in \mathbb{Z}$. [2]

Markscheme

a. $\mathrm{V} = 8.7 \times 5.6 \times 3.4$ ***(M1)***

Note: Award ***(M1)*** for multiplication of the 3 given values.

$= 165.648$ ***(A1)*** ***(C2)***

b. (i) 165.6 ***(A1)*(ft)**

Note: Follow through from their answer to part (a).

(ii) 166 ***(A1)*(ft)** ***(C2)***

Note: Follow through from their answer to part (a).

c. 1.66×10^2 ***(A1)*(ft)*(A1)*(ft)** ***(C2)***

Notes: Award ***(A1)*(ft)** for 1.66, ***(A1)*(ft)** for 10^2. Follow through from their answer to part (b)(ii) only. The follow through for the index should be dependent on the value of the mantissa in part (c) and their answer to part (b)(ii).

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

The first term of an arithmetic sequence is 0 and the common difference is 12.

a. Find the value of the 96^{th} term of the sequence. [2]

b. The first term of a geometric sequence is 6. The 6^{th} term of the geometric sequence is equal to the 17^{th} term of the arithmetic sequence given above. [2]

Write down an equation using this information.

c. The first term of a geometric sequence is 6. The $\6^{\text{th}}$ term of the geometric sequence is equal to the 17^{th} term of the arithmetic sequence given above. [2]

Calculate the common ratio of the geometric sequence.

Markscheme

a. $u_{96} = u_1 + 95d$ ***(M1)***

$= 0 + 95 \times 12$

$= 1140$ ***(A1)*** ***(C2)***

[2 marks]

b. $6r^5 = 16d$ ***(A1)***

$6r^5 = 16 \times 12\ (192)$ ***(A1)*** ***(C2)***

Note: ***(A1)*** only, if both terms seen without an equation.

[2 marks]

c. $r^5 = 32$ ***(A1)*****(ft)**

Note: (ft) from their (b).

$r = 2$ ***(A1)*****(ft)** ***(C2)***

[2 marks]

Examiners report

a. Part (a) was done well. There was some confusion in answering part (b) with many candidates unsure what they needed to write down. Often the two terms were seen somewhere in the working without the equation being written down in the answer box, or the equation was seen in the working for part (c). Part (c) was answered well, often with follow-through marks being awarded from an incorrect part (b) provided the working was seen.

b. Part (a) was done well. There was some confusion in answering part (b) with many candidates unsure what they needed to write down. Often the two terms were seen somewhere in the working without the equation being written down in the answer box, or the equation was seen in the working for part (c). Part (c) was answered well, often with follow-through marks being awarded from an incorrect part (b) provided the working was seen.

c. Part (a) was done well. There was some confusion in answering part (b) with many candidates unsure what they needed to write down. Often the two terms were seen somewhere in the working without the equation being written down in the answer box, or the equation was seen in the working for part (c). Part (c) was answered well, often with follow-through marks being awarded from an incorrect part (b) provided the working was seen.

512 competitors enter round 1 of a tennis tournament, in which each competitor plays a match against one other competitor.

The winning competitor progresses to the next round (round 2); the losing competitor leaves the tournament.
The tournament continues in this manner until there is a winner.

a. Find the number of competitors who play in round 6 of the tournament. [3]

b. Find the total number of matches played in the tournament. [3]

Markscheme

a. $512\left(\frac{1}{2}\right)^5$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted geometric progression formula, ***(A1)*** for correct substitution.

If a list is used, award ***(M1)*** for a list of at least six terms, beginning with 512 and ***(A1)*** for first six terms correct.

16 ***(A1)*** ***(C3)***

[3 marks]

b. $S_9 = 256\left(\frac{1-\left(\frac{1}{2}\right)^9}{1-\frac{1}{2}}\right)$ **OR** $\frac{(2^9-1)}{2-1}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted sum of a GP formula, ***(A1)*** for correct substitution.

If a list is used, award ***(A1)*** for at least 9 correct terms, including 1, and ***(M1)*** for their 9 terms, including 1, added together.

511 ***(A1)*** ***(C3)***

[3 marks]

Examiners report

a. The first part of this question was answered quite well, especially by candidates who used a list. Part (b) was poorly answered. Common errors in part (b) were to find the number of rounds rather than the total number of matches played or to take the first term as 512 rather than 256.

b. The first part of this question was answered quite well, especially by candidates who used a list. Part (b) was poorly answered. Common errors in part (b) were to find the number of rounds rather than the total number of matches played or to take the first term as 512 rather than 256.

a. Only one of the following four sequences is arithmetic and only one of them is geometric. [2]

$a_n = 1,\ 2,\ 3,\ 5,\ \ldots$

$b_n = 1,\ \frac{3}{2},\ \frac{9}{4},\ \frac{27}{8},\ \ldots$

$c_n = 1,\ \frac{1}{2},\ \frac{1}{3},\ \frac{1}{4},\ \ldots$

$d_n = 1,\ 0.95,\ 0.90,\ 0.85,\ \ldots$

State which sequence is

(i) arithmetic;

(ii) geometric.

b(i). For **another** geometric sequence $e_n = -6,\ -3,\ -\frac{3}{2},\ -\frac{3}{4},\ \ldots$ [1]

write down the common ratio;

b(ii). For **another** geometric sequence $e_n = -6,\ -3,\ -\frac{3}{2},\ -\frac{3}{4},\ \ldots$ [3]

find the **exact** value of the tenth term. Give your answer as a fraction.

Markscheme

a. (i) d_n **OR** $1,\ 0.95,\ 0.90,\ 0.85,\ \ldots$ ***(A1)*** ***(C1)***

(ii) b_n **OR** $1,\ \frac{3}{2},\ \frac{9}{4},\ \frac{27}{8},\ \ldots$ ***(A1)*** ***(C1)***

b(i). $\frac{1}{2}$ **OR** 0.5 ***(A1)*** ***(C1)***

Note: Accept 'divide by 2' for ***(A1)***.

b(ii). $-6\left(\frac{1}{2}\right)^{10-1}$ ***(M1)(A1)*****(ft)**

Notes: Award ***(M1)*** for substitution in the GP n^{th} term formula, ***(A1)*****(ft)** for their correct substitution.

Follow through from their common ratio in part (b)(i).

OR

$\left(-6,\ -3,\ -\frac{3}{2},\ -\frac{3}{4},\right) -\frac{3}{8},\ -\frac{3}{16},\ -\frac{3}{32},\ -\frac{3}{64},\ -\frac{3}{128}$ ***(M1)(A1)*****(ft)**

Notes: Award ***(M1)*** for terms 5 and 6 correct (using their ratio).

Award ***(A1)*****(ft)** for terms 7, 8 and 9 correct (using their ratio).

$-\frac{3}{256}$ $\left(-\frac{6}{512}\right)$ ***(A1)*****(ft)** ***(C3)***

Examiners report

a. [N/A]

b(i). [N/A]

b(ii). [N/A]

---

80 matches were played in a football tournament. The following table shows the number of goals scored in all matches.

Number of goals	0	1	2	3	4	5
Number of matches	16	22	19	17	1	5

a. Find the mean number of goals scored per match. [2]

b. Find the median number of goals scored per match. [2]

c. A local newspaper claims that the mean number of goals scored per match is two. Calculate the percentage error in the local newspaper's claim. [2]

Markscheme

a. $\frac{0\times16+1\times22+2\times19...}{80}$ ***(M1)***

Note: Award ***(M1)*** for substituting correct values into mean formula.

1.75 ***(A1)*** ***(C2)***

[2 marks]

b. An attempt to enumerate the number of goals scored. ***(M1)***

2 ***(A1)*** ***(C2)***

[2 marks]

c. $\frac{2-1.75}{1.75}\times100$ ***(M1)***

14.3% ***(A1)*(ft)** ***(C2)***

Notes: Award ***(M1)*** for correctly substituted $\%$ error formula. $\%$ sign not required. Follow through from their answer to part (a). If 100 is missing and answer incorrect award ***(M0)(A0)***. If 100 is missing and answer incorrectly rounded award ***(M1)(A1)*(ft)*(AP)***.

[2 marks]

Examiners report

a. In parts (a) and (b), 2.5 was a common incorrect error for both parts as some candidates were confused as to the concept of both the mean and the median from tabular data and simply looked at the mean and median of the *Number of goals*, ignoring the weighting of the number of matches. Candidates faired a little better with part (c) and many correct answers (many as follow through answers) were seen in this part of the question.

b. In parts (a) and (b), 2.5 was a common incorrect error for both parts as some candidates were confused as to the concept of both the mean and the median from tabular data and simply looked at the mean and median of the *Number of goals*, ignoring the weighting of the number of matches. Candidates faired a little better with part (c) and many correct answers (many as follow through answers) were seen in this part of the question.

c. In parts (a) and (b), 2.5 was a common incorrect error for both parts as some candidates were confused as to the concept of both the mean and the median from tabular data and simply looked at the mean and median of the *Number of goals*, ignoring the weighting of the number of matches. Candidates faired a little better with part (c) and many correct answers (many as follow through answers) were seen in this part of the question.

a. Calculate $\frac{77.2\times3^3}{3.60\times2^2}$. [1]

b. Express your answer to part (a) in the form $a \times 10^k$, where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. [2]

c. Juan estimates the length of a carpet to be 12 metres and the width to be 8 metres. He then estimates the area of the carpet. [3]

(i) Write down his estimated area of the carpet.

When the carpet is accurately measured it is found to have an area of 90 square metres.

(ii) Calculate the percentage error made by Juan.

Markscheme

a. $144.75 \left(= \frac{579}{4}\right)$ ***(A1)***

accept 145 ***(C1)***

[1 mark]

b. 1.4475×10^2 ***(A1)*****(ft)*****(A1)*****(ft)**

accept 1.45×10^2 ***(C2)***

[2 marks]

c. *Unit penalty* ***(UP)*** *is applicable in question part (c)(i)* ***only****.*

(UP) (i) Area = 96 m^2 ***(A1)***

(ii) $\%\text{ error} = \frac{(96-90)}{90} \times 100$ ***(M1)***

$= \frac{6\times100}{90}$

$\frac{20}{3}\%$ or 6.67 % ***(A1)*****(ft)** ***(C3)***

[3 marks]

Examiners report

a. (a) This was answered correctly by the majority of the candidates however some candidates entered the numbers without using brackets and arrived at the wrong answer.

b. (b) Most made a successful attempt to change their answer to part (a) into scientific notation.

c. (c) (i) Many candidates managed to find the answer but then lost the mark by not adding the units.

(ii) Several candidates are still having a problem finding the percentage error. The formula is given in their information booklet and they should have had practice using all the formulae that they are given. There are some schools that are still using the incorrect formula sheet for percentage error.

The following diagram shows a rectangle with sides of length 9.5×10^2 m and 1.6×10^3 m.

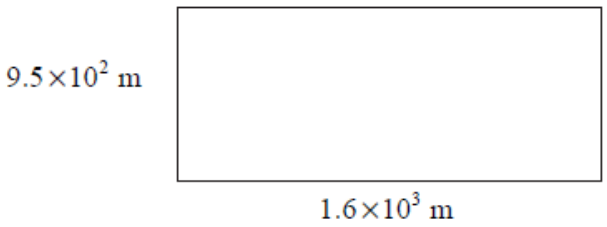


diagram not to scale

a. Write down the area of the rectangle in the form $a \times 10^k$, where $1 \leq a < 10$, $k \in \mathbb{Z}$. [3]

b. Helen's estimate of the area of the rectangle is $1\,600\,000$ m^2. [3]

Find the percentage error in Helen's estimate.

Markscheme

a. ***UP applies in part (a).***

$9.5 \times 10^2 \times 1.6 \times 10^3$ ***(M1)***

(UP) $= 1.52 \times 10^6$ m^2 ***(A1)(A1)*** ***(C3)***

Notes: Award ***(M1)*** for multiplication of the two numbers.

Award ***(A1)*** for 1.52, ***(A1)*** for 10^6.

[3 marks]

b. $\frac{1600000-1520000}{1520000} \times 100$ ***(M1)(A1)*****(ft)**

Note: Award ***(M1)*** for substitution in formula, ***(A1)*****(ft)** for their correct substitution.

= 5.26 % (percent sign not required). ***(A1)*****(ft)** ***(C3)***

Note: Accept positive or negative answer.

[3 marks]

Examiners report

a. This was generally well done except for missing or incorrect units. Most candidates could give their answer in standard form and find the percentage error.

b. This was generally well done except for missing or incorrect units. Most candidates could give their answer in standard form and find the percentage error.

$z = \frac{17x^2}{a-b}$.

a. Find the value of z when x = 12.5, a = 0.572 and b = 0.447. Write down your full calculator display. [2]

b. Write down your answer to part (a) [2]

(i) correct to the nearest 1000 ;

(ii) correct to three significant figures.

c. Write your answer to **part (b)(ii)** in the form $a \times 10^k$, where $1 \leq a < 10$, $k \in \mathbb{Z}$. [2]

Markscheme

a. $z = \frac{17(12.5)^2}{(0.572-0.447)}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into formula.

= 21250 ***(A1)*** ***(C2)***

[2 marks]

b. (i) 21000 ***(A1)*****(ft)**

(ii) 21300 ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (a).

[2 marks]

c. 2.13×10^4 ***(A1)*****(ft)*****(A1)*****(ft)** ***(C2)***

Notes: Award ***(A1)*****(ft)** for 2.13, ***(A1)*****(ft)** for $\times 10^4$. Follow through from part (b)(ii).

[2 marks]

Examiners report

a. Many candidates calculated $\frac{17x^2}{a} - b$ instead of $\frac{17x^2}{a-b}$ on their calculators; however they were able to get follow through points. It is important that candidates learn how to correctly input expressions into their calculators.

b. Many candidates calculated $\frac{17x^2}{a} - b$ instead of $\frac{17x^2}{a-b}$ on their calculators; however they were able to get follow through points. It is important that candidates learn how to correctly input expressions into their calculators.

c. Although the question explicitly stated in bold to use the answer to **part(b)(ii)** many candidates used their answer to part (a) for part (c). The general notes about rounding in the mark scheme are over-ruled if the question has explicit directions such as in this question.

Water has a lower boiling point at higher altitudes. The relationship between the boiling point of water (T) and the height above sea level (h) can be described by the model $T = -0.0034h + 100$ where T is measured in degrees Celsius (°C) and h is measured in metres from sea level.

a. Write down the boiling point of water at sea level. [1]

b. Use the model to calculate the boiling point of water at a height of 1.37 km above sea level. [3]

c. Water boils at the top of Mt. Everest at 70 °C. [2]

Use the model to calculate the height above sea level of Mt. Everest.

Markscheme

a. 100 °C ***(A1)*** ***(C1)***

[1 mark]

b. \(T = -0.0034 \times 1370 + 100\) ***(A1)(M1)***

Note: Award ***(A1)*** for 1370 seen, ***(M1)*** for substitution of their h into the equation.

95.3 °C (95.342) ***(A1)*** ***(C3)***

Notes: If their h is incorrect award at most ***(A0)(M1)(A0)***. If their h = 1.37 award at most ***(A0)(M1)(A1)*****(ft)**.

[3 marks]

c. $70 = -0.0034h + 100$ ***(M1)***

Note: Award ***(M1)*** for correctly substituted equation.

h = 8820 m (8823.52...) ***(A1)*** ***(C2)***

Note: The answer is 8820 m (or 8.82 km.) units are required.

[2 marks]

Examiners report

a. The majority of the candidates showed they were able to substitute values into the model. The most common mistake was to neglect converting 1.37 km into metres. Some candidates did not appreciate the practical considerations of this question; Mount Everest will never be less than one metre high. It is important to remind students to check their answers in terms of the context of the information given.

b. The majority of the candidates showed they were able to substitute values into the model. The most common mistake was to neglect converting 1.37 km into metres. Some candidates did not appreciate the practical considerations of this question; Mount Everest will never be less than one metre high. It is important to remind students to check their answers in terms of the context of the information given.

c. The majority of the candidates showed they were able to substitute values into the model. The most common mistake was to neglect converting 1.37 km into metres. Some candidates did not appreciate the practical considerations of this question; Mount Everest will never be less than one metre high. It is important to remind students to check their answers in terms of the context of the information given.

The length, in cm, of six baseball bats was measured. The lengths are given below.

104.5, 105.1, 104.8, 105.2, 104.9, 104.9

a. Calculate the **exact value** of the mean length. [2]

b. Write your answer to part (a) in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [2]

c. Marian calculates the mean length and finds it to be 105 cm. [2]

Calculate the percentage error made by Marian.

Markscheme

a. $\left(\frac{104.5+105.1+...}{6}\right)$ ***(M1)***

Note: Award ***(M1)*** for use of mean formula.

= 104.9 (cm) ***(A1)*** ***(C2)***

[2 marks]

b. 1.049×10^2 ***(A1)*****(ft)*****(A1)*****(ft)*** ***(C2)***

Notes: Award ***(A1)*****(ft)** for 1.049, ***(A1)*****(ft)** for 10^2. Follow through from their part (a).

[2 marks]

c. $\frac{105-104.9}{104.9} \times 100$ (%) ***(M1)***

Notes: Award ***(M1)*** for their correctly substituted % error formula.

% error = 0.0953 (%) (0.0953288...) ***(A1)*****(ft)** ***(C2)***

Notes: A 2sf answer of 0.095 following $\frac{105-104.9}{105} \times 100$ working is awarded no marks. Follow through from their part (a), provided it is not 105. Do not accept a negative answer. % sign not required.

[2 marks]

Examiners report

a. Another well answered question with candidates showing a good understanding of standard form and many correct answers were seen in parts (a) and (b). Whilst the formula is given for percentage error, there were still a minority of candidates who divided by 105 rather than the required value of 104.9.

b. Another well answered question with candidates showing a good understanding of standard form and many correct answers were seen in parts (a) and (b). Whilst the formula is given for percentage error, there were still a minority of candidates who divided by 105 rather than the required value of 104.9.

c. Another well answered question with candidates showing a good understanding of standard form and many correct answers were seen in parts (a) and (b). Whilst the formula is given for percentage error, there were still a minority of candidates who divided by 105 rather than the required value of 104.9.

In the Canadian city of Ottawa:

$$97\% \text{ of the population speak English,}$$
$$38\% \text{ of the population speak French,}$$
$$36\% \text{ of the population speak both English and French.}$$

The total population of Ottawa is $985\,000$.

a. Calculate the percentage of the population of Ottawa that speak English but not French. [2]

b. Calculate the number of people in Ottawa that speak both English and French. [2]

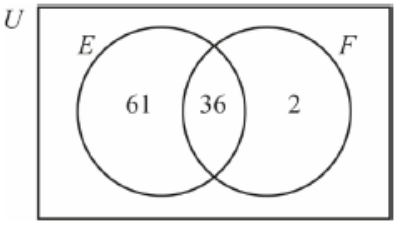
c. Write down your answer to part (b) in the form $a \times 10^k$ where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. [2]

Markscheme

a. $97 - 36$ ***(M1)***

Note: Award ***(M1)*** for subtracting 36 from 97.

OR



(M1)

Note: Award ***(M1)*** for 61 **and** 36 seen in the correct places in the Venn diagram.

$= 61\ (\%)$ ***(A1)*** ***(C2)***

Note: Accept 61.0 (%).

[2 marks]

b. $\frac{36}{100} \times 985\,000$ ***(M1)***

Note: Award ***(M1)*** for multiplying 0.36 (or equivalent) by $985\,000$.

$= 355\,000\ (354\,600)$ ***(A1)*** ***(C2)***

[2 marks]

c. $3.55 \times 10^5\ (3.546 \times 10^5)$ ***(A1)*****(ft)*****(A1)*****(ft)*** ***(C2)***

Note: Award ***(A1)(ft)*** for 3.55 (3.546) **must** match part (b), and ***(A1)(ft)*** $\times 10^5$.

Award ***(A0)(A0)*** for answers of the type: 35.5×10^4. Follow through from part (b).

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

In this question, give all answers correct to 2 decimal places.

Jose travelled from Buenos Aires to Sydney. He used Argentine pesos, ARS, to buy 350 Australian dollars, AUD, at a bank. The exchange rate was 1 ARS = 0.1559 AUD.

The bank charged Jose a commission of 2%.

Jose used his credit card to pay his hotel bill in Sydney. The bill was 585 AUD. The value the credit card company charged for this payment was 4228.38 ARS. The exchange rate used by the credit card company was 1 AUD = x ARS. No commission was charged.

a. Use this exchange rate to calculate the amount of ARS that is equal to 350 AUD. [2]

b. Calculate the **total** amount of ARS Jose paid to get 350 AUD. [2]

c. Find the value of x. [2]

Markscheme

a. **Note:** In this question, the first time an answer is not to 2 dp the final ***(A1)*** is not awarded.

$\frac{350}{0.1559}$ ***(M1)***

Note: Award ***(M1)*** for dividing 350 by 0.1559.

$= 2245.03\ (\text{ARS})$ ***(A1)*** ***(C2)***

[2 marks]

b. 2245.03×1.02 ***(M1)***

Note: Award ***(M1)*** for multiplying their answer to part (a) by 1.02.

$= 2289.93\ (\text{ARS})$ ***(A1)*****(ft)** ***(C2)***

OR

2245.03×0.02 ***(M1)***

Note: Award ***(M1)*** for multiplying their answer to part (a) by 0.02.

$= 44.9006$

$2245.03 + 44.90$

$= 2289.93\ (\text{ARS})$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (a).

[2 marks]

c. $\frac{4228.38}{585}$ ***(M1)***

Note: Award ***(M1)*** for dividing 4228.38 by 585.

$= 7.23$ ***(A1)*** ***(C2)***

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

U is the set of all the **positive** integers less than or equal to 12.

A , B and C are subsets of U .

$$A = \{1, 2, 3, 4, 6, 12\}$$

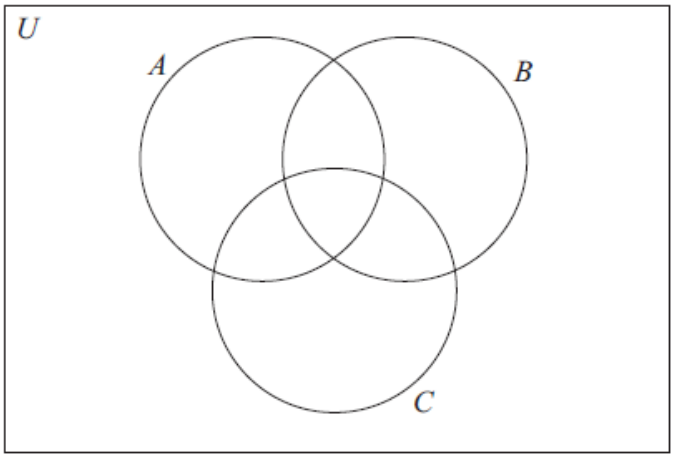
$$B = \{\text{odd integers}\}$$

$$C = \{5, 6, 8\}$$

a. Write down the number of elements in $A \cap C$. [1]

b. List the elements of B. [1]

c. Complete the following Venn diagram with **all** the elements of U. [4]



Markscheme

a. 1 (one) ***(A1)*** ***(C1)***

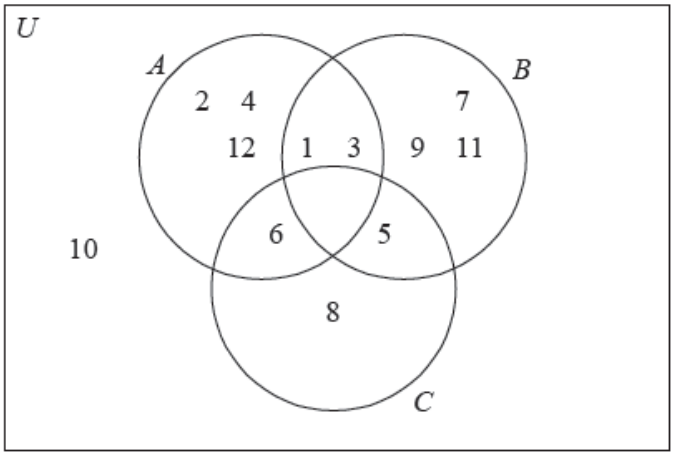
Note: 6, $\{6\}$ or $\{1\}$ earns no marks.

[1 mark]

b. $1, 3, 5, 7, 9, 11$ ***(A1)*** ***(C1)***

Note: Do not penalise if braces, parentheses or brackets are seen.

[1 mark]

c. 

(A1)(A1)(ft)***(A1)***(ft)***(A1)***(ft) ***(C4)***

Notes: Award ***(A1)*** for the empty set $A \cap B \cap C$.

Award ***(A1)***(ft) for the correct placement of 6, 5, 1 and 3.

Award ***(A1)***(ft) for the correct placement of 2, 4, 12, 7, 9, 11, 8.

Award ***(A1)***(ft) for the correct placement of 10.

Follow through from part (b).

[4 marks]

Examiners report

a. There was much confusion amongst candidates as to the understanding of the words *number of elements*. Many candidates simply wrote down 6 or $\{6\}$ and consequently lost the first mark.

b. There was much confusion amongst candidates as to the understanding of the words *number of elements*. Many candidates simply wrote down 6 or $\{6\}$ and consequently lost the first mark. Part (b) was done well and many successful attempts were made at completing the Venn diagram in part (c). The most common error in the last part of the question was the omission of the element 10.

c. Part (b) was done well and many successful attempts were made at completing the Venn diagram in part (c). The most common error in the last part of the question was the omission of the element 10.

The diagram below represents a rectangular flag with dimensions 150 cm by 92 cm. The flag is divided into three regions A, B and C.

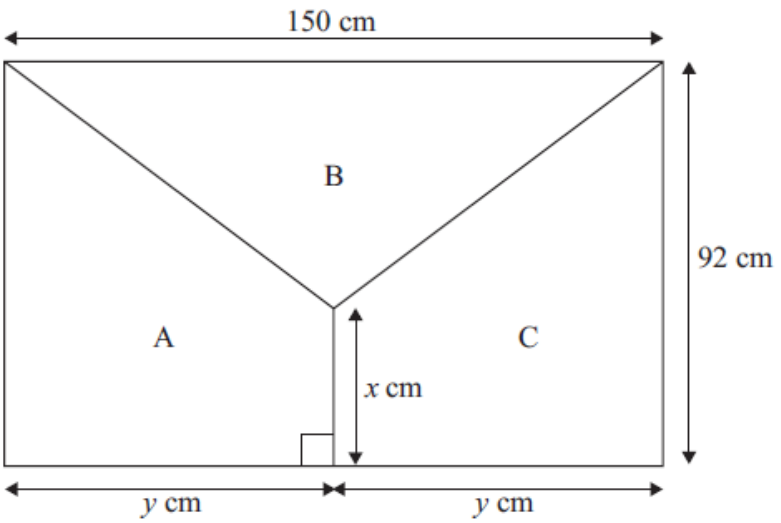


diagram not to scale

a. Write down the total area of the flag. [1]

b. Write down the value of y. [1]

c. The areas of regions A, B, and C are equal. [1]

Write down the area of region A.

d. Using your answers to **parts (b) and (c)**, find the value of x. [3]

Markscheme

a. ***Units are required in this question for full marks to be awarded.***

13800 cm^2 ***(A1)*** ***(C1)***

b. 75 ***(A1)*** ***(C1)***

c. ***Units are required in this question for full marks to be awarded.***

4600 cm^2 ***(A1)*(ft)** ***(C1)***

Notes: Units are required unless already penalized in part (a). Follow through from their part (a).

d. $0.5(x + 92) \times 75 = 4600$ ***(M1)(A1)*(ft)**

OR

$0.5 \times 150 \times (92 - x) = 4600$ ***(M1)(A1)*(ft)**

Note: Award ***(M1)*** for substitution into area formula, ***(A1)*(ft)** for their correct substitution.

(= 30.7 (cm)(30.6666...(cm)) ***(A1)*(ft)** ***(C3)***

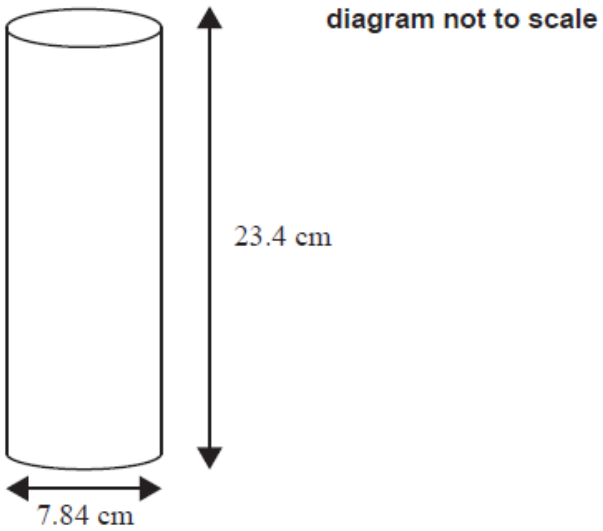
Note: Follow through from their parts (b) and (c).

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]
d. [N/A]

---

a. A snack container has a cylindrical shape. The diameter of the base is $7.84\,\text{cm}$. The height of the container is $23.4\,\text{cm}$. This is shown in the following diagram. [1]



Write down the radius, in cm, of the base of the container.

b. Calculate the area of the base of the container. [2]

c. Dan is going to paint the curved surface and the base of the snack container. [3]

Calculate the area to be painted.

Markscheme

a. $3.92\,(\text{cm})$ ***(A1)*** ***(C1)***

b. $\pi \times 3.92^2$ ***(M1)***

$= 48.3\,\text{cm}^2$ $(15.3664\,\pi\,\text{cm}^2,\ 48.2749...\,\text{cm}^2)$ ***(A1)*****(ft)** ***(C2)***

Note: Award ***(M1)*** for correct substitution in area of circle formula. Follow through from their part (a). The answer is $48.3\,\text{cm}^2$, units are required.

c. $2 \times \pi \times 3.92 \times 23.4 + 48.3$ ***(M1)(M1)***

$625\,\text{cm}^2$ $(624.618...\,\text{cm}^2)$ ***(A1)*****(ft)** ***(C3)***

Note: Award ***(M1)*** for correct substitution in curved surface area formula, ***(M1)*** for adding their answer to part (b). Follow through from their parts (a) and (b). The answer is $625\,\text{cm}^2$, units are required.

Examiners report

a. Question 11: Cylinder base area and curved surface area.

In responses to this question, units were sometimes missing or the wrong units were given. The question explicitly asked for the base and curved surface area but many gave both the top and bottom as well as the curved surface area, or omitted the ends.

b. Question 11: Cylinder base area and curved surface area.

In responses to this question, units were sometimes missing or the wrong units were given. The question explicitly asked for the base and curved surface area but many gave both the top and bottom as well as the curved surface area, or omitted the ends.

c. Question 11: Cylinder base area and curved surface area.

In responses to this question, units were sometimes missing or the wrong units were given. The question explicitly asked for the base and curved surface area but many gave both the top and bottom as well as the curved surface area, or omitted the ends.

The first term of an arithmetic sequence is 7 and the sixth term is 22.

a. Find the common difference. [2]

b. Find the twelfth term. [2]

c. Find the sum of the first 100 terms. [2]

Markscheme

a. $7 + 5d = 22$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in the AP formula. Accept list of numbers as solution.

$d = 3$ ***(A1)*** ***(C2)***

[2 marks]

b. $u_{12} = 7 + 11 \times 3$ ***(M1)***

$= 40$ ***(A1)*****(ft)** ***(C2)***

Note: Accept list of numbers.

[2 marks]

c. $S_{100} = \frac{100}{2}(2 \times 7 + 99 \times 3)$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in the AP formula.

= 15550 ***(A1)*****(ft)** ***(C2)***

Note: Accept 15600

[2 marks]

Examiners report

a. Most candidates recognized the arithmetic sequence and used the correct formula, although some used a list to find the answers. A significant number of candidates were unable to find the sum of the first 100 terms and attempted to find the 100^{th} term instead.

b. Most candidates recognized the arithmetic sequence and used the correct formula, although some used a list to find the answers. A significant number of candidates were unable to find the sum of the first 100 terms and attempted to find the 100^{th} term instead.

c. Most candidates recognized the arithmetic sequence and used the correct formula, although some used a list to find the answers. A significant number of candidates were unable to find the sum of the first 100 terms and attempted to find the 100^{th} term instead.

Consider the arithmetic sequence

$$326, 321, 316, 311, \ldots, 191.$$

a. Find the value of the common difference of this sequence. [2]

b. Calculate the sum of the first 10 terms of this sequence. [2]

c. Find the number of terms in this sequence. [2]

Markscheme

a. $d = 321 - 326$ (or equivalent)

$= -5$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for negative sign. ***(A1)*** for 5.

[2 marks]

b. $S_{10} = \frac{10}{2}(2(326) + 9(-5))$ ***(M1)***

Notes: Award ***(M1)*** for correctly substituted formula. Follow through from part (a).

OR

$u_{10} = 281$

$S_{10} = \frac{10}{2}(326 + 281)$ ***(M1)***

Note: Award ***(M1)*** for correctly substituted formula, not for finding 281.

OR

If a list is seen award ***(M1)*** for the correct list of 10 terms consistent with their d. ***(M1)***

$= 3035$ ***(A1)*****(ft)** ***(C2)***

Note: If $d = 5$ final answer is 3485. Follow through from part (a). No follow through if list used.

[2 marks]

c. $191 = 326 + (n-1)(-5)$ (or equivalent) ***(M1)***

Notes: Award (M1) for correctly substituted formula. Follow through from part (a).

OR

If a list is seen award ***(M1)*** for the complete and correct list of terms or complete list of terms consistent with their d. ***(M1)***

$n = 28$ ***(A1)*****(ft)** ***(C2)***

Note: n must be a positive integer. Follow through from part (a). No follow through if list used.

[2 marks]

Examiners report

a. At whatever ability, there were good attempts by all candidates on this question with an overwhelming majority scoring half marks or more. The most common error was in part (a) where 5, rather than -5 resulted in a lost mark. Recovery was, of course, possible in the remainder of the question. Further errors occurred where lists, rather than formulae, were used in parts (b) and (c). Using properly constructed and accurate lists were not in themselves penalized; arithmetical errors seen in a significant number of lists given by candidates, however, were penalized.

b. At whatever ability, there were good attempts by all candidates on this question with an overwhelming majority scoring half marks or more. The most common error was in part (a) where 5, rather than -5 resulted in a lost mark. Recovery was, of course, possible in the remainder of the question. Further errors occurred where lists, rather than formulae, were used in parts (b) and (c). Using properly constructed and accurate lists were not in themselves penalized; arithmetical errors seen in a significant number of lists given by candidates, however, were penalized.

c. At whatever ability, there were good attempts by all candidates on this question with an overwhelming majority scoring half marks or more. The most common error was in part (a) where 5, rather than -5 resulted in a lost mark. Recovery was, of course, possible in the remainder of the question. Further errors occurred where lists, rather than formulae, were used in parts (b) and (c). Using properly constructed and accurate lists were not in themselves penalized; arithmetical errors seen in a significant number of lists given by candidates, however, were penalized.

---

a. Factorise the expression $x^2 - 3x - 10$. [2]

b. A function is defined as $f(x) = 1 + x^3$ for $x \in \mathbb{Z}, -3 \leqslant x \leqslant 3$. [4]

(i) List the elements of the domain of $f(x)$.

(ii) Write down the range of $f(x)$.

Markscheme

a. $(x - 5)(x + 2)$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for $(x + 5)(x - 2)$, ***(A0)*** otherwise. If equation is equated to zero and solved by factorizing award ***(A1)*** for both correct factors, followed by ***(A0)***.

[2 marks]

b. (i) $-3, -2, -1, 0, 1, 2, 3$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A2)*** for all correct answers seen and no others. Award ***(A1)*** for 3 correct answers seen.

(ii) $-26, -7$, 0,1, 2, 9, 28 ***(A1)(A1)*** ***(C2)***

Note: Award ***(A2)*** for all correct answers seen and no others. Award ***(A1)*** for 3 correct answers seen. If domain and range are interchanged award ***(A0)*** for (b)(i) and ***(A1)*****(ft)*****(A1)*****(ft)** for (b)(ii).

[4 marks]

Examiners report

a. It was surprising how many candidates could not factorise this expression. Of those that could some went on to find the zeros of a quadratic equation which was not what the question was asking. Some confused domain and range and many did not write down all the values when they did know domain and range.

b. It was surprising how many candidates could not factorise this expression. Of those that could some went on to find the zeros of a quadratic equation which was not what the question was asking. Some confused domain and range and many did not write down all the values when they did know domain and range.

Daniela is going for a holiday to South America. She flies from the US to Argentina stopping in Peru on the way.

In Peru she exchanges 85 United States dollars (USD) for Peruvian nuevo sol (PEN). The exchange rate is 1 USD = 3.25 PEN and a flat fee of 5 USD commission is charged.

At the end of Daniela's holiday she has 370 Argentinean peso (ARS). She converts this back to USD at a bank that charges a 4% commission on the exchange. The exchange rate is 1 USD = 9.60 ARS.

a. Calculate the amount of PEN she receives. [3]

b. Calculate the amount of USD she receives. [3]

Markscheme

a. $(85-5)\times 3.25$ ***(M1)(M1)***

Note: Award ***(M1)*** for subtracting 5 from 85, ***(M1)*** for multiplying by 3.25.

Award ***(M1)*** for 85×3.25, ***(M1)*** for subtracting 5×3.25.

$=260\ (\text{PEN})$ ***(A1)*** ***(C3)***

[3 marks]

b. $\frac{(370\times 0.96)}{9.6}$ ***(M1)(M1)***

Note: Award ***(M1)*** for multiplying by 0.96 (or equivalent), ***(M1)*** for dividing by 9.6. If division by 3.25 seen in part (a), condone multiplication by 9.6 in part (b).

$=37\ (\text{USD})$ ***(A1)*** ***(C3)***

[3 marks]

Examiners report

a. [N/A]
b. [N/A]

Assume the Earth is a perfect sphere with radius 6371 km.

a. Calculate the volume of the Earth in km^3. Give your answer in the form $a\times 10^k$, where $1\leqslant a<10$ and $k\in\mathbb{Z}$. [3]

b. The volume of the Moon is $2.1958\times 10^{10}\ \text{km}^3$. [3]

Calculate how many times greater in volume the Earth is compared to the Moon.

Give your answer correct to the nearest **integer**.

Markscheme

a. $\frac{4}{3}\pi(6371)^3$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into volume formula.

$= 1.08 \times 10^{12}$ $(1.08320\ldots \times 10^{12})$ ***(A2)*** ***(C3)***

Notes: Award ***(A1)(A0)*** for correct mantissa between 1 and 10, with incorrect index.

Award ***(A1)(A0)*** for $1.08\text{E}12$

Award ***(A0)(A0)*** for answers of the type: 108×10^{10}.

b. $\frac{1.08320\ldots\times10^{12}}{2.1958\times10^{10}}$ ***(M1)***

Note: Award ***(M1)*** for dividing their answer to part (a) by 2.1958×10^{10}.

$= 49.3308\ldots$ ***(A1)*****(ft)**

Note: Accept $49.1848\ldots$ from use of 3 sf answer to part (a).

$= 49$ ***(A1)*** ***(C3)***

Notes: Follow through from part (a).

The final ***(A1)*** is awarded for their unrounded non-integer answer seen and given correct to the nearest integer.

Do not award the final ***(A1)*** for a rounded answer of 0 or if it is incorrect by a large order of magnitude.

Examiners report

a. In part (a) many candidates correctly substituted the volume formula and wrote correctly their answer using scientific notation. The calculator notation E12 was very rarely used. A minority converted to metres, resulting in an incorrect exponent. Some candidates used an incorrect equation or used their calculator incorrectly.

b. In part (b) many candidates subtracted the values, where they should be divided, resulting in an answer of an unrealistic magnitude. Some reversed the numerator and denominator, leading to an answer of 0.02, which would have rounded to the unrealistic answer of 0. When a reasonable answer was found, the final mark for rounding was lost by some candidates when there was no rounding or when rounding was incorrect. There seemed to be little understanding of whether or not an answer was reasonable.

In this question, give all answers to two decimal places.

Karl invests 1000 US dollars (USD) in an account that pays a nominal annual interest of 3.5%, **compounded quarterly**. He leaves the money in the account for 5 years.

a.i. Calculate the amount of money he has in the account after 5 years. [3]

a.ii. Write down the amount of **interest** he earned after 5 years. [1]

b. Karl decides to donate this **interest** to a charity in France. The charity receives 170 euros (EUR). The exchange rate is 1 USD = *t* EUR. [2]

Calculate the value of *t*.

Markscheme

a.i. $1000\left(1+\frac{3.5}{4\times100}\right)^{4\times5}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution in compound interest formula, ***(A1)*** for correct substitution.

OR

N = 5

I = 3.5

PV = 1000

P/Y = 1

C/Y = 4

Note: Award ***(A1)*** for *C/Y* = 4 seen, ***(M1)*** for other correct entries.

OR

N = 5 × 4

I = 3.5

PV = 1000

P/Y = 1

C/Y = 4

Note: Award ***(A1)*** for *C/Y* = 4 seen, ***(M1)*** for other correct entries.

= 1190.34 (USD) ***(A1)***

Note: Award ***(M1)*** for substitution in compound interest formula, ***(A1)*** for correct substitution.

[3 marks]

a.ii. 190.34 (USD) ***(A1)*****(ft)** ***(C4)***

Note: Award ***(A1)*****(ft)** for subtraction of 1000 from their part (a)(i). Follow through from (a)(i).

[1 mark]

b. $\frac{170}{190.34}$ ***(M1)***

Note: Award ***(M1)*** for division of 170 by their part (a)(ii).

= 0.89 ***(A1)*****(ft)** ***(C2)***

Note: Follow through from their part (a)(ii).

[2 marks]

Examiners report

a.i. [N/A]
a.ii. [N/A]
b. [N/A]

Consider the following four numbers.

$$p = 0.00314\ ;\ q = 0.00314 \times 10^2\ ;\ r = \tfrac{\pi}{1000}\ ;\ s = 3.14 \times 10^{-2}$$

a. One of these numbers is written in the form $a \times 10^k$ where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. Write down this number. [1]

b. Write down the smallest of these numbers. [2]

c. Write down the value of ***q + s***. [1]

d. Give your answer to part (c) in the form $a \times 10^k$ where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. [2]

Markscheme

a. 3.14×10^{-2} ***or*** s ***(A1)*** ***(C1)***

[1 mark]

b. 0.00314 ***or*** 3.14×10^{-3} ***or*** p ***(M1)(A1)*** ***(C2)***

Note: Award ***(M1)*** for indication of comparing numbers where at least one of them is converted. The converted number does not have to be correct. A single converted number is sufficient for ***(M1)*** to be awarded.

[2 marks]

c. 0.3454 (0.345) ***(A1)*** ***(C1)***

[1 mark]

d. 3.454×10^{-1} (3.45×10^{-1}) ***(A1)(A1)*****(ft)** ***(C2)***

Notes: Follow through from their (c).

Award ***(A1)*** for 3.454 (3.45) ***(A1)*** for 10^{-1}.

[2 marks]

Examiners report

a. In general this question was answered correctly by the majority of the candidates.

b. In general this question was answered correctly by the majority of the candidates. Part b presented difficulty for some students by asking them to compare the given numbers. A common error found in this part was that the value of π was given as 3.14. A method mark was awarded when a comparison was attempted.

c. In general this question was answered correctly by the majority of the candidates.

d. In general this question was answered correctly by the majority of the candidates.

Susi travels from Singapore to Thailand and changes 1500 Singapore dollars (SGD) to Thai baht (THB). The exchange rate is 1 SGD buys 21.03464 THB.

Susi leaves Thailand and travels to Indonesia. She has 20 000 THB and uses these to buy Indonesian rupiah (IDR). The exchange rate is 3.28352 THB buys 1000 IDR.

Susi wants to find the approximate exchange rate between Singapore dollars and Indonesian rupiah and uses the exchange rates for Thai baht to do this.

a. Calculate the number of Thai baht Susi buys. Give your answer **correct to the nearest baht**. [2]

b. Calculate the **total** number of Indonesian rupiah Susi receives, **correct to the nearest thousand rupiah**. [2]

c. Calculate Susi's exchange rate between Singapore dollars and Indonesian rupiah. Give your answer in the form 1 SGD buys *x* IDR, where *x* is given correct to the nearest rupiah. [2]

Markscheme

a. 1500×21.03464 ***(M1)***

$= 31\,552$ ***(A1)*** ***(C2)***

[2 marks]

b. $20\,000 \times \frac{1000}{3.28352}$ ***(M1)***

$= 6\,091\,000$ ***(A1)*** ***(C2)***

[2 marks]

c. $\frac{21.03464}{3.28352} \times 1000$ ***(M1)***

1 SGD = 6406 IDR ***(A1)*** ***(C2)***

Note: Accept 6406.

[2 marks]

Examiners report

a. The vast majority of candidates answered at least part of this question with a significant number achieving full marks. A number did have a financial penalty applied for not giving their answers according to the specified accuracy level for the question. The most difficult part turned out to be (c) and a number of students didn't attempt it at all. There were very few candidates who used the incorrect conversion.

b. The vast majority of candidates answered at least part of this question with a significant number achieving full marks. A number did have a financial penalty applied for not giving their answers according to the specified accuracy level for the question. The most difficult part turned out to be (c) and a number of students didn't attempt it at all. There were very few candidates who used the incorrect conversion.

c. The vast majority of candidates answered at least part of this question with a significant number achieving full marks. A number did have a financial penalty applied for not giving their answers according to the specified accuracy level for the question. The most difficult part turned out to be (c) and a number of students didn't attempt it at all. There were very few candidates who used the incorrect conversion.

$T = \frac{(\tan(2z)+1)(2\cos(z)-1)}{y^2-x^2}$, where $x = 9$, $y = 41$ and $z = 30^\circ$.

a. Calculate the **exact** value of T. [2]

b. Give your answer to T correct to [2]

(i) two significant figures;

(ii) three decimal places.

c. Pyotr estimates the value of T to be 0.002. [2]

Calculate the percentage error in Pyotr's estimate.

Markscheme

a. $\frac{(\tan(2\times30)+1)(2\cos(30)-1)}{41^2-9^2}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into formula.

$= 0.00125 \quad \left(\frac{1}{800}\right)$ ***(A1)*** ***(C2)***

Note: Using radians the answer is -0.000570502, award at most ***(M1)(A0)***.

b. (i) 0.0013 ***(A1)*(ft)**

Note: Follow through from part (a).

(ii) 0.001 ***(A1)*(ft)** ***(C2)***

Note: Follow through from part (a).

c. $\left|\frac{0.002-0.00125}{0.00125}\right| \times 100$ ***(M1)***

Notes: Award ***(M1)*** for their correct substitution into the percentage error formula. Absolute value signs are not required.

Their **unrounded** answer from part (a) must be used.

Do **not** accept use of answers from part (b).

$= 60\ (\%)$ ***(A1)*(ft)** ***(C2)***

Notes: The $\%$ sign is not required.

The answer from radians is 450.568%, award ***(M1)(A1)*****(ft)**.

Follow through from part (a).

Examiners report

a. Despite a significant number of candidates scoring well on this question, many candidates failed to use their calculator correctly. Common errors identified were: the use of radians; incorrect use of the double parentheses, calculating tan(61) instead of tan(60) + 1 ; or premature rounding. Such candidates earned, at most, method in part (a).

b. Despite errors in part (a), part (b)(i) tended to be often a correct follow through answer but some candidates struggled to give a 2 sf answer correctly, using truncation instead of rounding or dropping the leading zeros. Part (b)(ii) was more often answered correctly.

c. In part (c) many candidates used the percentage error formula incorrectly, reversing the estimated and the exact value, or using one of the rounded answers from part (b) as the exact value.

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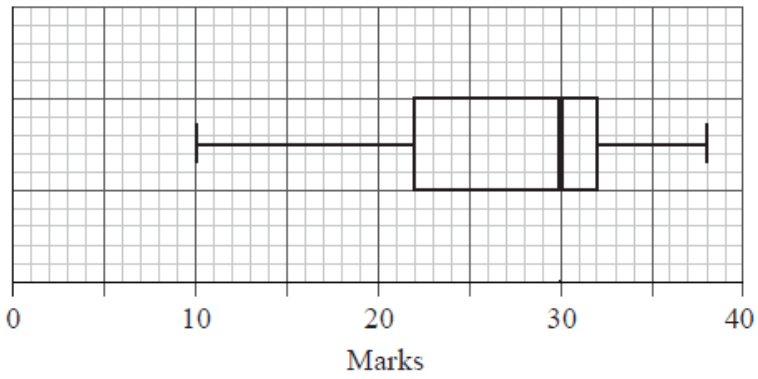
56 students were given a test out of 40 marks. The teacher used the following box and whisker plot to represent the marks of the students.



a.i. Write down the median mark. [1]

a.ii. Write down the 75th percentile mark. [1]

a.iii Write down the range of marks. [2]

b. Estimate the number of students who achieved a mark greater than 32. [2]

Markscheme

a.i. 30 ***(A1)*** ***(C1)***

[1 mark]

a.ii. 32 ***(A1)*** ***(C1)***

[1 mark]

a.iii. $38 - 10 = 28$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for 10 and 38 seen, ***(A1)*** for correct answer only.

[2 marks]

b. $0.25 \times 56 = 14$ ***(M1)(A1)*** ***(C2)***

Note: Award ***(M1)*** for multiplying 0.25 by 56.

[2 marks]

Examiners report

a.i. Many students had difficulty with reading the box and whisker plot and interpreting this question. Some candidates had difficulty with finding the range in part (a)(iii). Many wrote down the end points for the required range of data instead of writing the difference between the largest and smallest values. A number of candidates had problems estimating the number of students who achieved a mark greater than 32. Many students used the number 40 instead of the total number of student 56 for the estimation in part b).

a.ii. Many students had difficulty with reading the box and whisker plot and interpreting this question. Some candidates had difficulty with finding the range in part (a)(iii). Many wrote down the end points for the required range of data instead of writing the difference between the largest and smallest values. A number of candidates had problems estimating the number of students who achieved a mark greater than 32. Many students used the number 40 instead of the total number of student 56 for the estimation in part b).

a.iii. Many students had difficulty with reading the box and whisker plot and interpreting this question. Some candidates had difficulty with finding the range in part (a)(iii). Many wrote down the end points for the required range of data instead of writing the difference between the largest and smallest values. A number of candidates had problems estimating the number of students who achieved a mark greater than 32. Many students used the number 40 instead of the total number of student 56 for the estimation in part b).

b. Many students had difficulty with reading the box and whisker plot and interpreting this question. Some candidates had difficulty with finding the range in part (a)(iii). Many wrote down the end points for the required range of data instead of writing the difference between the largest and smallest values. A number of candidates had problems estimating the number of students who achieved a mark greater than 32. Many students used the number 40 instead of the total number of student 56 for the estimation in part b).

A comet orbits the Sun and is seen from Earth every 37 years. The comet was first seen from Earth in the year 1064.

a. Find the year in which the comet was seen from Earth for the fifth time. [3]

b. Determine how many times the comet has been seen from Earth up to the year 2014. [3]

Markscheme

a. $1064 + (5-1) \times 37$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted arithmetic sequence formula, ***(A1)*** for correct substitution.

$= 1212$ ***(A1)*** ***(C3)***

[3 marks]

b. $2014 > 1064 + (n-1) \times 37$ ***(M1)***

Note: Award ***(M1)*** for a correct substitution into arithmetic sequence formula.

Accept an equation.

$(n <) \ 26.6756\ldots$ ***(A1)***

26 (times) ***(A1)*** ***(C3)***

Note: Award the final ***(A1)*** for the correct rounding **down** of their unrounded answer.

OR

$2014 > 1064 + 37t$ ***(M1)***

Note: Award ***(M1)*** for a correct substitution into a linear model (where $t = n - 1$).

Accept an equation or weak inequality.

Accept $\frac{2014-1064}{37}$ for ***(M1)***.

$(t <) \ 25.6756\ldots$ ***(A1)***

26 (times) ***(A1)*** ***(C3)***

Note: Award the final ***(A1)*** for adding 1 to the correct rounding down of their unrounded answer.

[3 marks]

Examiners report

a. [N/A]
b. [N/A]

Kunal borrows 200 000 Indian rupees (INR) from a money lender for 18 months at a nominal annual interest rate of 15%, **compounded monthly**.

Calculate the **total amount** that Kunal must repay at the end of the 18 months. Give your answer to the nearest rupee.

Markscheme

$A = 200000\left(1 + \frac{15}{100\times 12}\right)^{1.5\times 12}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted compound interest formula, ***(A1)*** for correct substitutions.

$= 250115.4788$ INR ***(A1)***

$= 250115$ INR ***(A1)*** ***(C4)***

Note: Award final ***(A1)*** for their answer correct to the nearest rupee.

[4 marks]

Examiners report

In part (b), some candidates simply worked out the interest earned. If a correct substitution into the correct formula was seen leading to 50115 then only one mark was lost. Whilst many correctly quoted formula were seen in part (b), an incorrect substitution (particularly poor or missing use of the factor 12) lost the next two marks and, whilst the final mark could be earned irrespective of incorrect working, many candidates either ignored the final demand or did not know how to give their answer to the nearest rupee.

Sasha travelled from the USA to Mexico and converted 650 US dollars (USD) to Mexican pesos (MXN). Her bank offered an exchange rate of 1 USD = 12.50 MXN.

a. Find the number of MXN that Sasha received. [2]

b. Before her return to the USA, Sasha exchanged 2300 MXN back into USD. The bank charged a commission of 1 %. The exchange rate was still 1 USD = 12.50 MXN. [1]

   Write down the commission charged by the bank in MXN.

c. Before her return to the USA, Sasha exchanged 2300 MXN back into USD. The bank charged a commission of 1 %. The exchange rate was still 1 USD = 12.50 MXN. [3]

   Calculate the amount of USD that Sasha received after commission. Give your answer correct to the nearest USD.

Markscheme

a. 650×12.50 ***(M1)***

   8125 (MXN) ***(A1)*** ***(C2)***

   Note: Accept 8130.

[2 marks]

b. 23 (MXN) ***(A1)*** ***(C1)***

[1 mark]

c. $\frac{2300-their\ 23}{12.50}$ ***(M1)***

Note: Award ***(M1)*** for setting up the expression.

182.16 (USD) ***(A1)*****(ft)**

Note: Follow through from their answer to part (b).

182 (USD) ***(A1)*****(ft)** ***(C3)***

Notes: Award final ***(A1)*** for their answer correct to the nearest USD.

[3 marks]

Examiners report

a. A lot of good work was seen in this question with many completely correct solutions. The two marks which were seen to be lost more often than others were the answer to part (b) where $1.84 was seen rather than the required answer of 23 MXN, and the final mark in part (c) where, in many cases, the answer was left as $ 182.16.

b. A lot of good work was seen in this question with many completely correct solutions. The two marks which were seen to be lost more often than others were the answer to part (b) where $1.84 was seen rather than the required answer of 23 MXN, and the final mark in part (c) where, in many cases, the answer was left as $ 182.16.

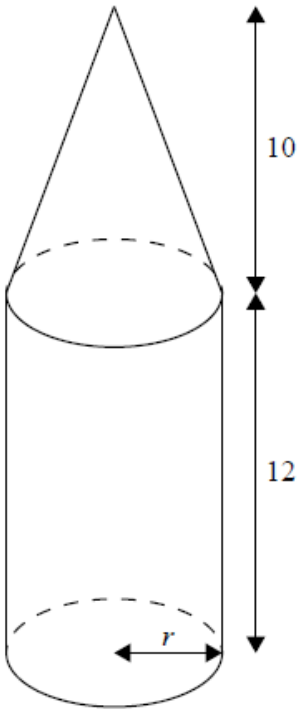
c. A lot of good work was seen in this question with many completely correct solutions. The two marks which were seen to be lost more often than others were the answer to part (b) where $1.84 was seen rather than the required answer of 23 MXN, and the final mark in part (c) where, in many cases, the answer was left as $ 182.16.

Julio is making a wooden pencil case in the shape of a large pencil. The pencil case consists of a cylinder attached to a cone, as shown.

The cylinder has a radius of r cm and a height of 12 cm.

The cone has a base radius of r cm and a height of 10 cm.

diagram not to scale



a. Find an expression for the slant height of the cone **in terms of *r***. [2]

b. The total external surface area of the pencil case rounded to 3 significant figures is 570 cm^2. [4]

Using your graphic display calculator, calculate the value of *r*.

Markscheme

a. (slant height^2 =) $10^2 + r^2$ ***(M1)***

Note: For correct substitution of 10 and *r* into Pythagoras' Theorem.

$\sqrt{10^2 + r^2}$ ***(A1) (C2)***

[2 marks]

b. $\pi r^2 + 2\pi r \times 12 + \pi r\sqrt{100 + r^2} = 570$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for correct substitution in curved surface area of cylinder and area of the base, ***(M1)*** for their correct substitution in curved surface area of cone, ***(M1)*** for adding their 3 surface areas and equating to 570. Follow through their part (a).

= 4.58 (4.58358...) ***(A1)*****(ft)** ***(C4)***

Note: Last line must be seen to award final ***(A1)***. Follow through from part (a).

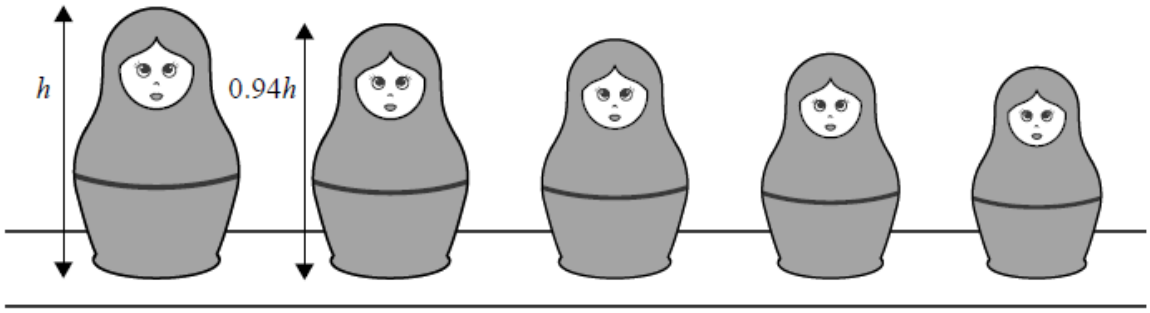
[4 marks]

Examiners report

a. [N/A]
b. [N/A]

Matryoshka dolls, or Russian dolls, are similarly designed dolls which open up and fit inside each other.

The largest set of these type of dolls is a 51 piece set which was completed in 2003. The height of the largest piece in this set is 54 cm. The heights of successive smaller dolls are 94 % of the preceding larger doll, as shown.



a. Find the height of the smallest doll in this set. [3]

b. Find the **total** height if all 51 dolls were placed one on top of another. [3]

Markscheme

a. $54 \times (0.94)^{50}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution into geometric sequence formula, ***(A1)*** for correct substitution.

2.45 (cm) (2.44785… cm) ***(A1) (C3)***

[3 marks]

b. $\frac{54\times\left(1-(0.94)^{51}\right)}{1-0.94}$ (or equivalent) ***(M1)(A1)*****(ft)**

Note: Award ***(M1)*** for substitution into geometric series formula, ***(A1)*****(ft)** for correct substitution using their common ratio from part (a).

= 862 (cm) (861.650…(cm)) ***(A1)*****(ft)** ***(C3)***

[3 marks]

Examiners report

a. [N/A]
b. [N/A]

---

a. Write down the following numbers in increasing order. [3]

$3.5,\ 1.6\times10^{-19},\ 60730,\ 6.073\times10^{5},\ 0.006073\times10^{6},\ \pi,\ 9.8\times10^{-18}$.

b. Write down the median of the numbers in part (a). [1]

c. State which of the numbers in part (a) is irrational. [1]

Markscheme

a. $1.6\times10^{-19},\ 9.8\times10^{-18},\ \pi,\ 3.5,\ 0.006073\times10^{6},\ 60730,\ 6.073\times10^{5}$ ***(A4)***

*Award **(A1)** for π before 3.5*

*Award **(A1)** for 1.6×10^{-19} before 9.8×10^{-18}*

*Award **(A1)** for the three numbers containing 6073 in the correct order.*

*Award **(A1)** for the pair with negative indices placed before 3.5 and π and the remaining three numbers placed after (independently of the other three marks).*

*Award **(A3)** for numbers given in correct decreasing order.*

*Award **(A2)** for decreasing order with at most 1 error **(C4)***

[3 marks]

b. The median is 3.5. ***(A1)*****(ft)**

Follow through from candidate's list. ***(C1)***

[1 mark]

c. π is irrational. ***(A1)*** ***(C1)***

[1 mark]

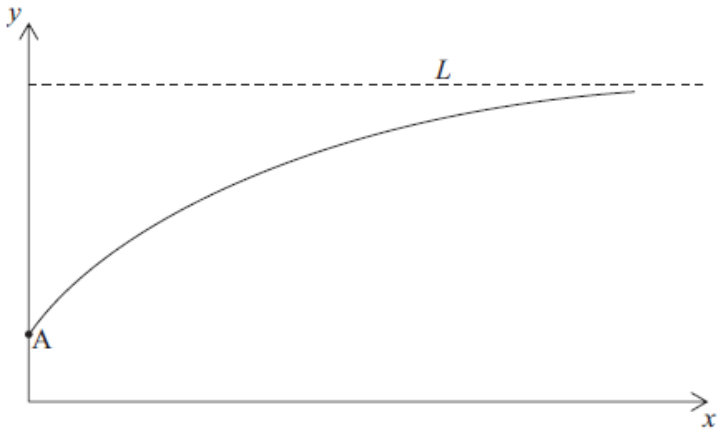
Examiners report

a. This was the best-answered question on the paper with most candidates achieving 5 or 6 marks. The main errors were finding the mean instead of the median in part (b) and giving numbers with negative indices as irrational numbers for part (c). Some candidates gave the list in reverse order (which lost them one mark).

b. This was the best-answered question on the paper with most candidates achieving 5 or 6 marks. The main errors were finding the mean instead of the median in part (b) and giving numbers with negative indices as irrational numbers for part (c). Some candidates gave the list in reverse order (which lost them one mark).

c. This was the best-answered question on the paper with most candidates achieving 5 or 6 marks. The main errors were finding the mean instead of the median in part (b) and giving numbers with negative indices as irrational numbers for part (c). Some candidates gave the list in reverse order (which lost them one mark).

Consider the function $f(x) = 1.25 - a^{-x}$, where a is a positive constant and $x \geqslant 0$. The diagram shows a sketch of the graph of f . The graph intersects the y-axis at point A and the line L is its horizontal asymptote.



a. Find the y-coordinate of A . [2]

b. The point $(2, 1)$ lies on the graph of $y = f(x)$. Calculate the value of a . [2]

c. The point $(2, 1)$ lies on the graph of $y = f(x)$. Write down the equation of L . [2]

Markscheme

a. $y = 1.25 - a^0 \quad 1.25 - 1$ ***(M1)***

$= 0.25$ ***(A1)*** ***(C2)***

Note: Award ***(M1)(A1)*** for $(0, 0.25)$.

[2 marks]

b. $1 = 1.25 - a^{-2}$ ***(M1)***

$a = 2$ ***(A1)*** ***(C2)***

[2 marks]

c. $y = 1.25$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for $y =$ "a constant", ***(A1)*** for 1.25.

[2 marks]

Examiners report

a. Very few candidates showed working and subsequently lost marks due to this. Many candidates seemed to forget that $a^0 = 1$ and not 0.

b. Very few candidates showed working and subsequently lost marks due to this. Many candidates seemed to forget that $a^0 = 1$ and not 0.

c. Very few candidates showed working and subsequently lost marks due to this. Many candidates seemed to forget that $a^0 = 1$ and not 0.

---

a. **In this question give all answers correct to the nearest whole number.** [2]

Loic travelled from China to Brazil. At the airport he exchanged 3100 Chinese Yuan, CNY, to Brazilian Real, BRL, at an exchange rate of $1\ \mathrm{CNY} = 0.3871\ \mathrm{BRL}$.

No commission was charged.

Calculate the amount of BRL he received.

b. When he returned to China, Loic changed his remaining BRL at a bank. The exchange rate at the bank was $1\ \mathrm{CNY} = 0.3756\ \mathrm{BRL}$ and a commission of 5% was charged. He received $285\ \mathrm{CNY}$. [4]

i) Calculate the amount of CNY Loic would have received if no commission was charged.

ii) Calculate the amount of BRL Loic exchanged when he returned to China.

Markscheme

a. 3100×0.3871 ***(M1)***

$= 1200$ ***(A1)*** ***(C2)***

Note: Award ***(M1)*** for multiplication by 0.3871. Answer must be an integer for the ***(A1)*** to be awarded.

b. i) $\frac{285}{0.95}$ ***(M1)***

$= 300$ ***(A1)***

Note: Award ***(M1)*** for division by 0.95. Answer must be an integer for the ***(A1)*** to be awarded.

ii) $\text{their } 300 \times 0.3756$ ***(M1)***

$= 113$ ***(A1)*(ft)** ***(C4)***

Note: Award ***(M1)*** for multiplying their answer to part (b)(i) by 0.3756. Follow through from part (b)(i). Answer must be an integer.

Examiners report

a. Question 9: Currency exchange

In this question, incorrect rounding was once again the cause of many lost marks. It was surprising how many candidates have little idea about currency exchange and even less about the notion of commission. This part of the course is tested every year.

b. In this question, incorrect rounding was once again the cause of many lost marks. It was surprising how many candidates have little idea about currency exchange and even less about the notion of commission. This part of the course is tested every year.

Consider the geometric sequence 16, 8, *a*, 2, *b*, …

a. Write down the common ratio. [1]

b.i. Write down the value of *a*. [1]

b.ii. Write down the value of *b*. [1]

c. The sum of the first *n* terms is 31.9375. Find the value of *n*. [3]

Markscheme

a. 0.5 $\left(\frac{1}{2}\right)$ ***(A1)*** ***(C1)***

[1 mark]

b.i. 4 ***(A1)***

[1 mark]

b.ii. 1 ***(A1)*** ***(C2)***

[1 mark]

c. $\frac{16(1-0.5^n)}{(1-0.5)} = 31.9375$ ***(M1)(M1)***

Note: Award ***(M1)*** for correct substitution in the GP formula, ***(M1)*** for equating their sum to 31.9375.

OR

sketch of the function $y = \frac{16(1-0.5^n)}{(1-0.5)}$ ***(M1)***

indication of point where *y* = 31.9375 ***(M1)***

OR

16 + 8 + 4 + 2 + 1 + 0.5 + 0.25 + 0.125 + 0.0625 = 31.9375 ***(M1)(M1)***

Note: Award ***(M1)*** for a list of at least 7 correct terms, ***(A1)*** for the sum of the terms equated to 31.9375.

n = 9 ***(A1)*****(ft)** ***(C3)***

Note: Follow through from their answer to part (a) but answer mark is lost if *n* is not a whole number.

[3 marks]

Examiners report

a. Parts a) and b) of this question were well answered by many of the candidates, although in some cases students wrote ½ instead of 2 for the common ratio in a).

b.i. Parts a) and b) of this question were well answered by many of the candidates, although in some cases students wrote ½ instead of 2 for the common ratio in a).

b.ii. Parts a) and b) of this question were well answered by many of the candidates, although insome cases students wrote ½ instead of 2 for the common ratio in a).

c. Many candidates were also able to set an equation in c) with a correct expression of the sum of the first n terms equated to 31.9375, for which they gained two more marks. The last mark in many cases was not awarded either because the candidates didn't know how to solve the equation or/and gave an incorrect answer.

Mr Tan invested 5000 Swiss Francs (CHF) in Bank A at an annual simple interest rate of *r* %, for four years. The total interest he received was 568 CHF.

Mr Black invested 5000 CHF in Bank B at a nominal annual interest rate of 3.6 %, **compounded quarterly** for four years.

Calculate the total interest he received at the end of the four years. Give your answer correct to **two decimal places**.

Markscheme

Financial penalty (FP) applies in part (b).

$I = 5000(1.009)^{16} - 5000$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution into the compound interest formula, ***(A1)*** for correct values.

(FP) *I* = 770.70 CHF ***(A1)*** ***(C3)***

[3 marks]

Examiners report

This question was answered well by many candidates, with a majority of them gaining maximum marks. Some candidates used the proper formula but had done incorrect substitution.

Each year the soccer team, Peterson United, plays 25 games at their home stadium. The owner of Peterson United claimed that last year the mean attendance per game at their home stadium was 24500.

The actual total attendance last year was 617700.

a. Based on the owner's claim, calculate the total attendance for the games at Peterson United's home stadium last year. [2]

b. Calculate the percentage error in the owner's claim. [2]

c. Write down your answer to **part (b)** in the form $a \times 10^k$ where $1 \leq a < 10$, $k \in \mathbb{Z}$. [2]

Markscheme

a. 24500 × 25 ***(M1)***

Note: Award ***(M1)*** for multiplying 24500 by 25.

= 613000 (612500) ***(A1) (C2)***

[2 marks]

b. $\left|\frac{612500-617700}{617700}\right| \times 100$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into the percentage error formula.

= 0.842 (0.841832) **(A1)*(ft)* (C2)**

Note: Follow through from part (a).

[2 marks]

c. 8.42×10^{-1} ***(A1)*(ft)*(A1)*(ft) *(C2)***

Note: Award ***(A0)(A0)*** for answers of the type 84.2×10^{-2}. Follow through from part (b). Ignore '%' sign.

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

The population of big cats in Africa is increasing at a rate of 5 % per year. At the beginning of 2004 the population was 10 000.

a. Write down the population of big cats at the beginning of 2005. [1]

b. Find the population of big cats at the beginning of 2010. [2]

c. Find the number of years, from the beginning of 2004, it will take the population of big cats to exceed $50\,000$. [3]

Markscheme

a. $10\,000 \times 1.05$

$= 10\,500$ ***(A1)*** ***(C1)***

[1 mark]

b. $10\,000 \times 1.05^6$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into correct formula.

$= 13\,400$ ***(A1)*** ***(C2)***

[2 marks]

c. $50\,000 = 10\,000 \times 1.05''$ ***(M1)(A1)***

Note: Award ***(M1)*** for $10\,000 \times 1.05''$ or equivalent, ***(A1)*** for $50\,000$

$n = 33.0$ (Accept 33) ***(A1)*** ***(C3)***

[3 marks]

Examiners report

a. This question was well answered by many candidates, particularly part (a).

b. This question was well answered by many candidates, particularly part (a). However, a significant number of students lost a mark for rounding up rather than down in part (b).

c. This question was well answered by many candidates, particularly part (a). However, a significant number of students lost a mark for rounding up rather than down in part (b). Part (c) proved to be the most difficult both for generating the equation and for solving it.

Consider the numbers $p = 2.78 \times 10^{11}$ and $q = 3.12 \times 10^{-3}$.

a. Calculate $\sqrt[3]{\frac{p}{q}}$. Give your full calculator display. [2]

b.i. Write down your answer to part (a) correct to two decimal places; [1]

b.ii. Write down your answer to part (a) correct to three significant figures. [1]

c. Write your answer to **part (b)(ii)** in the form $a \times 10^k$, where $1 \leqslant a < 10,\ k \in \mathbb{Z}$. [2]

Markscheme

a. $\sqrt[3]{\frac{2.78\times10^{11}}{3.12\times10^{-3}}}$ **OR** $\sqrt[3]{8.91025\ldots\times10^{13}}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into given expression.

44664.59503 ***(A1)*** ***(C2)***

Note: Award ***(A1)*** for a correct answer with at least 8 digits.

Accept 44664.5950301.

[2 marks]

b.i. 44664.60 ***(A1)*(ft)** ***(C1)***

Note: For a follow through mark, the answer to part (a) must be to at least 3 decimal places.

[1 mark]

b.ii. 44700 ***(A1)*(ft)** ***(C1)***

Notes: Answer to part (a) must be to at least 4 significant figures.

Accept any equivalent notation which is correct to 3 significant figures.

For example 447×10^2 or 44.7×10^3.

Follow through from part (a).

[1 mark]

c. 4.47×10^4 ***(A1)*(ft)*(A1)*(ft)** ***(C2)***

Notes: Award ***(A1)*(ft)*** for 4.47 and ***(A1)*(ft)*** for 10^4.

Award ***(A0)(A0)*** for answers such as 44.7×10^3.

Follow through from part (b)(ii) **only**.

[2 marks]

Examiners report

a. [N/A]
b.i. [N/A]
b.ii. [N/A]
c. [N/A]

Veronica wants to make an investment and accumulate 25 000 EUR over a period of 18 years. She finds two investment options.

Option 2 offers a nominal annual interest rate of 4 %, **compounded monthly**.

Find the amount that Veronica has to invest with option 2 to have 25 000 EUR in her account after 18 years. Give your answer correct to **two decimal places**.

Markscheme

$\mathrm{C} = \left(1 + \frac{0.04}{12}\right)^{12 \times 18} = 25000$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution into a compound interest formula. Award ***(A1)*** for correct substitution and equation.

C =12183.39 (EUR) ***(A1)*** ***(C3)***

Note: The final ***(A1)*** can only be given for seeing the correct figures.

[3 marks]

Examiners report

In part (b) a mark was awarded for substitution of **any** values into a compound interest formula. This seemed to be as far as the majority of candidates were able to go and few scripts gave the required answer of 12183.39 EUR.

Consider the geometric sequence $u_1 = 18,\ u_2 = 9,\ u_3 = 4.5,\ \ldots$.

a. Write down the common ratio of the sequence. [1]

b. Find the value of u_5. [2]

c. Find the smallest value of n for which u_n is less than 10^{-3}. [3]

Markscheme

a. $\frac{1}{2}\ (0.5)$ ***(A1)*** ***(C1)***

[1 mark]

b. $18 \times \left(\frac{1}{2}\right)^4$ ***(M1)***

Note: Award ***(M1)*** for their correct substitution into the geometric sequence formula. Accept a list of their five correct terms.

$1.125\ \left(1.13,\ \frac{9}{8}\right)$ ***(A1)*(ft)** ***(C2)***

Note: Follow through from their common ratio from part (a).

[2 marks]

c. $18 \times \left(\frac{1}{2}\right)^{n-1} < 10^{-3}$ ***(M1)(M1)***

Notes: Award ***(M1)*** for their correct substitution into the geometric sequence formula with a variable in the exponent, ***(M1)*** for comparing their expression with $10^{-3}\ \left(\frac{1}{1000}\right)$.

Accept an equation.

$n = 16$ ***(A1)*(ft)** ***(C3)***

Note: Follow through from their common ratio from part (a). "n" must be a positive integer for the ***(A1)*** to be awarded.

[3 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

Let $p = \frac{\cos x + \sin y}{\sqrt{w^2 - z}}$,

where $x = 36^\circ,\ y = 18^\circ,\ w = 29$ and $z = 21.8$.

a. Calculate the value of p. Write down your full calculator display. [2]

b. Write your answer to part (a) [2]

(i) correct to two decimal places;

(ii) correct to three significant figures.

c. Write your answer to **part (b)(ii)** in the form $a \times 10^k$, where $1 \leqslant a < 10,\ k \in \mathbb{Z}$. [2]

Markscheme

a. $\frac{\cos 36^\circ + \sin 18^\circ}{\sqrt{29^2 - 21.8}}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into formula.

$= 0.0390625$ ***(A1)*** ***(C2)***

Note: Accept $\frac{5}{128}$.

[2 marks]

b. (i) 0.04 ***(A1)*****(ft)**

(ii) 0.0391 ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (a).

[2 marks]

c. 3.91×10^{-2} ***(A1)*****(ft)*****(A1)*****(ft)** ***(C2)***

Note: Answer should be consistent with their answer to part (b)(ii). Award ***(A1)*****(ft)** for 3.91, and ***(A1)*****(ft)** for 10^{-2}. Follow through from part (b)(ii).

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

The first term of an arithmetic sequence is 3 and the seventh term is 33.

a. Calculate the common difference; [2]

b. Calculate the 95th term of the sequence; [2]

c. Calculate the sum of the first 250 terms. [2]

Markscheme

a. $33 = 3 + d(6)$ ***(M1)***

Note: Award ***(M1)*** for correctly substituted formula or a correct numerical expression to find the common difference.

$(d =)5$ ***(A1)*** ***(C2)***

[2 marks]

b. $u_{95} = 3 + 94(5)$ ***(M1)***

Note: Award ***(M1)*** for their correctly substituted formula.

$= 473$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from their part (a).

[2 marks]

c. $S_{250} = 125[2(3) + 249(5)]$ ***(M1)***

Note: Award ***(M1)*** for correctly substituted formula.

$S_{250} = 156375$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from their part (a).

[2 marks]

Examiners report

a. Much good work was seen in parts (a) and (b) showing that many centres had well prepared their students for questions on arithmetic sequences. In part (c) however there was poor use of $S_n = \frac{n}{2}\{\text{first term } + \text{last term}\}$ with the incorrect calculation $\frac{250}{2}\{3 + 250\}$ seen on a significant number of scripts.

b. Much good work was seen in parts (a) and (b) showing that many centres had well prepared their students for questions on arithmetic sequences. In part (c) however there was poor use of $S_n = \frac{n}{2}\{\text{first term} + \text{last term}\}$ with the incorrect calculation $\frac{250}{2}\{3 + 250\}$ seen on a significant number of scripts.

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Yun Bin invests 5000 euros in an account which pays a nominal annual interest rate of 6.25% , **compounded monthly**.

Give all answers correct to two decimal places.

a. Find the value of the investment after 3 years. [3]

b. Find the difference in the final value of the investment if the interest was compounded quarterly at the same nominal rate. [3]

Markscheme

a. $FV = 5000\left(1 + \frac{6.25}{1200}\right)^{3\times 12}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted compound interest formula, ***(A1)*** for correct substitutions.

OR

$N = 3$
$I\% = 6.25$
$PV = -5000$
$P/Y = 1$
$C/Y = 12$ ***(M1)(A1)***

Note: Award ***(A1)*** for $C/Y = 12$ seen, ***(M1)*** for other correct entries.

OR

$N = 36$
$I\% = 6.25$
$PV = -5000$

$P/Y = 12$
$C/Y = 12$ ***(M1)(A1)***

Note: Award ***(A1)*** for $C/Y = 12$ seen, ***(M1)*** for other correct entries.

$= 6028.22$ ***(A1)*** ***(C3)***

Note: The answer should be given correct to two decimal places or the final ***(A1)*** is not awarded.

b. $FV = 5000\left(1 + \frac{6.25}{400}\right)^{3\times 4}$ ***(M1)***

Note: Award ***(M1)*** for correctly substituted compound interest formula.

OR

$N = 3$
$I\% = 6.25$
$PV = -5000$
$P/Y = 1$
$C/Y = 4$ ***(M1)***

Note: Award ***(M1)*** for all correct entries seen.

OR

$N = 12$
$I\% = 6.25$
$PV = -5000$
$P/Y = 4$
$C/Y = 4$ ***(M1)***

Note: Award ***(M1)*** for all correct entries seen.

$FV = 6022.41$ ***(A1)***
$\text{Difference} = 5.80$ ***(A1)*****(ft)** ***(C3)***

Notes: Accept 5.81. This answer should be given correct to two decimal places or the final ***(A1)*** is not awarded unless this has already been penalized in part (a). Follow through from part (a).
Notes: Illustrating use of GDC notation acceptable in this case only. However on P2 an answer given with no working would receive G2.

Examiners report

a. [N/A]
b. [N/A]

In the diagram, triangle ABC is isosceles. AB = AC and angle ACB is 32° . The length of side AC is x cm.

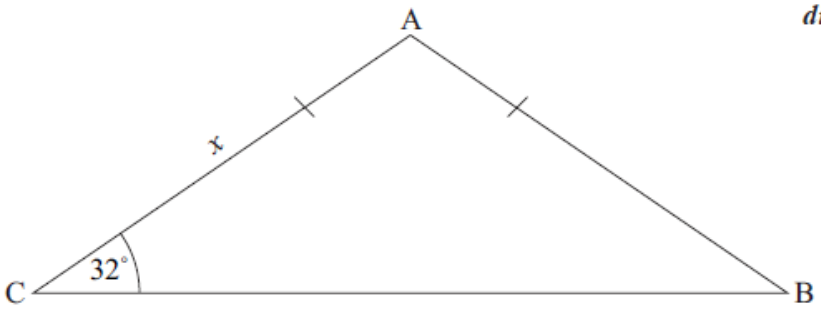

diagram not to scale

a. Write down the size of angle CBA. [1]

b. Write down the size of angle CAB. [1]

c. The area of triangle ABC is 360 cm^2. Calculate the length of side AC. Express your answer in **millimetres**. [4]

Markscheme

a. 32° ***(A1)*** ***(C1)***

[1 mark]

b. 116° ***(A1)*** ***(C1)***

[1 mark]

c. $360 = \frac{1}{2} \times x^2 \times \sin 116^\circ$ ***(M1)(A1)*****(ft)**

Notes: Award ***(M1)*** for substitution into correct formula with 360 seen, ***(A1)*****(ft)** for correct substitution, follow through from their answer to part (b).

x = 28.3 (cm) ***(A1)*****(ft)**

x = 283 (mm) ***(A1)*****(ft)** ***(C4)***

Notes: The final ***(A1)*****(ft)** is for their cm answer converted to mm. If their incorrect cm answer is seen the final ***(A1)*****(ft)** can be awarded for correct conversion to mm.

[4 marks]

Examiners report

a. Candidates had difficulties finding the length of the side of the isosceles triangle and chose an incorrect angle in their substitution into the area formula. Many candidates thought this question related to right angle triangle trigonometry.

b. Candidates had difficulties finding the length of the side of the isosceles triangle and chose an incorrect angle in their substitution into the area formula. Many candidates thought this question related to right angle triangle trigonometry.

c. Candidates had difficulties finding the length of the side of the isosceles triangle and chose an incorrect angle in their substitution into the area formula. Many candidates thought this question related to right angle triangle trigonometry.

The first term, u_1, of an arithmetic sequence is 145. The fifth term, u_5, of the sequence is 113.

a. Find the common difference of the sequence. [2]

b. The n^{th} term, u_n, of the sequence is -7. [2]

Find the value of n.

c. The n^{th} term, u_n, of the sequence is -7. [2]

Find S_{20}, the sum of the first twenty terms of the sequence.

Markscheme

a. $145 + (5-1)d = 113$ ***(M1)***

Note: Award ***(M1)*** for correctly substituted AP formula.

OR

$\frac{113-145}{4}$ ***(M1)***

$= -8$ ***(A1)*** ***(C2)***

[2 marks]

b. $145 + (n-1) \times -8 = -7$ ***(M1)***

Note: Award ***(M1)*** for their correctly substituted AP formula.

If a list is used award ***(M1)*** for their correct values down to -7.

$n = 20$ ***(A1)*(ft)** ***(C2)***

Note: Follow through from their part (a).

[2 marks]

c. $S_{20} = \frac{20}{2}(2 \times 145 + (20-1) \times -8)$ ***(M1)***

Note: Award ***(M1)*** for their correctly substituted sum of an AP formula.

If a list is used award ***(M1)*** for their correct terms up to 1380

$= 1380$ ***(A1)*(ft)**

Note: Follow through from their part (a).

OR

$S_{20} = \frac{20}{2}(145 + (-7))$ ***(M1)***

Note: Award ***(M1)*** for correctly substituted sum of an AP formula.

$= 1380$ ***(A1)*** ***(C2)***

Note: If candidates have listed the terms correctly and given the common difference as 8, award ***(M1)(A0)*** for part (a), ***(M1)(A0)*** for an answer of -18 or 18 for part (b) and ***(M1)(A1)*(ft)** for an answer of 4420 in part (c) with working seen.

[2 marks]

Examiners report

a. Many candidates gave an answer of 8 rather than –8 but were awarded follow through marks in parts (b) and (c) where working was shown. Some candidates appeared unaware that the common difference in both the AP formula for a term and for a sum is multiplied rather than added or subtracted. Candidates who used a list to answer this question were able to gain full marks.

b. Many candidates gave an answer of 8 rather than –8 but were awarded follow through marks in parts (b) and (c) where working was shown. Some candidates appeared unaware that the common difference in both the AP formula for a term and for a sum is multiplied rather than added or subtracted. Candidates who used a list to answer this question were able to gain full marks.

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A rumour spreads through a group of teenagers according to the exponential model

$$N = 2 \times (1.81)^{0.7t}$$

where N is the number of teenagers who have heard the rumour t hours after it is first started.

a. Find the number of teenagers who started the rumour. [2]

b. Write down the number of teenagers who have heard the rumour five hours after it is first started. [1]

c. Determine the length of time it would take for 150 teenagers to have heard the rumour. **Give your answer correct to the nearest minute.** [3]

Markscheme

a. $N = 2 \times (1.81)^{0.7\times0}$ ***(M1)***

$N = 2$ ***(A1)*** ***(C2)***

Notes: Award ***(M1)*** for correct substitution of $t = 0$.
Award ***(A1)*** for correct answer.

[2 marks]

b. 16.0 (3 s.f) ***(A1)*** ***(C1)***

Note: Accept 16 and 15.

[1 mark]

c. $150 = 2 \times (1.81)^{0.7t}$ ***(M1)***

$t = 10.39...$ h ***(A1)***

$t = 624$ minutes ***(A1)*****(ft)** ***(C3)***

Notes: Accept 10 hours 24 minutes. Accept alternative methods.

Award last ***(A1)*****(ft)** for correct rounding to the nearest minute of their answer.

Unrounded answer must be seen so that the follow through can be awarded.

[3 marks]

Examiners report

a. Parts (a) and (b) were confidently answered with many candidates correctly finding the number who started the rumour and also the number involved after 5 hours. A common mistake was to let $t = 0$ but not evaluate the expression correctly.

b. Parts (a) and (b) were confidently answered with many candidates correctly finding the number who started the rumour and also the number involved after 5 hours. A common mistake was to let $t = 0$ but not evaluate the expression correctly.

c. Very few candidates could answer part (c). With the working shown, it was obvious candidates could correctly state the equation, but could not use their calculators to find the value of t.

---

a. The golden ratio, r , was considered by the Ancient Greeks to be the perfect ratio between the lengths of two adjacent sides of a rectangle. The exact value of r is $\frac{1+\sqrt{5}}{2}$. [2]

Write down the value of r

i) correct to 5 significant figures;

ii) correct to 2 decimal places.

b. Phidias is designing rectangular windows with adjacent sides of length x metres and y metres. The area of each window is $1\ \mathrm{m}^2$. [1]

Write down an equation to describe this information.

c. Phidias designs the windows so that the ratio between the longer side, y , and the shorter side, x , is the golden ratio, r. [1]

Write down an equation in y , x and r to describe this information.

d. Find the value of x . [2]

Markscheme

a. i) 1.6180 ***(A1)***

ii) 1.62 ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (a)(i).

b. $xy = 1$ ***(A1)*** ***(C1)***

c. $\frac{y}{x} = r$ **OR** $\frac{y}{x} = \frac{1+\sqrt{5}}{2}$ **OR** equivalent ***(A1)*** ***(C1)***

Note: Accept $\frac{y}{x} =$ their part (a)(i) or (a)(ii).

d. $x^2 r = 1$ or eqivalent ***(M1)***

$x = 0.786 \ (0.78615...)$ ***(A1)*****(ft)** ***(C2)***

Note: Award ***(M1)*** for substituting their part (c) into their equation from part (b). Follow through from parts (a), (b) and (c). Use of $r = 1.62$ gives $0.785674...$

Examiners report

a. Question 13: Golden ratio

This question was partially answered by all but the best candidates. Parts (a) and (b) yielded the most success. Only the best candidates were successful in part (d).

b. Question 13: Golden ratio

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c. Question 13: Golden ratio

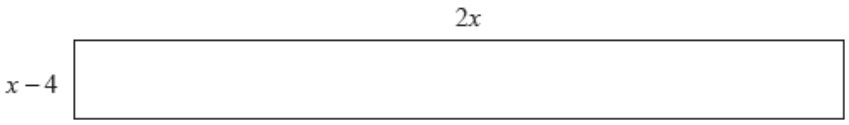
This question was partially answered by all but the best candidates. Parts (a) and (b) yielded the most success. Only the best candidates were successful in part (d).

d. Question 13: Golden ratio

This question was partially answered by all but the best candidates. Parts (a) and (b) yielded the most success. Only the best candidates were successful in part (d).

The surface of a red carpet is shown below. The dimensions of the carpet are in metres.

diagram not to scale



a. Write down an expression for the area, A, in m^2, of the carpet. [1]

b. The area of the carpet is $10\ \mathrm{m}^2$. [3]

Calculate the value of x.

c. The area of the carpet is $10\ \mathrm{m}^2$. [2]

Hence, write down the value of the length and of the width of the carpet, in metres.

Markscheme

a. $2x(x-4)$ **or** $2x^2-8x$ ***(A1)*** ***(C1)***

Note: Award ***(A0)*** for $x-4\times 2x$.

[1 mark]

b. $2x(x-4)=10$ ***(M1)***

Note: Award ***(M1)*** for equating their answer in part (a) to 10.

$x^2-4x-5=0$ ***(M1)***

OR

Sketch of $y=2x^2-8x$ and $y=10$ ***(M1)***

OR

Using GDC solver $x=5$ and $x=-1$ ***(M1)***

OR

$2(x+1)(x-5)$ ***(M1)***

$x=5\ (\mathrm{m})$ ***(A1)*****(ft)** ***(C3)***

Notes: Follow through from their answer to part (a).

Award at most ***(M1)(M1)(A0)*** if both 5 and -1 are given as final answer.

Final ***(A1)*****(ft)** is awarded for choosing only the positive solution(s).

[3 marks]

c. $2\times 5=10\ (\mathrm{m})$ ***(A1)*****(ft)**

$5-4=1\ (\mathrm{m})$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from their answer to part (b).

Do not accept negative answers.

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

---

a. Solve the following equation for *x* [2]

$3(2x+1)-2(3-x)=13.$

b. Factorize the expression x^2+2x-3. [2]

c. Find the **positive** solution of the equation [2]

$x^2+2x-6=0.$

Markscheme

a. $6x+3-6+2x=13$ ***(M1)***

$8x=16$

$x=2$ ***(A1)*** ***(C2)***

[2 marks]

b. $(x+3)(x-1)$ ***(A1)(A1)*** ***(C2)***

[2 marks]

c. $x=1.64575...$

$x=1.65$ ***(A2)***

If formula is used award ***(M1)(A1)*** *for correct solution. If graph is sketched award* ***(M1)(A1)*** *for correct solution.* ***(C2)***

[2 marks]

Examiners report

a. (a) Many candidates forgot that a minus times a minus gives a plus and so did not solve the equation correctly.

b. (b) A good attempt was made at factorising the function although $x(x+2)-3$ was seen frequently too.

c. (a) Many candidates forgot that a minus times a minus gives a plus and so did not solve the equation correctly.

(b) A good attempt was made at factorising the function although $x(x+2)-3$ was seen frequently too.

(c) Few candidates realised that they had to use their GDC to find this answer and hence there were few correct answers. Some did not read the question correctly and solved part (b) to find the positive solution of the expression they had factorised.

Yoshi is spending a year travelling from Japan to Italy and then to the United States of America.

Before Yoshi leaves Japan he changes 100 000 Japanese Yen (JPY) into euro (EUR). The exchange rate is 1 JPY = 0.006 EUR.

a. Calculate the amount Yoshi receives, in EUR. [2]

b. Yoshi spends 426.70 EUR in Italy. In an American bank he changes the remaining amount, into US dollars (USD), at an exchange rate of 1 USD = 0.673 EUR. [4]

The bank charges 1.5 % commission.

Calculate the amount, in USD, Yoshi receives after commission. **Give your answer correct to the nearest USD.**

Markscheme

a. 0.006×100000 ***(M1)***

Note: Award ***(M1)*** for multiplication by 0.006.

$= 600$ ***(A1)*** ***(C2)***

b. $\frac{(600-426.70)}{0.673} \times 0.985$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for subtracting 426.70 from their answer to part (a), ***(M1)*** for division by 0.673, ***(M1)*** for multiplication by 0.985 (or equivalent).

OR

$\frac{173.30-(600-426.70)\times 0.015}{0.673}$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for subtracting 426.70 from their answer to part (a), ***(M1)*** for division by 0.673, ***(M1)*** for multiplication by 0.015 (or equivalent) and subtraction from their 173.30.

254 ***(A1)*****(ft)** ***(C4)***

Notes: Follow through from their part (a). In order to award the final ***(A1)*****(ft)** the answer must be given correct to the nearest dollar. If division used in part (a) and multiplication in part (b) award at most ***(M1)(M1)(M1)(A0)***.

Examiners report

a. [N/A]
b. [N/A]

---

a. Consider the following statements [2]

z : x is an integer
q : x is a rational number
r : x is a real number.

i) Write down, in words, $\neg q$.

ii) Write down a value for x such that the statement $\neg q$ is true.

b. Write the following argument in symbolic form: [3]

"If x is a real number and x is not a rational number, then x is not an integer".

c. Phoebe states that the argument in part (b) can be shown to be valid, without the need of a truth table. [1]

Justify Phoebe's statement.

Markscheme

a. i) x is not a rational number ***(A1)***

Note: Accept "x is an irrational number".

ii) any non-rational number (for example: π, $\sqrt{2}$, ...) ***(A1) (C2)***

b. $(r \wedge \neg q) \Rightarrow \neg z$ ***(A1)(A1)(A1) (C3)***

Note: Award ***(A1)*** for "$\Rightarrow$" seen, ***(A1)*** for "$\neg z$" as the consequent and ***(A1)*** for "$(r \wedge \neg q)$" or "$(\neg q \wedge r)$" as the antecedent (the parentheses are required).

c. all integers are rational numbers (and therefore x cannot be an integer if it is not a rational number) ***(R1)***

Note: Accept equivalent expressions.

OR

if x is an integer, then x is a rational number, therefore if x is not a rational number, then x is not an integer (contrapositive) ***(R1) (C1)***

Note: Accept "If x is not in $\mathbb{Q}$, then x is not in $\mathbb{Z}$" with a Venn diagram showing $\mathbb{R}$, $\mathbb{Q}$ and $\mathbb{Z}$ correctly.

Examiners report

a. Question 5 Logic

In part (a), the majority of candidates were able to state the negation, but surprisingly many were unable to give an example of a non-rational number.

b. In part (b), a common error was the lack of parentheses in the antecedent. A further error was the use of the "intersection" symbol rather than that for conjunction; care must be taken in this regard.

c. Part (c) proved problematic for all but the best candidates.

The volume of a sphere is $V = \sqrt{\frac{S^3}{36\pi}}$, where S is its surface area.

The surface area of a sphere is 500 cm^2 .

a. Calculate the volume of the sphere. Give your answer correct to **two decimal places**. [3]

b. Write down your answer to (a) correct to the nearest integer. [1]

c. Write down your answer to (b) in the form $a \times 10^n$, where $1 \leqslant a < 10$ and $n \in \mathbb{Z}$. [2]

Markscheme

a. $V = \sqrt{\frac{500^3}{36\pi}}$ ***(M1)***

Note: Award ***(M1)*** correct substitution into formula.

V = 1051.305 … ***(A1)***
V = 1051.31 cm^3 ***(A1)*****(ft)** ***(C3)***

Note: Award last ***(A1)*****(ft)** for correct rounding to 2 decimal places of their answer. Unrounded answer must be seen so that the follow through can be awarded.

[3 marks]

b. 1051 ***(A1)*****(ft)**

[1 mark]

c. 1.051×10^3 ***(A1)*****(ft)*****(A1)*****(ft)** ***(C2)***

Note: Award ***(A1)*** for 1.051 (accept 1.05) ***(A1)*** for $\times 10^3$.

[2 marks]

Examiners report

a. This question was well answered by many of the candidates. A significant number of candidates lost two marks in part (a) for not using the calculator correctly and omitting brackets in the denominator when entering the volume expression in their GDC. Also, those students who did not show the unrounded answer in the working box could not be awarded the last mark in part a). Follow through marks were awarded for parts (b) and (c) which most candidates gained.

b. This question was well answered by many of the candidates. A significant number of candidates lost two marks in part (a) for not using the calculator correctly and omitting brackets in the denominator when entering the volume expression in their GDC. Also, those students who did not show the unrounded answer in the working box could not be awarded the last mark in part (a). Follow through marks were awarded for parts (b) and (c) which most candidates gained.

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Five pipes labelled, “6 metres in length”, were delivered to a building site. The contractor measured each pipe to check its length (in metres) and recorded the following;

5.96, 5.95, 6.02, 5.95, 5.99.

a. (i) Find the mean of the contractor’s measurements. [3]

(ii) Calculate the percentage error between the mean and the stated, **approximate** length of 6 metres.

b. Calculate $\sqrt{3.87^5 - 8.73^{-0.5}}$, giving your answer [3]

(i) correct to the nearest integer,

(ii) in the form $a \times 10^k$, where $1 \leq a < 10$, $k \in \mathbb{Z}$.

Markscheme

a. (i) Mean = (5.96 + 5.95 + 6.02 + 5.95 + 5.99) / 5 = 5.974 (5.97) ***(A1)***

(ii) $\%\ \text{error} = \frac{error}{actualvalue} \times 100\%$

$= \frac{6-5.974}{5.974} \times 100\% = 0.435\%$ ***(M1)(A1)*****(ft)**

(M1) *for correctly substituted formula.*

Allow 0.503% as follow through from 5.97

Note: An answer of 0.433% is incorrect. ***(C3)***

[3 marks]

b. number is 29.45728613

(i) Nearest integer = 29 ***(A1)***

(ii) Standard form = 2.95×10^1 (*accept* 2.9×10^1) ***(A1)*****(ft)*****(A1)***

Award ***(A1)*** *for each correct term*

Award ***(A1)(A0)*** *for* 2.95×10 ***(C3)***

[3 marks]

Examiners report

a. a) Almost all candidates calculated the mean correctly but less than half were able to find the % error, many dividing by 6. This was despite the boldening of 'approximate' in the question.

b. b) Main errors were giving the answer correct to 1 significant figure (30) or 1 decimal place. Some candidates just counted the number of figures on the calculator to determine the index for the standard form, giving 10^9 instead of 10^1.

A rectangle is 2680 cm long and 1970 cm wide.

a. Find the perimeter of the rectangle, giving your answer in the form $a \times 10^k$, where $1 \leqslant a \leqslant 10$ and $k \in \mathbb{Z}$. [3]

b. Find the area of the rectangle, giving your answer correct to the nearest thousand square centimetres. [3]

Markscheme

a. ***Note: Unit penalty (UP) applies in this part***

(2680 + 1970) × 2 ***(M1)***

(UP) = 9.30 × 10^3 cm ***(A1)(A1)*** ***(C3)***

Notes: Award ***(M1)*** for correct formula.

(A1) for 9.30 (Accept 9.3).

(A1) for 10^3.

[3 marks]

b. 2680 × 1970 ***(M1)***

= 5279600 ***(A1)***

= 5,280,000 (5280 thousand) ***(A1)*****(ft)** ***(C3)***

Note: Award ***(M1)*** for correctly substituted formula.

Accept 5.280 × 10^6.

Note: The last ***(A1)*** is for specified accuracy, **(ft)** from their answer.

The ***(AP)*** for the paper is not applied here.

[3 marks]

Examiners report

a. This question was well answered by many candidates although the majority lost a mark as a unit penalty in part (a). Some candidates used the wrong formula for the perimeter. Most could give their answer in standard form.

b. This question was well answered by many candidates although the majority lost a mark as a unit penalty in part (a). Some candidates used the wrong formula for the perimeter. Most could give their answer in standard form.

Give all answers in this question correct to two decimal places.

Isabel is travelling from Geneva to Toronto via Amsterdam.

She changes 1240 Swiss francs (CHF) to Euros (EUR).

The exchange rate is 1 CHF = 0.7681 EUR.

a. Calculate the amount of Euros Isabel receives. [2]

b. Isabel then changes 750 EUR into Canadian dollars (CAD) and is charged 3.12 % commission. [4]

The exchange rate is 1 CAD = 0.7470 EUR .

Calculate the amount of Canadian dollars she receives.

Markscheme

a. 1240 × 0.7681 ***(M1)***

Note: Award ***(M1)*** for multiplying by 0.7681

= 952.44 ***(A1)*** ***(C2)***

[2 marks]

b. $\frac{750}{0.7470} \times (1 - 0.0312)$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for dividing by 0.7470, ***(M1)*** for subtracting 0.0312 from 1, ***(M1)*** for multiplying by the (1 – 0.0312).

OR

$\frac{750}{0.7470} (= 1004.016...)$ ***(M1)***

1004.016... × 0.0312 (= 31.325...) ***(M1)***

1004.016... – 31.325... ***(M1)***

Note: Award ***(M1)*** for dividing by 0.7470, ***(M1)*** for multiplication by 0.0312, ***(M1)*** for subtraction of their 31.325 from their 1004.016.

OR

750 × 3.12 % = 23.4 ***(M1)***

750 – 23.4 = 726.60 ***(M1)***

$\frac{726.60}{0.7470}$ ***(M1)***

Note: Award ***(M1)*** for multiplication by 3.12 %, ***(M1)*** for subtraction of their 23.4 from 750, ***(M1)*** for division by 0.7470.

= 972.69 ***(A1)*** ***(C4)***

Note: If division by 0.7681 is used in part (a) then award ***(M1)*** for multiplying by 0.7470 in part (b).

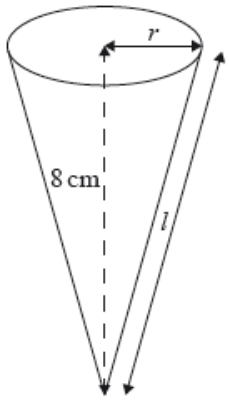
[4 marks]

Examiners report

a. This question was generally well done with the majority of candidates correctly using the currency conversions (multiplying in part (a) and dividing in part (b)) and, in most cases, working out the commission correctly in part (b). On a few scripts, candidates failed to round either one or both of their answers correctly to two decimal places and, as a consequence, lost a mark.

b. This question was generally well done with the majority of candidates correctly using the currency conversions (multiplying in part (a) and dividing in part (b)) and, in most cases, working out the commission correctly in part (b). On a few scripts, candidates failed to round either one or both of their answers correctly to two decimal places and, as a consequence, lost a mark.

A type of candy is packaged in a right circular cone that has volume $100\ \text{cm}^3$ and vertical height 8 cm.



a. Find the radius, r, of the circular base of the cone. [2]

b. Find the slant height, l, of the cone. [2]

c. Find the curved surface area of the cone. [2]

Markscheme

a. $100 = \frac{1}{3}\pi r^2(8)$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into volume of cone formula.

$r = 3.45\ (\text{cm})\ \ (3.45494\ldots\ (\text{cm}))$ ***(A1)*** ***(C2)***

[2 marks]

b. $l^2 = 8^2 + (3.45494\ldots)^2$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into Pythagoras' theorem.

$l = 8.71\ (\text{cm})\ \ (8.71416\ldots\ (\text{cm}))$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (a).

[2 marks]

c. $\pi \times 3.45494\ldots \times 8.71416\ldots$ ***(M1)***

Note: Award ***(M1)*** for their correct substitutions into curved surface area of a cone formula.

$= 94.6\ \text{cm}^2\ (94.5836\ldots\ \text{cm}^2)$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from parts (a) and (b). Accept $94.4\ \text{cm}^2$ from use of 3 sf values.

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

Sergei is training to be a weightlifter. Each day he trains at the local gym by lifting a metal bar that has heavy weights attached. He carries out successive lifts. After each lift, the same amount of weight is **added** to the bar to increase the weight to be lifted.

The weights of each of Sergei's lifts form an arithmetic sequence.

Sergei's friend, Yuri, records the weight of each lift. Unfortunately, last Monday, Yuri misplaced all but two of the recordings of Sergei's lifts.

On that day, Sergei lifted 21 kg on the third lift and 46 kg on the eighth lift.

a.i. For that day find how much weight was added after each lift. [2]

a.ii. For that day find the weight of Sergei's first lift. [2]

b. On that day, Sergei made 12 successive lifts. Find the total combined weight of these lifts. [2]

Markscheme

a.i. $5d = 46 - 21$ **OR** $u_1 + 2d = 21$ and $u_1 + 7d = 46$ ***(M1)***

Note: Award ***(M1)*** for a correct equation in d or for two correct equations in u_1 and d.

(d =) 5 (kg) ***(A1) (C2)***

[2 marks]

a.ii $u_1 + 2 \times 5 = 21$ ***(M1)***

OR

$u_1 + 7 \times 5 = 46$ ***(M1)***

Note: Award ***(M1)*** for substitution of their d into either of the two equations.

(u_1 =) 11 (kg) ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (a)(i).

[2 marks]

b. $\frac{12}{2}(2 \times 11 + (12 - 1) \times 5)$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into arithmetic series formula.

= 462 (kg) ***(A1)*****(ft)** ***(C2)***

Note: Follow through from parts (a) and (b).

[2 marks]

Examiners report

a.i. [N/A]
a.ii. [N/A]
b. [N/A]

The table below shows the frequency distribution of the number of dental fillings for a group of 25 children.

Number of fillings	0	1	2	3	4	5
Frequency	4	3	8	q	4	1

a. Find the value of q . [2]

b. Use your graphic display calculator to find [4]

(i) the mean number of fillings;

(ii) the median number of fillings;

(iii) the standard deviation of the number of fillings.

Markscheme

a. $q = 25 - (4 + 3 + 8 + 4 + 1)$ ***(M1)***

Note: Award ***(M1)*** for subtraction from 25 of all values from the table.

$= 5$ ***(A1)*** ***(C2)***

[2 marks]

b. (i) 2.2 ***(A2)*****(ft)** ***(C2)***

Note: Award ***(M1)*** for use of mean formula with correct substitution. Follow through from part (a), irrespective of whether working is shown.

(ii) 2 ***(A1)*** ***(C1)***

(iii) 1.39 ***(A1)*****(ft)** ***(C1)***

Note: Follow through from part (a), irrespective of whether working is shown. Award ***(A1)*** for 1.38.

[4 marks]

Examiners report

a. Part b was not well answered by the majority of candidates, indicating that the use of the GDC is not a natural tool for answering this type of question. Many students ignored the frequencies when finding the mean, median, and standard deviation.

b. Part b was not well answered by the majority of candidates, indicating that the use of the GDC is not a natural tool for answering this type of question. Many students ignored the frequencies when finding the mean, median, and standard deviation.

Jane plans to travel from Amsterdam to Chicago. She changes 1500 Euros (EUR) to US Dollars (USD) at an exchange rate of 1 EUR to 1.33 USD. Give all answers in this question **correct to two decimal places**.

a. Calculate the number of USD Jane receives. [1]

b. Jane spends 1350 USD and then decides to convert the remainder back to EUR at a rate of 1 EUR to 1.38 USD. [3]

Calculate the amount of EUR Jane receives.

c. If Jane had waited until she returned to Amsterdam she could have changed her USD at a rate of 1 EUR to 1.36 USD but the bank would have charged 0.8% commission. [2]

Calculate the amount of EUR Jane gained or lost by changing her money in Chicago.

Markscheme

a. *Financial penalty **(FP)** may apply in this question.*

1500×1.33

(FP) $= 1995.00$ *(accept* 1995*)* ***(A1)*** ***(C1)***

[1 mark]

b. *Financial penalty **(FP)** may apply in this question.*

$\text{USD left} = 1995 - 1350 = 645$ ***(A1)***

$= \frac{645}{1.38} \text{ Euros}$ ***(A1)*****(ft)**

(FP) $= 467.39 \text{ Euros}$ ***(A1)*****(ft)** ***(C3)***

[3 marks]

c. *Financial penalty **(FP)** may apply in this question.*

$\frac{645}{1.36} \times 0.992 = 470.47$ ***(A1)*****(ft)**

(FP) She lost 3.08 Euros ***(A1)*****(ft)** ***(C2)***

Notes: The word 'lost' is not required.
If candidate has divided in (a) and multiplied in (b) and (c) consistently award ***(A0)(A1)*****(ft)*****(A1)*****(ft)** for answers of -222.18 for USD left and 306.61 Euros in (b) and ***(A1)*****(ft)*****(A1)*****(ft)** for 299.75 and 6.86 in (c).

[2 marks]

Examiners report

a. This question was well answered by a number of the candidates although a significant number lost a mark due to a financial penalty through not giving an answer correct to 2 decimal places. A very common mistake was to use 8% (0.08) for 0.8% (0.008) as the multiplier in part (c).

b. This question was well answered by a number of the candidates although a significant number lost a mark due to a financial penalty through not giving an answer correct to 2 decimal places. A very common mistake was to use 8% (0.08) for 0.8% (0.008) as the multiplier in part (c).

c. This question was well answered by a number of the candidates although a significant number lost a mark due to a financial penalty through not giving an answer correct to 2 decimal places. A very common mistake was to use 8% (0.08) for 0.8% (0.008) as the multiplier in part (c).

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a. One of the locations in the 2016 Olympic Games is an amphitheatre. The number of seats in the first row of the amphitheatre, u_1 , is 240. The number of seats in each subsequent row forms an arithmetic sequence. The number of seats in the sixth row, u_6 , is 270. [2]

Calculate the value of the common difference, d.

b. There are 20 rows in the amphitheatre. [2]

Find the **total** number of seats in the amphitheatre.

c. Anisha visits the amphitheatre. She estimates that the amphitheatre has 6500 seats. [2]

Calculate the percentage error in Anisha's estimate.

Markscheme

a. $270 = 240 + d(6-1)$ ***(M1)***

OR

$d = \frac{270-240}{5}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into the arithmetic sequence formula.

$(d =) 6$ ***(A1) (C2)***

b. $\frac{20}{2}[2 \times 240 + 19 \times \text{their } d]$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into sum of an arithmetic sequence.

OR

$u_{20} = 354$

$S_{20} = \frac{20}{2}[240 + 354]$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into sum of an arithmetic sequence.

OR

adding 20 terms consistent with their d ***(M1)***

$= 5940$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from (a).

c. $\left|\frac{6500-5940}{5940}\right| \times 100$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into percentage error formula.

$= 9.43\,(\%)$ $(9.42760...)$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from (b).

Examiners report

a. Question 6: Arithmetic sequence and series

This question was well attempted by the majority.

In part (a), a common error was calculating the difference as 5.

b. Part (b) was well attempted by the majority; with full follow-through being obtained.

c. In part (c) The incorrect denominator was the major error here.

The table below shows some exchange rates for the Japanese Yen (JPY).

Currency	**1 JPY**
Canadian Dollar	0.010406
Chinese Yuan	0.07127
Euro	0.0072591
Norwegian Kroner	0.057319

a. Minbin has 1250 Japanese Yen which she wishes to exchange for Chinese Yuan. [2]

Calculate how many Yuan she will receive. Give your answer to the nearest Yuan.

b. Rupert has 855 Canadian Dollars which he wishes to exchange for Japanese Yen. [2]

Calculate how many Yen he will receive. Give your answer to the nearest Yen.

c. Find how many Norwegian Kroner there are to the Euro. Give your answer correct to 2 decimal places. [2]

Markscheme

a. *Financial accuracy penalty **(FP)** is applicable where indicated in the left hand column.*

Multiplying 1250 by 0.07127 or 0.7127 ***(M1)***

(FP) 89 ***(A1)*** ***(C2)***

[2 marks]

b. *Financial accuracy penalty **(FP)** is applicable where indicated in the left hand column.*

Dividing by 0.010406 or 0.10406 ***(M1)***

(FP) 82164 ***(A1)*** ***(C2)***

Note: If candidate has divided in (a) and multiplied in (b) award ***(M1)(A1)*****(ft)** for 9 in (b).

[2 marks]

c. *Financial accuracy penalty **(FP)** is applicable where indicated in the left hand column.*

(FP) $\frac{0.057319}{0.0072591}$ *allow* 0.57319 *and/or* 0.072591 ***(M1)***

7.90 ***(A1)*** ***(C2)***

Note: The ***(M1)*** is being allowed for misreading values from the table but do not **(ft)** to candidate's answers.

[2 marks]

Examiners report

a. This question was well answered by a number of candidates with few confusing the conversions. Some found the last part difficult with many leaving it out.

b. This question was well answered by a number of candidates with few confusing the conversions. Some found the last part difficult with many leaving it out.

c. This question was well answered by a number of candidates with few confusing the conversions. Some found the last part difficult with many leaving it out.

Pierre invests 5000 euros in a fixed deposit that pays a nominal annual interest rate of 4.5%, compounded **monthly**, for seven years.

a. Calculate the value of Pierre's investment at the end of this time. Give your answer correct to two decimal places. [3]

b. Carla has 7000 dollars to invest in a fixed deposit which is compounded **annually**. [3]

She aims to double her money after 10 years.

Calculate the minimum annual interest rate needed for Carla to achieve her aim.

Markscheme

a. $5000\left(1+\frac{4.5}{12\times100}\right)^{12\times7}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution into compound interest formula, ***(A1)*** for correct substitutions.

OR

$N=7$

$I\%=4.5$

$PV=(\pm)5000$

$P/Y=1$

$C/Y=12$ ***(A1)(M1)***

Note: Award ***(A1)*** for $C/Y=12$ seen, ***(M1)*** for all other correct entries.

OR

$N=84$

$I\%=4.5$

$PV=(\pm)5000$

$P/Y=12$

$C/Y=12$ ***(A1)(M1)***

Note: Award ***(A1)*** for $C/Y=12$ seen, ***(M1)*** for all other correct entries.

$=6847.26\ (\text{euros})$ ***(A1)*** ***(C3)***

Note: Answer must be correct to 2 decimal places for the final ***(A1)*** to be awarded.

b. $14000=7000\left(1+\frac{r}{100}\right)^{10}$ ***(M1)(A1)***

Notes: Award ***(M1)*** for substitution into compound interest formula equated to 14000 or equivalent.

Award ***(A1)*** for correct substitutions.

OR

$N=10$

$PV=\pm7000$

$FV\mp14000$

$P/Y=1$

$C/Y=1$ ***(A1)(M1)***

Note: Award ***(A1)*** for $C/Y=1$ seen, ***(M1)*** for other correct entries. PV and FV must have opposite signs.

$r = 7.18\%$ $(7.17734\ldots\%,\ 0.0718)$ ***(A1)*** ***(C3)***

Note: Do not penalize if $\%$ sign is missing. Do not accept 0.0718%.

Examiners report

a. Many correct answers were given for part (a). Incorrect answers were in most cases the result of incorrect substitution into the compound interest formula, or incorrect use of the calculator, both in using the formula or when using the finance application. A common mistake was the use of 0.045 instead of 4.5 for r in the formula.

b. In part (b) a correct equation was often given, but an analytical or graphical solution was rarely found. When the finance application of the GDC was used candidates often found the correct answer.

Juan buys a bicycle in a sale. He gets a discount of 30% off the original price and pays 560 US dollars (USD).

To buy the bicycle, Juan takes a loan of 560 USD for 6 months at a nominal annual interest rate of 75%, **compounded monthly**. Juan believes that the total amount he will pay will be less than the original price of the bicycle.

a. Calculate the original price of the bicycle. [2]

b. Calculate the difference between the original price of the bicycle and the total amount Juan will pay. [4]

Markscheme

a. $\frac{560}{70} \times 100$ (or equivalent) ***(M1)***

Note: Award ***(M1)*** for dividing 560 by 0.7 or equivalent.

$= 800\ (\text{USD})$ ***(A1)*** ***(C2)***

[2 marks]

b. $560\left(1 + \frac{75}{12\times100}\right)^{12\times\frac{1}{2}}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution into interest formula, ***(A1)*** for their correct substitution.

OR

$\text{N} = \frac{1}{2}$

$\text{I}\% = 75$

$\text{PV} = (\pm)560$

$\mathrm{P/Y} = 1$

$\mathrm{C/Y} = 12$ ***(A1)(M1)***

Note: Award ***(A1)*** for $\mathrm{C/Y} = 12$ seen, ***(M1)*** for all other entries correct.

OR

$\mathrm{N} = 6$

$\mathrm{I\%} = 75$

$\mathrm{PV} = (\pm)560$

$\mathrm{P/Y} = 12$

$\mathrm{C/Y} = 12$ ***(A1)(M1)***

Note: Award ***(A1)*** for $\mathrm{C/Y} = 12$ seen, ***(M1)*** for all other entries correct.

$= 805.678\ldots\ (\mathrm{USD})$ ***(A1)***

Note: Award ***(A3)*** for 805.678… (806) seen without working.

(Juan spends) 5.68 (USD) (5.67828… USD) (more than the original price) ***(A1)*(ft)*** ***(C4)***

[4 marks]

Examiners report

a. [N/A]
b. [N/A]

The distance d from a point $\mathrm{P}(x,\ y)$ to the point $\mathrm{A}(1,\ -2)$ is given by $d = \sqrt{(x-1)^2 + (y+2)^2}$

a. Find the distance from $\mathrm{P}(100,\ 200)$ to A. Give your answer correct to two decimal places. [3]

b. Write down your answer to **part (a)** correct to three significant figures. [1]

c. Write down your answer to **part (b)** in the form $a \times 10^k$, where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. [2]

Markscheme

a. $\sqrt{(100-1)^2 + (200+2)^2}$ ***(M1)***

$\sqrt{50605}\ \ (= 224.955\ldots)$ ***(A1)***

Note: Award ***(M1)(A1)*** if $\sqrt{50605}$ seen.

224.96 ***(A1)*** ***(C3)***

Note: Award ***(A1)*** for their answer given correct to 2 decimal places.

b. 225 ***(A1)*****(ft)** ***(C1)***

Note: Follow through from their part (a).

c. 2.25×10^2 ***(A1)*****(ft)*****(A1)*****(ft)** ***(C2)***

Notes: Award ***(A1)(A0)*** for 2.25 and an incorrect index value.

Award ***(A0)(A0)*** for answers such as 22.5×10^1.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

---

a. Expand the expression $x(2x^3 - 1)$. [2]

b. Differentiate $f(x) = x(2x^3 - 1)$. [2]

c. Find the x-coordinate of the local minimum of the curve $y = f(x)$. [2]

Markscheme

a. $2x^4 - x$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for $2x^4$, ***(A1)*** for $-x$.

[2 marks]

b. $8x^3 - 1$ ***(A1)*****(ft)*****(A1)*****(ft)** ***(C2)***

Note: Award ***(A1)*****(ft)** for $8x^3$, ***(A1)*****(ft)** for -1. Follow through from their part (a).

Award at most ***(A1)(A0)*** if extra terms are seen.

[2 marks]

c. $8x^3 - 1 = 0$ ***(M1)***

Note: Award ***(M1)*** for equating their part (b) to zero.

$(x =)\frac{1}{2}\ (0.5)$ ***(A1)*****(ft)** ***(C2)***

Notes: Follow through from part (b).

0.499 is the answer from the use of trace on the GDC; award ***(A0)(A0)***.

For an answer of $(0.5, -0.375)$, award ***(M1)(A0)***.

[2 marks]

Examiners report

a. A surprising number of candidates were unable to correctly expand the expression given in part (a). Most candidates were able to differentiate their function but a considerable number were unable to find the x-coordinate of the minimum point. Candidates must read the questions correctly as answers giving ordered pairs were not awarded the final mark. A number of candidates did not use calculus to determine the local minimum but graphed the function, often achieving full marks for part (c), even when parts (b) or (a) were incorrect or left blank.

b. A surprising number of candidates were unable to correctly expand the expression given in part (a). Most candidates were able to differentiate their function but a considerable number were unable to find the x-coordinate of the minimum point. Candidates must read the questions correctly as answers giving ordered pairs were not awarded the final mark. A number of candidates did not use calculus to determine the local minimum but graphed the function, often achieving full marks for part (c), even when parts (b) or (a) were incorrect or left blank.

c. A surprising number of candidates were unable to correctly expand the expression given in part (a). Most candidates were able to differentiate their function but a considerable number were unable to find the x-coordinate of the minimum point. Candidates must read the questions correctly as answers giving ordered pairs were not awarded the final mark. A number of candidates did not use calculus to determine the local minimum but graphed the function, often achieving full marks for part (c), even when parts (b) or (a) were incorrect or left blank.

Marcus has been given 500 Australian dollars (AUD) by his grandmother for his 18th birthday.

He plans to deposit it in a bank which offers a nominal annual interest rate of 6.0 %, **compounded quarterly**, for three years.

a. Calculate the total amount of interest Marcus would earn, in AUD, over the three years. **Give your answer correct to two decimal places.** [3]

b. Marcus would earn the same amount of interest, **compounded annually**, for three years if he deposits the 500 AUD in a second bank. [3]

Calculate the interest rate the second bank offers.

Markscheme

a. $500\left(1+\frac{6}{100\times 4}\right)^{4\times 3}-500$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution in correct formula ***(A1)*** for correct substitutions.

$=97.81$ ***(A1)*** ***(C3)***

Note: The answer must be given to 2 dp or the final ***(A1)*** is not awarded.

b. $97.8090... = 500\left(1+\frac{r}{100}\right)^{3}-500$ ***(M1)(A1)*****(ft)**

Note: Award ***(M1)*** for substitution in correct formula, ***(A1)*(ft)** for their correct substitutions.

$= 6.14$ (6.13635...) ***(A1)*(ft)** ***(C3)***

Note: Follow through from their answer to part (a).

Examiners report

a. [N/A]
b. [N/A]

Charles invests $3000\ \text{USD}$ in a bank that offers compound interest at a rate of 3.5% per annum, compounded half-yearly.

Calculate the number of years that it takes for Charles's money to double.

Markscheme

$6000 = 3000\left(1 + \frac{3.5}{200}\right)^{2n}$ ***(M1)(A1)***

Note: ***(M1)*** for substituting values into a compound interest formula, ***(A1)*** for correct values with a variable for the power.

$n = 20\ \text{years}$ ***(A1)*** ***(C3)***

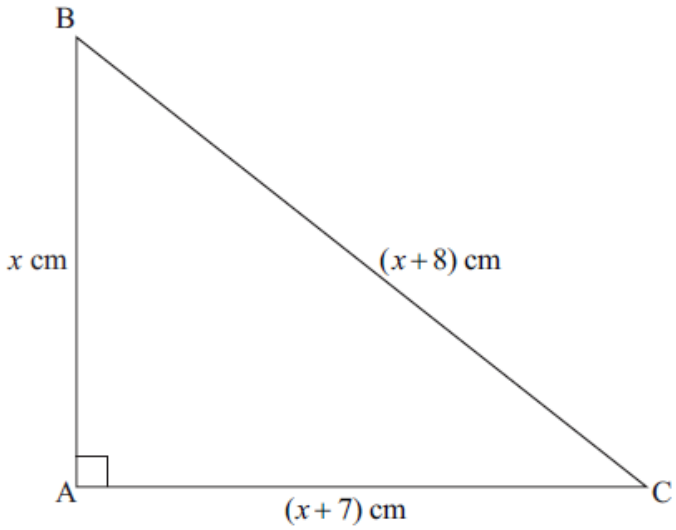
Note: If n used in formula instead of $2n$, can allow as long as final answer is halved to get 20.

[3 marks]

Examiners report

Part (a) on simple interest was answered well - common errors being 0.04 in the numerator as well as 100 in denominator, and using 6000 as the interest. Part (b) was not well done. Candidates struggled with interest that was not compounded yearly although such questions have been asked on previous papers.

In the diagram, $\text{B}\hat{\text{A}}\text{C} = 90^\circ$. The length of the three sides are x cm, $(x + 7)$ cm and $(x + 8)$ cm.



a. Write down and **simplify** a quadratic equation in x which links the three sides of the triangle. [3]

b. Solve the quadratic equation found in part (a). [2]

c. Write down the value of the perimeter of the triangle. [1]

Markscheme

a. $(x+8)^2 = (x+7)^2 + x^2$ ***(A1)***

Note: Award ***(A1)*** for a correct equation.

$x^2 + 16x + 64 = x^2 + 14x + 49 + x^2$ ***(A1)***

Note: Award ***(A1)*** for correctly removed parentheses.

$x^2 - 2x - 15 = 0$ ***(A1)*** ***(C3)***

Note: Accept any equivalent form.

[3 marks]

b. $x = 5, x = -3$ ***(A1)*****(ft)*****(A1)*****(ft)*** ***(C2)***

Notes: Accept ***(A1)*****(ft)** only from the candidate's **quadratic** equation.

[2 marks]

c. 30 cm ***(A1)*****(ft)** ***(C1)***

Note: Follow through from a positive answer found in part (b).

[1 mark]

Examiners report

a. This question proved to be difficult for the majority of candidates. Many simply were unable to see that, to relate the three given lengths, a Pythagorean equation needed to be produced. Indeed, many did not seem to appreciate the concept of a quadratic equation and, as a consequence, either wrote down a linear equation linking one length to the sum of the other two lengths or multiplied all three lengths together. For the minority who stated a correct Pythagorean equation, many could not remove brackets successfully and arrived at $x^2 = 15$. Consequently, very few candidates earned more than one mark for part (a). Where the correct quadratic equation was seen in part (a), many were able to solve this quadratic correctly in part (b) and arrive at the required value of $x = 5$ for the answer for part (c).

b. This question proved to be difficult for the majority of candidates. Many simply were unable to see that, to relate the three given lengths, a Pythagorean equation needed to be produced. Indeed, many did not seem to appreciate the concept of a quadratic equation and, as a consequence, either wrote down a linear equation linking one length to the sum of the other two lengths or multiplied all three lengths together. For the minority who stated a correct Pythagorean equation, many could not remove brackets successfully and arrived at $x^2 = 15$. Consequently, very few candidates earned more than one mark for part (a). Where the correct quadratic equation was seen in part (a), many were able to solve this quadratic correctly in part (b) and arrive at the required value of $x = 5$ for the answer for part (c).

c. This question proved to be difficult for the majority of candidates. Many simply were unable to see that, to relate the three given lengths, a Pythagorean equation needed to be produced. Indeed, many did not seem to appreciate the concept of a quadratic equation and, as a consequence, either wrote down a linear equation linking one length to the sum of the other two lengths or multiplied all three lengths together. For the minority who stated a correct Pythagorean equation, many could not remove brackets successfully and arrived at $x^2 = 15$. Consequently, very few candidates earned more than one mark for part (a). Where the correct quadratic equation was seen in part (a), many were able to solve this quadratic correctly in part (b) and arrive at the required value of $x = 5$ for the answer for part (c).

A teacher earns an annual salary of 45000 USD for the first year of her employment. Her annual salary increases by 1750 USD each year.

a. Calculate the annual salary for the fifth year of her employment. [3]

b. She remains in this employment for 10 years. Calculate the **total** salary she earns in this employment during these 10 years. [3]

Markscheme

a. $45000 + (5 - 1)1750$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted AP formula, ***(A1)*** for correct substitutions.

$= 52000$ USD ***(A1)*** ***(C3)***

Notes: If a list is used, award ***(M1)*** for recognizing AP, award ***(A1)*** for seeing 52000 in their list, ***(A1)*** for final answer.

[3 marks]

b. $\frac{10}{2}(2(45000) + (10 - 1)(1750))$ ***(M1)(A1)***

Notes: Award ***(M1)*** for substituted AP formula, ***(A1)*(ft)** for correct substitutions. Follow through from their common difference used in part (a).

$= 528750$ USD ***(A1)*(ft)** ***(C3)***

Notes: Accept 529000. If a list is used, award ***(M1)*** for recognizing sum of AP, ***(A1)*** for seeing 60750 included in the sum or 528750 in a cumulative list.

[3 marks]

Examiners report

a. Although part a was very well done, a large number of candidates multiplied the difference by n rather than $n-1$.

b. Although part a was very well done, a large number of candidates multiplied the difference by n rather than $n-1$. Many candidates misread, or misinterpreted, part b and found the 10^{th} term rather than the sum of the first 10 terms.

In this question give all answers correct to 2 decimal places.

George travelled from the USA to Europe and changed 1200 dollars (USD) into Euros (EUR). The exchange rate was $1 \text{ USD} = 0.8154 \text{ EUR}$.

a. Calculate the number of EUR George received. [2]

b. On his return, George had 160 EUR to change back into USD. There was 4.5% commission charged on the exchange. The exchange rate was [2]

1 USD = 0.8202 EUR.

Calculate the value, in EUR, of the commission that George paid.

c. On his return, George had 160 EUR to change back into USD. There was 4.5% commission charged on the exchange. The exchange rate was [2]

1 USD = 0.8202 EUR.

Calculate the number of dollars George received.

Markscheme

a. ***The first time the answer is not given to 2 decimal places the final (A1) in that part is not awarded, incorrect rounding, following correct method, can be ignored in subsequent parts.***

\(1200 \times 0.8154\) ***(M1)***

$= 978.48 \text{ EUR}$ ***(A1)*** ***(C2)***

[2 marks]

b. ***The first time the answer is not given to 2 decimal places the final (A1) in that part is not awarded, incorrect rounding, following correct method, can be ignored in subsequent parts.***

160×0.045 ***(M1)***

$= 7.20 \text{ EUR}$ ***(A1)*** ***(C2)***

[2 marks]

c. ***The first time the answer is not given to 2 decimal places the final (A1) in that part is not awarded, incorrect rounding, following correct method, can be ignored in subsequent parts.***

$152.80 \times \frac{1}{0.8202}$ ***(M1)***

Note: Follow through from their answer to part (b).

$= 186.30 \text{ USD}$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (b).

[2 marks]

Examiners report

a. At whatever ability, there were good attempts by all candidates on this question with an overwhelming majority scoring half marks or more. Indeed, three out of the first four marks were invariably earned with only answers of 7.2 EUR losing the final mark in part (b). In part (c), errors were invariably caused by candidates ignoring the commission charge or multiplying by 0.8202 rather than dividing by this value. Another common, but incorrect, method seen was multiply 152.80 by $(1 + 1 - 0.8202)$, giving the wrong answer of 180.27 USD. Both marks were lost in all the cases listed.

b. At whatever ability, there were good attempts by all candidates on this question with an overwhelming majority scoring half marks or more. Indeed, three out of the first four marks were invariably earned with only answers of 7.2 EUR losing the final mark in part (b). In part (c), errors were invariably caused by candidates ignoring the commission charge or multiplying by 0.8202 rather than dividing by this value. Another common, but incorrect, method seen was multiply 152.80 by $(1 + 1 - 0.8202)$, giving the wrong answer of 180.27 USD. Both marks were lost in all the cases listed.

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Ludmila takes a loan of 320 000 Brazilian Real (BRL) from a bank for two years at a nominal annual interest rate of 10%, **compounded half yearly**.

a. Write down the number of times interest is added to the loan in the two years. [1]

b. Calculate the **exact** amount of money that Ludmila must repay at the end of the two years. [3]

c. Ludmila estimates that she will have to repay $360\,000$ BRL at the end of the two years. [2]

Calculate the percentage error in her estimate.

Markscheme

a. 4 ***(A1)*** ***(C1)***

[1 mark]

b. $320\,000\left(1+\frac{10}{2\times100}\right)^{2\times2}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted compound interest formula, ***(A1)*** for correct substitutions.

OR

$\mathrm{N}=2$

$\mathrm{I}\%=10$

$\mathrm{PV}=-320000$

$\mathrm{P}\,/\,\mathrm{Y}=1$

$\mathrm{C}\,/\,\mathrm{Y}=2$ ***(A1)(M1)***

Note: Award ***(A1)*** for $\mathrm{C}\,/\,\mathrm{Y}=2$ seen, ***(M1)*** for correctly substituted values from the question into the finance application.

OR

$\mathrm{N}=4$

$\mathrm{I}\%=10$

$\mathrm{PV}=-320000$

$\mathrm{P}\,/\,\mathrm{Y}=2$

$\mathrm{C}\,/\,\mathrm{Y}=2$ ***(A1)(M1)***

Note: Award ***(A1)*** for $\mathrm{C}\,/\,\mathrm{Y}=2$ seen, ***(M1)*** for correctly substituted values from the question into the finance application.

amount to repay $=388962$ ***(A1)*** ***(C3)***

Note: Award ***(C2)*** for final answer 389000 if 388962 not seen previously.

[3 marks]

c. $\left|\frac{360\,000-388\,962}{388\,962}\right|\times100$ ***(M1)***

Note: Award ***(M1)*** for correctly substituted percentage error formula.

$=7.45\ (\%)\ (7.44597\ldots)$ ***(A1)*****(ft)** ***(C2)***

Notes: Follow through from their answer to part (b).

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

A cuboid has a rectangular base of width x cm and length $2x$ cm . The height of the cuboid is h cm . The total length of the edges of the cuboid is 72 cm.

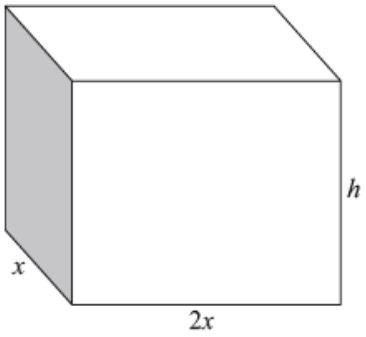

diagram not to scale

The volume, V, of the cuboid can be expressed as $V = ax^2 - 6x^3$.

a. Find the value of a. [3]

b. Find the value of x that makes the volume a maximum. [3]

Markscheme

a. $72 = 12x + 4h$ (or equivalent) ***(M1)***

Note: Award ***(M1)*** for a correct equation obtained from the total length of the edges.

$V = 2x^2(18 - 3x)$ ***(A1)***

$(a =)\ 36$ ***(A1)*** ***(C3)***

b. $\frac{\mathrm{d}V}{\mathrm{d}x} = 72x - 18x^2$ ***(A1)***

$72x - 18x^2 = 0$ **OR** $\frac{\mathrm{d}V}{\mathrm{d}x} = 0$ ***(M1)***

Notes: Award ***(A1)*** for $-18x^2$ seen. Award ***(M1)*** for equating derivative to zero.

$(x =)\ 4$ ***(A1)*****(ft)** ***(C3)***

Note: Follow through from part (a).

OR

Sketch of V with visible maximum ***(M1)***

Sketch with $x \geqslant 0,\ V \geqslant 0$ and indication of maximum (e.g. coordinates) ***(A1)*****(ft)**

$(x =)\ 4$ ***(A1)*****(ft)** ***(C3)***

Notes: Follow through from part (a).

Award ***(M1)(A1)(A0)*** for $(4,\ 192)$.

Award ***(C3)*** for $x = 4,\ y = 192$.

Examiners report

a. The model in this question seemed to be too difficult for the vast majority of the candidates, and therefore was a strong discriminator between grade 6 and grade 7 candidates. An attempt to find an equation for the volume of the cube often started with *V* = *x* x 2*x* x *h* . Many struggled to translate the total length of the edges into a correct equation, and consequently were unable to substitute *h*. Some tried to write *x* in terms of *h* and got lost, others tried to work backwards from the expression given in the question.

b. As very few found a value for *a*, often part (b) was not attempted. When a derivative was calculated this was usually done correctly.

Emma places €8000 in a bank account that pays a nominal interest rate of 5% per annum, compounded quarterly.

a. Calculate the amount of money that Emma would have in her account after 15 years. Give your answer correct to the nearest Euro. [3]

b. After a period of time she decides to withdraw the money from this bank. There is $€9058.17$ in her account. Find the number of months that Emma had left her money in the account. [3]

Markscheme

a. $FV = 8000(1.0125)^{60}$ ***(M1)(A1)***

Note: ***(M1)*** for substituting in compound interest formula, ***(A1)*** for correct substitution.

$€16857$ only ***(A1)*** ***(C3)***

[3 marks]

b. $8000(1.0125)^n = 9058.17$ ***(M1)***

Note: ***(M1)*** for equating compound interest formula to 9058.17

$n = 10$ *correct answer only* ***(A1)***

So 30 months, **(ft)** on their n ***(A1)*****(ft)** ***(C3)***

Note: Award ***(C2)*** for 2.5 seen with no working.

[3 marks]

Examiners report

a. Again this is a question that has been tested before but few candidates managed to gain full marks. Many, in part (b), believed they had to subtract 8000 from the value to get the interest first. This could possibly be a result of the way the formula is given in the formula booklet so teachers need to be aware of this.

b. Again this is a question that has been tested before but few candidates managed to gain full marks. Many, in part (b), believed they had to subtract 8000 from the value to get the interest first. This could possibly be a result of the way the formula is given in the formula booklet so teachers need to be aware of this.

A liquid is heated so that after 20 seconds of heating its temperature, T , is $25^{\circ}\mathrm{C}$ and after 50 seconds of heating its temperature is $37^{\circ}\mathrm{C}$.

The temperature of the liquid at time t can be modelled by $T = at + b$, where t is the time in seconds after the start of heating.
Using this model one equation that can be formed is $20a + b = 25$.

a. Using the model, write down a second equation in a and b . [2]

b. Using your graphic display calculator or otherwise, find the value of a and of b . [2]

c. Use the model to predict the temperature of the liquid 60 seconds after the start of heating. [2]

Markscheme

a. $50a + b = 37$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for $50a + b$, ***(A1)*** for $= 37$.

b. $a = 0.4, b = 17$ ***(A1)*****(ft)*****(A1)*****(ft)*** ***(C2)***

Notes: Award ***(M1)*** for attempt to solve their equations if this is done analytically. If the GDC is used, award **(ft)** even if no working seen.

c. $T = 0.4(60) + 17$ ***(M1)***

Note: Award ***(M1)*** for correct substitution of their values and 60 into equation for T.

$T = 41\ (^{\circ}\mathrm{C})$ ***(A1)*****(ft)*** ***(C2)***

Note: Follow through from their part (b).

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

The seventh term, u_7 , of a geometric sequence is 108. The eighth term, u_8 , of the sequence is 36 .

a. Write down the common ratio of the sequence. [1]

b. Find u_1 . [2]

c. The sum of the first k terms in the sequence is 118096 . Find the value of k . [3]

Markscheme

a. $r = \frac{36}{108}\left(\frac{1}{3}\right)$ ***(A1)*** ***(C1)***

Note: Accept 0.333.

[1 mark]

b. $u_1\left(\frac{1}{3}\right)^7 = 36$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in formula for nth term of a GP. Accept equivalent forms.

$u_1 = 78732$ ***(A1)*(ft)** ***(C2)***

Notes: Accept 78700. Follow through from their common ratio found in part (a). If 0.333 used from part (a) award ***(M1)(A1)*(ft)** for an answer of 79285 or 79300 irrespective of whether working is shown.

[2 marks]

c. $118096 = \frac{78732\left(1-\left(\frac{1}{3}\right)^k\right)}{\left(1-\frac{1}{3}\right)}$ ***(M1)(M1)***

Notes: Award ***(M1)*** for correct substitution in the sum of a GP formula, ***(M1)*** for equating their sum to 118096. Follow through from parts (a) and (b).

OR

Sketch of the function $y = 78732\frac{\left(1-\left(\frac{1}{3}\right)^k\right)}{\left(1-\frac{1}{3}\right)}$ ***(M1)***

Indication of point where $y = 118096$ ***(M1)***

OR

$78732 + 26244 + 8748 + 2916 + 972 + 324 + 108 + 36 + 12 + 4 = 118096$ ***(M1)(M1)***

Note: Award ***(M1)*** for a list of at least 8 correct terms, ***(M1)*** for the sum of the terms equated to 118096.

$k = 10$ ***(A1)*(ft)** ***(C3)***

Notes: Follow through from parts (a) and (b). If k is not an integer, do not award final ***(A1)***. Accept alternative methods. If 0.333 and 79285 used award ***(M1)(M1)(A1)*(ft)** for $k = 5$. If 0.333 and 79300 used award ***(M1)(M1)(A0)***.

[3 marks]

Examiners report

a. In part a, many candidates gave the common ratio as 3.

b. In part a, many candidates gave the common ratio as 3. While they could set up the equation for part c, relatively few succeeded in solving it. Those who arrived at an answer did not always realize that the answer must be an integer.

c. In part a, many candidates gave the common ratio as 3. While they could set up the equation for part c, relatively few succeeded in solving it. Those who arrived at an answer did not always realize that the answer must be an integer.

A shipping container is a cuboid with dimensions 16 m, $1\frac{3}{4}\text{ m}$ and $2\frac{2}{3}\text{ m}$.

a. Calculate the **exact** volume of the container. Give your answer as a fraction. [3]

b. Jim estimates the dimensions of the container as 15 m, 2 m and 3 m and uses these to estimate the volume of the container. [3]

Calculate the percentage error in Jim's estimated volume of the container.

Markscheme

a. $V = 16 \times 1\frac{3}{4} \times 2\frac{2}{3}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in volume formula. Accept decimal substitution of 2.66 or better.

$= 74.6666\ldots$ ***(A1)***

$= 74\frac{2}{3}\text{ m}^3\ \left(\frac{224}{3}\text{ m}^3\right)$ ***(A1)*** ***(C3)***

Note: Correct answer only.

[3 marks]

b. $\%\ \text{error} = \frac{\left(90-74\frac{2}{3}\right)\times 100}{74\frac{2}{3}}$ ***(A1)(M1)***

Note: Award ***(A1)*** for 90 seen, or inferred in numerator, ***(M1)*** for correct substitution into percentage error formula.

$= 20.5$ ***(A1)*****(ft)** ***(C3)***

Note: Accept -20.5.

[3 marks]

Examiners report

a. This question was well answered by the majority of candidates. Candidates encountered difficulty in part (a) with using fractions finding the exact volume. Nearly all candidates could use the formula for volume and most could achieve at least 2 marks in this first part. Most candidates could find the percentage error correctly using the formula once they found the estimate for the volume. Very few candidates substituted the formula incorrectly, or had an incorrect denominator.

b. This question was well answered by the majority of candidates. Candidates encountered difficulty in part (a) with using fractions finding the exact volume. Nearly all candidates could use the formula for volume and most could achieve at least 2 marks in this first part. Most candidates could find the percentage error correctly using the formula once they found the estimate for the volume. Very few candidates substituted the formula incorrectly, or had an incorrect denominator.

10000 people attended a sports match. Let x be the number of adults attending the sports match and y be the number of children attending the sports match.

a. Write down an equation in x and y. [1]

b. The cost of an adult ticket was 12 Australian dollars (AUD). The cost of a child ticket was 5 Australian dollars (AUD). [2]

Find the total cost for a family of 2 adults and 3 children.

c. The total cost of tickets sold for the sports match was $108800\ \text{AUD}$. [1]

Write down a second equation in x and y.

d. Write down the value of x and the value of y. [2]

Markscheme

a. $x + y = 10000$ ***(A1)*** ***(C1)***

[1 mark]

b. $2 \times 12 + 3 \times 5$ ***(M1)***

$39\ (39.0, 39.00)$ (AUD) ***(A1)*** ***(C2)***

[2 marks]

c. $12x + 5y = 108800$ ***(A1)*** ***(C1)***

[1 mark]

d. $x = 8400, y = 1600$ ***(A1)*(ft)*(A1)*(ft)** ***(C2)***

Notes: Follow through from their equations. If x and y are both incorrect then award ***(M1)*** for attempting to solve simultaneous equations.

[2 marks]

Examiners report

a. The first three marks were obtained by a significant majority of candidates. The second equation in x and y proved to be a little more elusive and a popular, but incorrect, answer seen was $12x + 5y = 10000$. Where working was seen in part (d), much of it was wrong. Indeed, a popular, but erroneous method, was to make either x (or y) the subject using one equation and then back substituting the value found into the same equation. Answers, involving decimals, should have flagged to the candidate that something was going wrong somewhere and another look at the question was required. Algebra is always a discriminator on these papers and centres would be well advised to reinforce concepts in such topics.

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$f(x) = 5x^3 - 4x^2 + x$

a. Find $f'(x)$. [3]

b. Find using your answer to part (a) the x-coordinate of [3]

(i) the local maximum point;

(ii) the local minimum point.

Markscheme

a. $15x^2 - 8x + 1$ ***(A1)(A1)(A1)*** ***(C3)***

Note: Award ***(A1)*** for each correct term.

[3 marks]

b. $15x^2 - 8x + 1 = 0$ ***(A1)*****(ft)**

Note: Award ***(A1)*****(ft)** for setting their derivative to zero.

(i) $(x =)\frac{1}{5}(0.2)$ ***(A1)*****(ft)**

(ii) $(x =)\frac{1}{3}(0.333)$ ***(A1)*****(ft)** ***(C3)***

Notes: Follow through from their answer to part (a).

[3 marks]

Examiners report

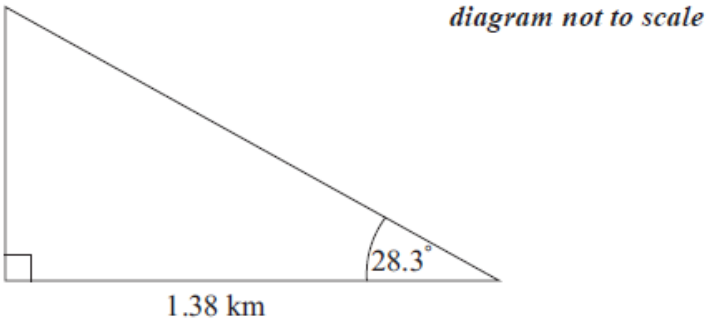
a. Many candidates lost 1 mark in part (a) through not realizing that the derivative of x is 1. As a consequence, $15x^2 - 8x$ proved to be a popular answer.

b. Very few candidates gained the marks in part (b) to find the maximum and minimum point. Although the question indicated to use their answer to part (a), very few candidates set the derivative to zero which would have given them 1 mark. It seemed as if many candidates were trying to use their calculators to find the coordinates but could not find which was the maximum and which was the minimum.

José stands 1.38 kilometres from a vertical cliff.

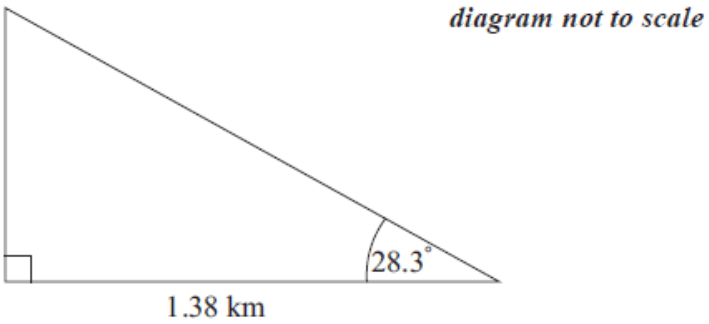
a. Express this distance in metres. [1]

b. José estimates the angle between the horizontal and the top of the cliff as 28.3° and uses it to find the height of the cliff. [3]



Find the height of the cliff according to José's calculation. **Express your answer in metres, to the nearest whole metre.**

c. José estimates the angle between the horizontal and the top of the cliff as 28.3° and uses it to find the height of the cliff. [2]



The actual height of the cliff is 718 metres. Calculate the percentage error made by José when calculating the height of the cliff.

Markscheme

a. 1380 (m) ***(A1)*** ***(C1)***

[1 mark]

b. $1380 \tan 28.3$ ***(M1)***

$= 743.05 \ldots .$ ***(A1)*****(ft)**

$= 743$ (m) ***(A1)*****(ft)** ***(C3)***

Notes: Award ***(M1)*** for correct substitution in tan formula or equivalent, ***(A1)*****(ft)** for their 743.05 seen, ***(A1)*****(ft)** for their answer correct to the nearest m.

[3 marks]

c. $\text{percentage error} = \frac{743.05\ldots - 718}{718} \times 100$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in formula.

= 3.49 % (% *symbol not required*) ***(A1)*****(ft)** ***(C2)***

Notes: Accept 3.48 % for use of 743.

Accept negative answer.

[2 marks]

Examiners report

a. This question was well answered by the majority of candidates although it was surprising to find some who could not express the given distance in metres. Where working was present, follow through marks could be awarded in the remainder of the question. Most candidates could give their answer correct to the nearest metre and find the percentage error correctly, using the formula. A common error was to use the calculated value in the denominator.

b. This question was well answered by the majority of candidates although it was surprising to find some who could not express the given distance in metres. Where working was present, follow through marks could be awarded in the remainder of the question. Most candidates could give their answer correct to the nearest metre and find the percentage error correctly, using the formula. A common error was to use the calculated value in the denominator.

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Ross is a star that is 82 414 080 000 000 km away from Earth. A spacecraft, launched from Earth, travels at 48 000 kmh^{-1} towards Ross.

a. Calculate the **exact** time, in hours, for the spacecraft to reach the star Ross. [2]

b. Give your answer to part (a) in years. (Assume 1 year = 365 days) [2]

c. Give your answer to part (b) in the form $a\times10^k$, where $1 \le a < 10$ and $k \in \mathbb{Z}$. [2]

Markscheme

a. $\frac{82\ 414\ 080\ 000\ 000}{48\ 000}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in correct formula.

1 716 960 000 (hours) ***(A1)*** ***(C2)***

[2 marks]

b. $\frac{\text{their (a)}}{24\times365}$ ***(M1)***

196 000 (years) ***(A1)*****(ft)** ***(C2)***

Note: Award ***(A1)*****(ft)** from their part (a).

[2 marks]

c. 1.96×10^5 ***(A1)*****(ft)*****(A1)*****(ft)** ***(C2)***

Note: Award ***(A1)*****(ft)** for 1.96 (accept 1.96000), ***(A1)*****(ft)** for 10^5 . Follow through from their answer to part (b).

[2 marks]

Examiners report

a. (a) The large numbers given in the stem of this question led to some candidates being a factor of 10 out in their answer to part (a) and therefore losing at least the A mark. Errors were compounded in this first part of the question with some candidates dividing by 48000^{-1} which effectively meant multiplying by 48000. Much good work, however, was seen in the remaining two parts of the question with candidates well able to show a correct standard form from their figures.

b. (a) The large numbers given in the stem of this question led to some candidates being a factor of 10 out in their answer to part (a) and therefore losing at least the A mark. Errors were compounded in this first part of the question with some candidates dividing by 48000^{-1} which effectively meant multiplying by 48000. Much good work, however, was seen in the remaining two parts of the question with candidates well able to show a correct standard form from their figures.

c. (a) The large numbers given in the stem of this question led to some candidates being a factor of 10 out in their answer to part (a) and therefore losing at least the A mark. Errors were compounded in this first part of the question with some candidates dividing by 48000^{-1} which effectively meant multiplying by 48000. Much good work, however, was seen in the remaining two parts of the question with candidates well able to show a correct standard form from their figures.

Dumisani has received a scholarship of 5000 US dollars (USD) to study in Singapore.

He has to travel from South Africa and must change USD for his air fare of 6600 South African rand (ZAR).
The exchange rate is 1USD = 8.2421 ZAR.
In this question give all answers correct to two decimal places.

a. Calculate the number of USD that Dumisani must change to pay for his air fare. [2]

b. On arrival in Singapore, Dumisani changes 3000 USD to Singapore dollars (SGD) to pay for his school fees. There is a 2.8% commission charged on the exchange. [2]

Calculate the value, **in USD**, of the commission that Dumisani has to pay.

c. The exchange rate is $1\ \text{USD} = 1.29903\ \text{SGD}$. [2]

Calculate the number of SGD Dumisani receives.

Markscheme

a. $6600 \times \frac{1}{8.2421}$ ***(M1)***

$= 800.77$ ***(A1)*** ***(C2)***

[2 marks]

b. 3000×0.028 ***(M1)***

$= 84.00$ (accept 84) ***(A1)*** ***(C2)***

[2 marks]

c. $(3000 - 84) \times 1.29903$ ***(M1)***

OR

$3000 \times 1.29903 \times 0.972$ ***(M1)***

$= 3787.97$ ***(A1)*****(ft)** ***(C2)***

Notes: Follow through from their answer to part (b).

Note: Do not penalize in part (c) if conversion process has been reversed consistently ie, multiplication by 8.2421 in part (a) and division by 1.29903 in part (c).

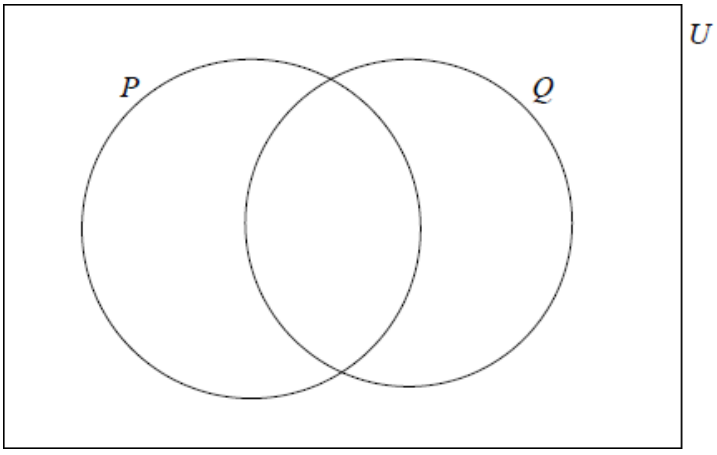
[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

The sets P, Q and U are defined as

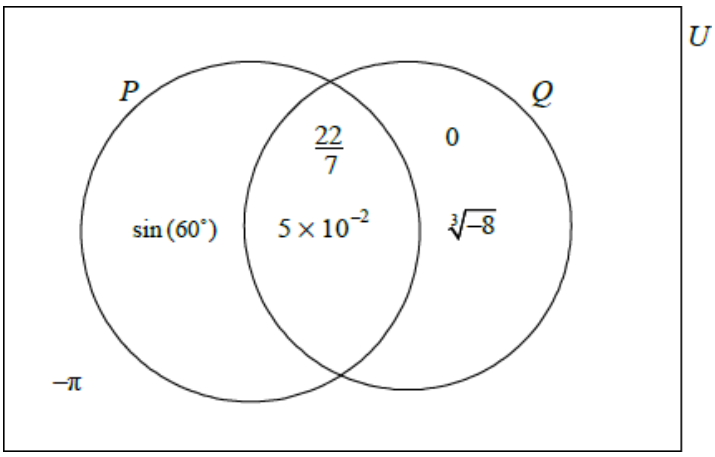
U = {Real Numbers} , *P* = {Positive Numbers} and *Q* = {Rational Numbers}.



Write down in the correct region on the Venn diagram the numbers

$\frac{22}{7}$, 5×10^{-2} , $\sin(60^\circ)$, 0 , $\sqrt[3]{-8}$, $-\pi$.

Markscheme



(A1)(A1)(A1)(A1)(A1)(A1) ***(C6)***

Note: Award ***(A1)*** for each number placed once in the correct region. Accept equivalent forms for numbers.

[6 marks]

Examiners report

Very few candidates gained full marks in this question. A common error turned out to be that $\frac{22}{7}$ and 5×10^{-2} were not considered rational numbers. Also, 0 and $\sin(60^\circ)$ were often placed incorrectly. However, it was encouraging that very few candidates placed values in more than one region.

In this question give all answers correct to two decimal places.

Javier takes 5000 US dollars (USD) on a business trip to Venezuela. He exchanges 3000 USD into Venezuelan bolívars (VEF).
The exchange rate is 1 USD $=$ 6.3021 VEF.

During his time in Venezuela, Javier spends 1250 USD and 12 000 VEF. On his return home, Javier exchanges his remaining VEF into USD.

The exchange rate is 1 USD $=$ 8.7268 VEF.

a. Calculate the amount of VEF that Javier receives. [2]

b. Calculate the total amount, in USD, that Javier has remaining from his 5000 USD after his trip to Venezuela. [4]

Markscheme

a. **The first answer not given correct to two decimal places is not awarded the final *(A1)*.**

Incorrect rounding is not penalized thereafter.

3000×6.3021 ***(M1)***

Note: Award ***(M1)*** for multiplying 3000 by 6.3021.

$= 18906.30$ ***(A1)*** ***(C2)***

[2 marks]

b. $\frac{18906.30-12000}{8.7268} + (2000 - 1250)$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for subtracting 12 000 from their answer to part (a) OR for 6906.30 seen, ***(M1)*** for dividing their amount by 8.7268 (can be implied if 791.389… seen) and ***(M1)*** for $2000 - 1250$ ***OR*** 750 seen.

$= 1541.39$ ***(A1)*****(ft)** ***(C4)***

Note: Follow through from part (a).

[4 marks]

Examiners report

a. [N/A]
b. [N/A]

---

a. The length of one side of a rectangle is 2 cm longer than its width. [1]

If the smaller side is *x* cm, find the perimeter of the rectangle in terms of *x*.

b. The length of one side of a rectangle is 2 cm longer than its width. [1]

The perimeter of a square is equal to the perimeter of the rectangle in part (a).

Determine the length of each side of the square in terms of *x*.

c. The length of one side of a rectangle is 2 cm longer than its width. [4]

The perimeter of a square is equal to the perimeter of the rectangle in part (a).

The sum of the areas of the rectangle and the square is $2x^2 + 4x + 1$ (cm^2).

(i) Given that this sum is 49 cm^2, find *x*.

(ii) Find the area of the square.

Markscheme

a. ***Unit penalty (UP) is applicable where indicated in the left hand column.***

(UP) $\mathrm{P}\,(\text{rectangle}) = 2x + 2(x + 2) = 4x + 4\text{ cm}$ ***(A1)*** ***(C1)***

(UP) *Simplification not required*

[1 mark]

b. ***Unit penalty (UP) is applicable where indicated in the left hand column.***

(UP) Side of square = (4*x* + 4)/4 = *x* + 1 cm ***(A1)*****(ft)** ***(C1)***

[1 mark]

c. (i) $2x^2 + 4x + 1 = 49$ or equivalent ***(M1)***

$(x + 6)(x - 4) = 0$

$x = -6$ and 4 ***(A1)***

*Note: award **(A1)** for the values or for correct factors*

Choose $x = 4$ ***(A1)*****(ft)**

*Award **(A1)**(ft) for choosing positive value.* ***(C3)***

(ii) $\text{Area of square} = 5 \times 5 = 25 \text{ cm}^2$ ***(A1)*****(ft)**

Note: Follow through from both (b) and (c)(i). ***(C1)***

[4 marks]

Examiners report

a. a) and b) Two thirds of the candidates found the perimeter of the rectangle and the side of the square correctly, though most of them did not include units (thereby incurring a unit penalty).

b. a) and b) Two thirds of the candidates found the perimeter of the rectangle and the side of the square correctly, though most of them did not include units (thereby incurring a unit penalty).

c. c) Although a majority of candidates produced the quadratic equation many were unable to solve it correctly. This could easily be done using the GDC so it was disappointing.

A hydraulic hammer drives a metal post vertically into the ground by striking the top of the post. The distance that the post is driven into the ground, by the $n\text{th}$ strike of the hammer, is d_n.

The distances $d_1,\ d_2,\ d_3\ \ldots,\ d_n$ form a geometric sequence.

The distance that the post is driven into the ground by the first strike of the hammer, d_1, is 64 cm.

The distance that the post is driven into the ground by the second strike of the hammer, d_2, is 48 cm.

a. Find the value of the common ratio for this sequence. [2]

b. Find the distance that the post is driven into the ground by the eighth strike of the hammer. [2]

c. Find the **total depth** that the post has been driven into the ground after 10 strikes of the hammer. [2]

Markscheme

a. $48 = 64r$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into geometric sequence formula.

$= 0.75 \left(\frac{3}{4},\ \frac{48}{64}\right)$ ***(A1)*** ***(C2)***

[2 marks]

b. $64 \times (0.75)^7$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into geometric sequence formula or list of eight values using their r. Follow through from part (a), only if answer is positive.

$= 8.54\ (\text{cm})\ (8.54296\ldots\ \text{cm})$ ***(A1)*(ft)** ***(C2)***

[2 marks]

c. $\text{depth} = \frac{64\left(1-(0.75)^{10}\right)}{1-0.75}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into geometric series formula. Follow through from part (a), only if answer is positive.

$= 242(\text{cm})\ (241.583\ldots)$ ***(A1)*(ft)** ***(C2)***

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

In an arithmetic sequence, the fifth term, u_5, is greater than the first term, u_1. The difference between these terms is 36.

a. Find the common difference, *d*. [2]

b. The tenth term of the sequence is double the seventh term. [4]

(i) Write down an equation in u_1 and *d* to show this information.

(ii) Find u_1.

Markscheme

a. $u_1 + 4d - u_1 = 36$ ***(M1)***

Note: Accept equivalent forms including the use of a instead of u_1.

$(d =)9$ ***(A1)*** ***(C2)***

b. (i) $u_{10} = 2u_7$ ***(M1)***

Note: Award ***(M1)*** for correct use of 2 (may be implied).

$u_1 + 9d = 2[u_1 + 6d]$ ***(A1)***

Notes: Accept equivalent forms. Award ***(M1)(A0)*** for $a + 9d = 2[a + 6d]$.

(ii) $u_1 + 81 = 2u_1 + 108$ ***(M1)***

$(u_1 =) - 27$ ***(A1)*(ft)** ***(C4)***

Notes: Follow through from their *d* found in part (a) and equation in (b)(i). Do not penalize further use of a instead of u_1.

Examiners report

a. Some candidates confused geometric sequence with arithmetic sequence. Candidates found the algebraic manipulations difficult so scores on this question were weak.

b. Some candidates confused geometric sequence with arithmetic sequence. Candidates found the algebraic manipulations difficult so scores on this question were weak.

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a. Obi travels from Dubai to Pretoria and changes 2000 United Arab Emirates Dirham (AED) at a bank. He receives 6160 South African Rand (ZAR). [2]

The exchange rate is $1\ \mathrm{AED} = x\ \mathrm{ZAR}$.

Calculate the value of x .

b. Obi decides to invest half of the money he receives, $3080\ \mathrm{ZAR}$, in an account which pays a nominal interest rate of $9\ \%$, **compounded monthly**. [4]

The amount of money in the account will have doubled before the end of the $n\mathrm{th}$ year of the investment.

Calculate the minimum value of n .

Markscheme

a. $\frac{6160}{2000}$ ***(M1)***

$= 3.08$ ***(A1)*** ***(C2)***

Note: Award ***(M1)*** for correct division.

b. $3080\left(1+\frac{9}{12\times 100}\right)^{n\times 12}=6160$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution into compound interest formula equated to 6160, ***(A1)*** for correct substitution.

OR

$I=9$

$PV=\pm 3080$

$FV=\mp 6160$

$P/Y=1$

$C/Y=12$ ***(A1)(M1)***

Note: Award ***(A1)*** for $C/Y=12$ seen, ***(M1)*** for other correct entries.
FV and PV must have opposite sign.

$=7.73048...$ ***(A1)***

$=8$ ***(A1)*****(ft)** ***(C4)***

Note: Award the final ***(A1)*****(ft)** for the correct rounding **up**, of their unrounded answer, to complete years.

Examiners report

a. Question 10: Currency conversion and compound interest.

Currency conversion was done well by all but the weakest candidates. Most of the candidates that used the compound interest formula did a correct substitution but some did not equate this to the future value and found solving an equation to be challenging. Candidates that used the financial application on their GDC almost always wrote down a correct unrounded answer.

b. Question 10: Currency conversion and compound interest.

Currency conversion was done well by all but the weakest candidates. Most of the candidates that used the compound interest formula did a correct substitution but some did not equate this to the future value and found solving an equation to be challenging. Candidates that used the financial application on their GDC almost always wrote down a correct unrounded answer.

Consider the following sequence:

57, 55, 53 ..., 5, 3

a. Find the number of terms of the sequence. [3]

b. Find the sum of the sequence. [3]

Markscheme

a. 3 = 57 + (*n* − 1) × (−2)

OR

57 = 3 + (*n* − 1) × (2) ***(A1)(M1)***

Note: Award ***(A1)*** for 3 **or** 57 seen as u_n, ***(M1)*** for correctly substituted formula or list of values seen.

$n = 28$ ***(A1)*** ***(C3)***

[3 marks]

b. $S_{28} = \frac{28}{2}(57 + 3)$

OR

$S_{28} = \frac{28}{2}(2(57) + (28 - 1) \times -2)$

OR

$S_{28} = \frac{28}{2}(2(3) + (28 - 1) \times 2)$ ***(M1)(A1)*****(ft)**

Note: ***(A1)*****(ft)** for 28 seen.

Award ***(M1)*** for correctly substituted formula or list of values seen.

$S_{28} = 840$ ***(A1)*****(ft)** ***(C3)***

[3 marks]

Examiners report

a. Most candidates recognised the arithmetic sequence and used the correct formula, although some used a list to find the answers. A common error was to use the common difference as 2 rather than −2. Many candidates were awarded follow through marks in part (b), correctly using their incorrect value of *n* from part (a).

b. Most candidates recognised the arithmetic sequence and used the correct formula, although some used a list to find the answers. A common error was to use the common difference as 2 rather than −2. Many candidates were awarded follow through marks in part (b), correctly using their incorrect value of n from part (a).

Given $p = x - \frac{\sqrt{y}}{z}$, $x = 1.775$, $y = 1.44$ and $z = 48$.

a. Calculate the value of p. [2]

b. Barry **first** writes x , y and z correct to one significant figure and **then** uses these values to estimate the value of p . [2]

(i) Write down x , y and z each correct to one significant figure.

(ii) Write down Barry's estimate of the value of p .

c. Calculate the percentage error in Barry's estimate of the value of p . [2]

Markscheme

a. $p = 1.775 - \frac{\sqrt{1.44}}{48}$ ***(M1)***

Note: Award ***(M1)*** for correctly substituted equation for p.

$= 1.75 \left(1.750, \frac{7}{4}\right)$ ***(A1)(C2)***

[2 marks]

b. (i) $x = 2, y = 1, z = 50$ ***(A1)***

(ii) $p = 1.98 \left(\frac{99}{50}\right)$ ***(A1)*(ft)** ***(C2)***

Note: Follow through from part (b)(i), irrespective of whether working is shown.

Note: If 2 s.f. used throughout part (b)(i) award ***(A1)*(ft)** for 1.78 or 1.8.

[2 marks]

c. $\frac{1.98-1.75}{1.75} \times 100$ ***(M1)***

Note: Award ***(M1)*** for correctly substituted $\%$ error formula.

Note: Follow through from parts (a) and (b).

$= 13.1\%$ ***(A1)*(ft)** ***(C2)***

Notes: $\%$ sign not required. Do not accept -13.1%. If 100 missing and incorrect answer, award ***(M0)(A0)***. If 100 missing and answer incorrectly rounded, award ***(M1)(A1)***.

[2 marks]

Examiners report

a. This question was not well answered by the majority of candidates. Candidates encountered difficulty in part b, not being able to express their answer to one significant figure, or used a mixture of one and two significant figures. Follow through marks in parts bii and c were awarded for candidates who showed their working in calculating p and the percentage error.

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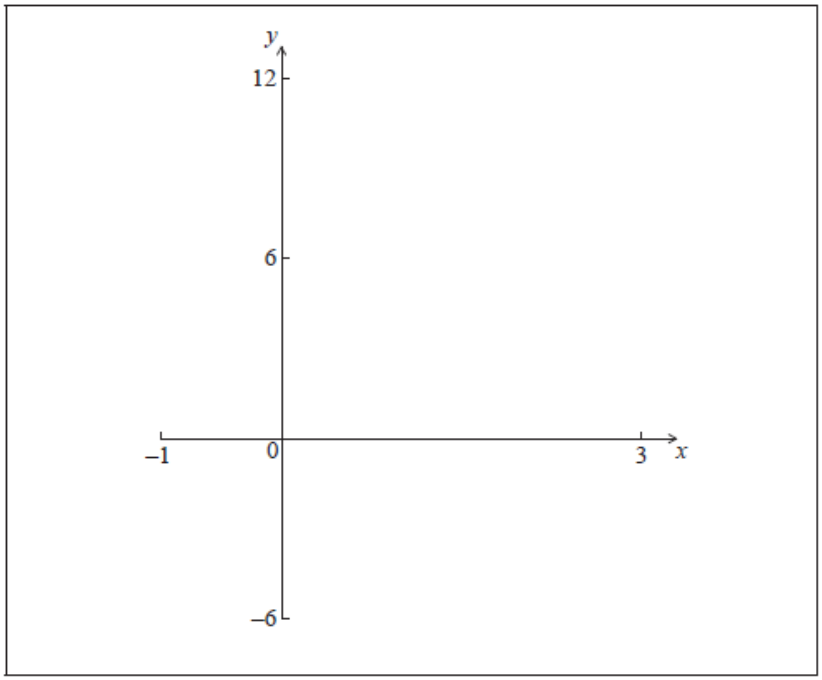
The x-coordinate of the minimum point of the quadratic function $f(x) = 2x^2 + kx + 4$ is $x = 1.25$.

a. (i) Find the value of k . [4]

(ii) Calculate the y-coordinate of this minimum point.

b. Sketch the graph of $y = f(x)$ for the domain $-1 \leqslant x \leqslant 3$. [2]



Markscheme

a. (i) $1.25 = -\frac{k}{2(2)}$ ***(M1)***

OR

$f'(x) = 4x + k = 0$ ***(M1)***

Note: Award ***(M1)*** for setting the gradient function to zero.

$k = -5$ ***(A1)*** ***(C2)***

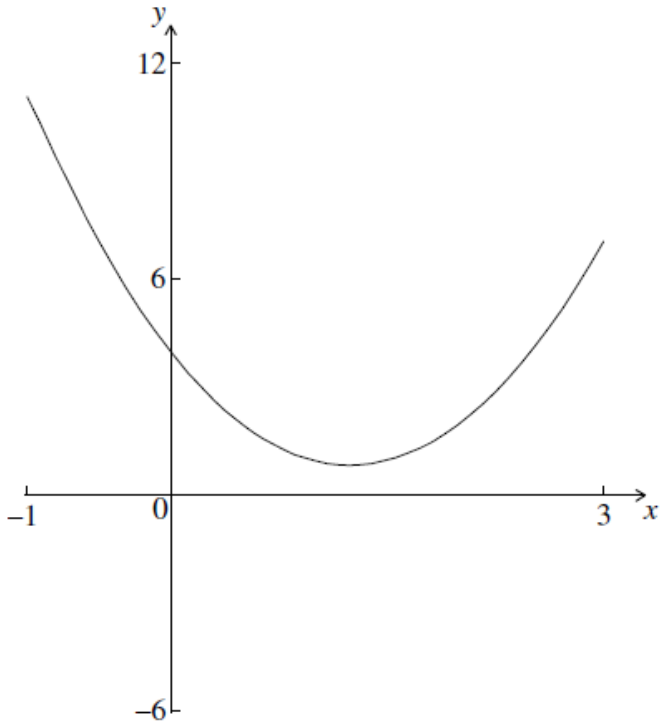
(ii) $2(1.25)^2 - 5(1.25) + 4$ ***(M1)***

$= 0.875$ ***(A1)*(ft)** ***(C2)***

Note: Follow through from their k.

[4 marks]

b.



(A1)*(ft)*(A1)*(ft)** ***(C2)

Notes: Award ***(A1)*(ft)** for a curve with correct concavity consistent with their k passing through (0, 4).

***(A1)*(ft)** for minimum in approximately the correct place. Follow through from their part (a).

[2 marks]

Examiners report

a. This question was not answered well at all except by the more able. Indeed, of the lower quartile of candidates, the maximum mark achieved was only 1. Of those that did make a successful attempt at the question, very few used the fact that $1.25 = -\frac{k}{2(2)}$ preferring instead to differentiate and equate to zero. But such candidates were in the minority as substituting $x = 1.25$ into the given quadratic and equating to zero produced the popular, but erroneous, answer of -5.7. Recovery was possible for the next two marks if this incorrect value had been seen to be substituted into the correct quadratic, along with $x = 1.25$ to arrive at an answer of 0. This would have given (M1)(A1)(ft). However, candidates who had an answer of $k = -5.7$ in part (a)(i), invariably showed no working in part (ii) and consequently earned no marks here. Irrespective of incorrect working in part (a), the quadratic function clearly passes through (0, 4) and has a minimum at $x = 1.25$. Using this information, a minority of candidates picked up at least one of the two marks in part (b).

b. This question was not answered well at all except by the more able. Indeed, of the lower quartile of candidates, the maximum mark achieved was only 1. Of those that did make a successful attempt at the question, very few used the fact that $1.25 = -\frac{k}{2(2)}$ preferring instead to differentiate and equate to zero. But such candidates were in the minority as substituting $x = 1.25$ into the given quadratic and equating to zero produced the popular, but erroneous, answer of -5.7. Recovery was possible for the next two marks if this incorrect value had been seen to be substituted into the correct quadratic, along with $x = 1.25$ to arrive at an answer of 0. This would have given (M1)(A1)(ft). However, candidates who had an answer of $k = -5.7$ in part (a)(i), invariably showed no working in part (ii) and consequently earned no marks here. Irrespective of incorrect working in part (a), the quadratic function clearly passes through (0, 4) and has a minimum at $x = 1.25$. Using this information, a minority of candidates picked up at least one of the two marks in part (b).

Tomás is playing with sticks and he forms the first three diagrams of a pattern. These diagrams are shown below.

Tomás continues forming diagrams following this pattern.

Tomás forms a total of 24 diagrams.

a. Diagram n is formed with 52 sticks. Find the value of n. [3]

b. Find the total number of sticks used by Tomás for all 24 diagrams. [3]

Markscheme

a. $4 + 3(n - 1) = 52$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution into the formula of the nth term of an arithmetic sequence, ***(A1)*** for correct substitution.

$n = 17$ ***(A1)*** ***(C3)***

[3 marks]

b. $\frac{24}{2}(2 \times 4 + 23 \times 3)$ **OR** $\frac{24}{2}(4 + 73)$ ***(M1)(A1)*****(ft)**

Notes: Award ***(M1)*** for substitution into the sum of the first n terms of an arithmetic sequence formula, ***(A1)*****(ft)** for their correct substitution, consistent with part (a).

924 ***(A1)*****(ft)** ***(C3)***

Note: Follow through from part (a).

[3 marks]

Examiners report

a. [N/A]
b. [N/A]

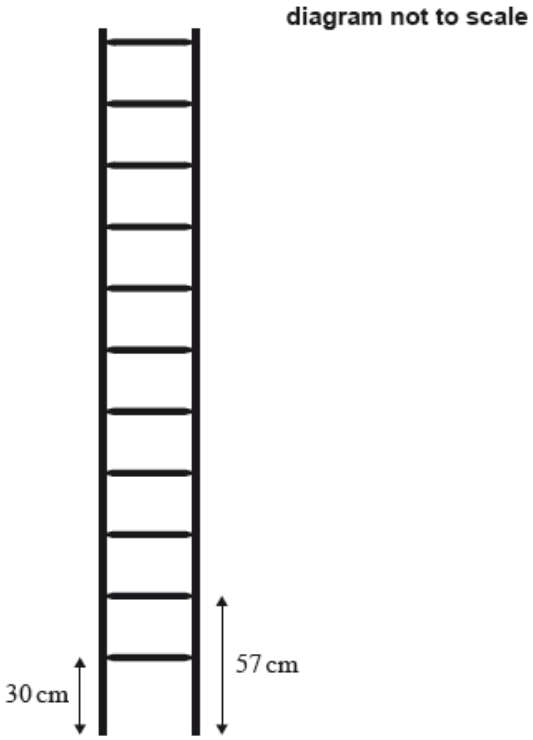
The company Snakezen's Ladders makes ladders of different lengths. All the ladders that the company makes have the same design such that:

the first rung is 30 cm from the base of the ladder,

the second rung is 57 cm from the base of the ladder,

the distance between the first and second rung is equal to the distance between all adjacent rungs on the ladder.

The ladder in the diagram was made by this company and has eleven equally spaced rungs.



a. Find the distance from the base of this ladder to the top rung. [3]

b. The company also makes a ladder that is 1050 cm long. [3]

Find the maximum number of rungs in this 1050 cm long ladder.

Markscheme

a. $30 + (11 - 1) \times 27$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted arithmetic sequence formula, ***(A1)*** for correct substitutions.

$= 300\ (\text{cm})$ ***(A1)*** ***(C3)***

Note: Units are not required.

[3 marks]

b. $1050 \geqslant 30 + (n - 1) \times 27$ ***(M1)(A1)*****(ft)**

Note: Award ***(M1)*** for substituted arithmetic sequence formula $\leqslant 1050$, accept an equation, ***(A1)*** for correct substitutions.

$n = 38$ ***(A1)*****(ft)** ***(C3)***

Note: Follow through from their 27 in part (a). The answer must be an integer and rounded down.

[3 marks]

Examiners report

a. [N/A]
b. [N/A]

Inge borrows € 4500 for 2 years.

Bank 1 charges compound interest at a rate of 15 % per annum, compounded quarterly.

Calculate the **total** amount to be repaid at the end of the 2 years. **Give your answer correct to two decimal places**.

Markscheme

Note: Financial penalty (FP) applies in this part

$A = 4500\left(1 + \frac{15}{400}\right)^{4\times 2}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution into CI formula, ***(A1)*** for correct substitution.

(FP) *A* = € 6041.12 *(€ not required)* ***(A1)*** ***(C3)***

[3 marks]

Examiners report

This is a question that has been tested before but few candidates managed to gain full marks. Compounding the interest quarterly and using the correct compound interest formula appeared to challenge many candidates.

Mandzur, a farmer, takes out a loan to buy a buffalo. He borrows 900 000 Cambodian riels (KHR) for 2 years. The nominal annual interest rate is 15%, compounded **monthly**.

a. Find the amount of the **interest** that Mandzur must pay. Give your answer correct to the nearest 100 KHR. [4]

b. Write down your answer to part (a) in the form $a \times 10^k,\ \text{where } 1 \leqslant a < 10,\ k \in \mathbb{Z}$. [2]

Markscheme

a. $FV = 900000\left(1 + \frac{15}{12 \times 100}\right)^{24}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution in the compound interest formula (either FV or interest), do not penalize if $-PV$ not seen.

Award ***(A1)*** for correct substitution.

OR

$\mathrm{N} = 2$

$\mathrm{I}\% = 15$

$\mathrm{PV} = 900\,000$

$\mathrm{P/Y} = 1$

$\mathrm{C/Y} = 12$ ***(A1)(M1)***

Note: Award ***(A1)*** for $\mathrm{C/Y} = 12$ seen, ***(M1)*** for other correct entries.

OR

$\mathrm{N} = 24$

$\mathrm{I}\% = 15$

$\mathrm{PV} = 900\,000$

$\mathrm{P/Y} = 12$

$\mathrm{C/Y} = 12$ ***(A1)(M1)***

Note: Award ***(A1)*** for $\mathrm{C/Y} = 12$ seen, ***(M1)*** for other correct entries.

$\text{interest} = 321615.945$ ***(A1)***

$= 312\,600 \quad (\mathrm{KHR})$ ***(A1)*(ft)** ***(C4)***

Notes: Award the final ***(A1)*** for the correct rounding of their unrounded answer.

If final amount is 1212600 and working is shown award ***(M1)(A1)(A0)(A1)*(ft)**.

Award ***(A2)*** for $(FV =)\ 1212600$ if no working is seen.

b. 3.126×10^5 ***(A1)*(ft)*(A1)*(ft)** ***(C2)***

Notes: Award ***(A1)*(ft)** for their $3.126\ (3.13)$, ***(A1)*(ft)** for $\times 10^5$.

Follow through from part (a).

Examiners report

a. [N/A]
b. [N/A]

Consider the numbers $\sqrt{3}$, 6, $2\frac{1}{2}$, π, -5, and the sets $\mathbb{N}$, $\mathbb{Z}$, and $\mathbb{Q}$. Complete the following table by placing a tick in the appropriate box if the number is an element of the set.

	$\sqrt{3}$	6	$2\frac{1}{2}$	π	-5
$\mathbb{N}$					
$\mathbb{Z}$					
$\mathbb{Q}$					

Markscheme

	$\sqrt{3}$	6	$2\frac{1}{2}$	π	-5
$\mathbb{N}$		✔			
$\mathbb{Z}$		✔			✔
$\mathbb{Q}$		✔	✔		✔

Note: Accept any symbol for ticks. Do not penalize if candidate had also indicated, by a different symbol, that the number is not an element of the set.

Row $\mathbb{N}$ correct, no extra entries. ***(A1)*** ***(C1)***

Row $\mathbb{Z}$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for each correct tick and no extra entries. Award ***(A1)*** only for both ticks correct and 1 extra entry, ***(A0)*** otherwise.

Row $\mathbb{Q}$ ***(A1)(A1)(A1)*** ***(C3)***

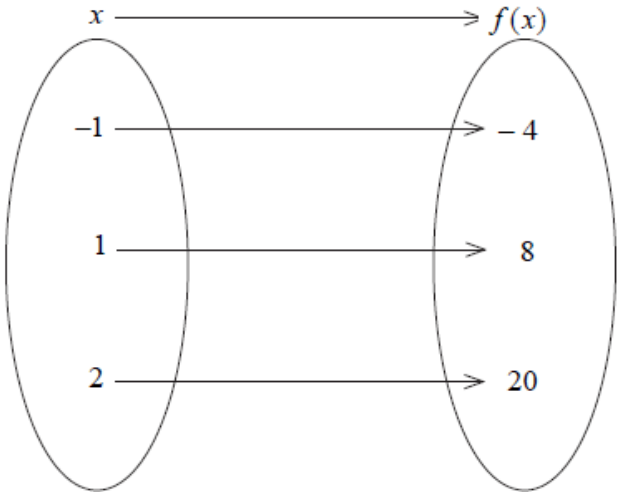
Note: Award ***(A1)*** for each correct tick and no extra entries. Award ***(A2)*** only for all 3 correct and one extra entry. Award ***(A1)*** only for 2 correct and one extra entry. ***(A0)*** otherwise.

[6 marks]

Examiners report

This question was poorly answered with many thinking $\mathbb{Q}$ was the set of irrational numbers. Very few candidates were awarded full marks for this question.

A quadratic function, $f(x) = ax^2 + bx$, is represented by the mapping diagram below.



a. Use the mapping diagram to write down **two** equations in terms of *a* and *b*. [2]

b.i. Find the value of *a*. [1]

b.ii. Find the value of *b*. [1]

c. Calculate the *x*-coordinate of the vertex of the graph of *f* (*x*). [2]

Markscheme

a. $4a + 2b = 20$

$a + b = 8$ ***(A1)***

$a - b = -4$ ***(A1)*** ***(C2)***

Note: Award ***(A1)(A1)*** for any two of the given or equivalent equations.

[2 marks]

b.i. $a = 2$ ***(A1)*****(ft)**

[1 mark]

b.ii. $b = 6$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from their (a).

[1 mark]

c. $x = -\frac{6}{2(2)}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in correct formula.

$= -1.5$ ***(A1)*****(ft)** ***(C2)***

[2 marks]

Examiners report

a. Most candidates attempted this question but very few of them completed it entirely. A number of students wrote incorrect equations in part (a), which shows that the mapping diagram was poorly understood and read. Part (c) proved to be difficult for many who didn't know how to find the x-coordinate of the vertex of the graph of the function. Some students gave the two coordinates instead of the x-coordinate only.

b.i. Most candidates attempted this question but very few of them completed it entirely. A number of students wrote incorrect equations in part (a), which shows that the mapping diagram was poorly understood and read. Part (c) proved to be difficult for many who didn't know how to find the x-coordinate of the vertex of the graph of the function. Some students gave the two coordinates instead of the x-coordinate only.

b.ii. Most candidates attempted this question but very few of them completed it entirely. A numberof students wrote incorrect equations in part (a), which shows that the mapping diagram was poorly understood and read. Part (c) proved to be difficult for many who didn't know how to find the x-coordinate of the vertex of the graph of the function. Some students gave the two coordinates instead of the x-coordinate only.

c. Most candidates attempted this question but very few of them completed it entirely. A number of students wrote incorrect equations in part (a), which shows that the mapping diagram was poorly understood and read. Part (c) proved to be difficult for many who didn't know how to find the x-coordinate of the vertex of the graph of the function. Some students gave the two coordinates instead of the x-coordinate only.

The number of cells, C, in a culture is given by the equation $C = p \times 2^{0.5t} + q$, where t is the time in hours measured from 12:00 on Monday and p and q are constants.

The number of cells in the culture at 12:00 on Monday is 47.
The number of cells in the culture at 16:00 on Monday is 53.

a. Use the above information to write down two equations in p and q ; [2]

b. Use the above information to calculate the value of p and of q ; [2]

c. Use the above information to find the number of cells in the culture at 22:00 on Monday. [2]

Markscheme

a. $p + q = 47$ ***(A1)***

$4p + q = 53$ ***(A1)*** ***(C2)***

[2 marks]

b. Reasonable attempt to solve their equations ***(M1)***

$p = 2$, $q = 45$ ***(A1)*** ***(C2)***

Note: Accept only the answers $p = 2$, $q = 45$.

[2 marks]

c. $C = 2 \times 2^{0.5(10)} + 45$ ***(M1)***

$C = 109$ ***(A1)*(ft)** ***(C2)***

Note: Award ***(M1)*** for substitution of 10 into the formula with their values of p and q.

[2 marks]

Examiners report

a. Concern was expressed about the wording of the question; answers were given great leeway by examiners and suggestions for wording are welcome. The 24 hour clock method of describing time is the norm in IB examinations. It should be recognised that the purpose of this question was to discriminate at the grade 6/7 level.

The concept of the zero index was not understood by many.

b. Concern was expressed about the wording of the question; answers were given great leeway by examiners and suggestions for wording are welcome. The 24 hour clock method of describing time is the norm in IB examinations. It should be recognised that the purpose of this question was to discriminate at the grade 6/7 level.

The use of the GDC was (as always) expected in solving the simultaneous equations.

c. Concern was expressed about the wording of the question; answers were given great leeway by examiners and suggestions for wording are welcome. The 24 hour clock method of describing time is the norm in IB examinations. It should be recognised that the purpose of this question was to discriminate at the grade 6/7 level.

Working was required for follow through in this part.

The speed of light is $300\,000$ kilometres per second. The average distance from the Sun to the Earth is 149.6 million km.

A light-year is the distance light travels in one year and is equal to $9\,467\,280$ million km. Polaris is a bright star, visible from the Northern Hemisphere. The distance from the Earth to Polaris is 323 light-years.

a. Calculate the time, **in minutes**, it takes for light from the Sun to reach the Earth. [3]

b. Find the distance from the Earth to Polaris in millions of km. Give your answer in the form $a \times 10^k$ with $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. [3]

Markscheme

a. $\frac{149600000}{300000 \times 60}$ ***(M1)(M1)***

Note: Award ***(M1)*** for dividing the **correct** numerator (which can be presented in a different form such as 149.6×10^6 or 1.496×10^8) by $300\,000$ and ***(M1)*** for dividing by 60.

$= 8.31 \text{ (minutes)} \ (8.31111\ldots, 8 \text{ minutes } 19 \text{ seconds})$ ***(A1)*** ***(C3)***

[3 marks]

b. $323 \times 9467\,280$ ***(M1)***

Note: Award ***(M1)*** for multiplying 323 by $9\,467\,280$, seen with **any** power of 10; therefore only penalizing incorrect power of 10 once.

$= 3.06 \times 10^9 \ (= 3.05793\ldots \times 10^9)$ ***(A1)(A1)*** ***(C3)***

Note: Award ***(A1)*** for 3.06.

Award ***(A1)*** for $\times 10^9$

Award ***(A0)(A0)*** for answers of the type: 30.6×10^8

[3 marks]

Examiners report

a. [N/A]
b. [N/A]

In this question give all answers correct to the nearest whole number.

a. Fumie is going for a holiday to Great Britain. She changes $100\,000$ Japanese Yen (JPY) into British Pounds (GBP) with no commission charged. [2]

The exchange rate between GBP and JPY is

1 GBP = 129 JPY.

Calculate the value of $100\,000$ JPY in GBP.

b. At the end of Fumie's holiday in Great Britain she has 239 GBP. She converts this back to JPY at a bank, which does not charge commission, [4]

and receives 30 200 JPY

(i) Find the exchange rate of this second transaction.

(ii) Determine, when changing GBP back to JPY, whether the exchange rate found in part (b)(i) is better value for Fumie than the exchange rate in part (a). Justify your answer.

Markscheme

a. $\frac{100\,000}{129}$ ***(M1)***

$= 775 \text{ (GBP)}$ ***(A1)*** ***(C2)***

[2 marks]

b. (i) $\frac{30\,200}{239}$ ***(M1)***

$1\text{ GBP} = 126\text{ JPY}$ ***(A1)***

Note: Accept $126\,(\text{JPY})$.

Award ***(M1)*** for $\frac{239}{30\,300}$.

Award ***(A0)*** for $1\text{ JPY} = 0\text{ GBP}$

(ii) No, the part (b)(i) rate is not better value than the part (a) rate. ***(A1)*****(ft)**

$30\,200 < 30\,831$ ***(R1)***

OR

No, the part (b)(i) rate is not better value than the part (a) rate. ***(A1)*****(ft)**

$129 > 126$ ***(R1)*** ***(C4)***

Note: Accept "part (a) rate is better" for the ***(A1)*****(ft)**.

Follow through from part (b)(i).

A numerical comparison must be seen to award ***(R1)***.

[4 marks]

Examiners report

a. [N/A]
b. [N/A]

Arthur and Jacob dream of owning a speedboat that costs $35\,300$ euros (EUR).

Arthur invested x EUR in an account that pays a nominal annual interest rate of 3.6%, compounded **monthly**. After 18 years he will have $35\,300$ EUR in the account.

Jacob invested 9000 EUR for n years. The investment has a nominal annual interest rate of 3.2% and is compounded **quarterly**. After n years, the investment will be worth $35\,300$ EUR.

a. Calculate the value of Arthur's initial investment, x. Give your answer to two decimal places. [3]

b. Find the value of n. [3]

Markscheme

a. $35\,300 = PV\left(1 + \frac{3.6}{100\times 12}\right)^{12\times 18}$ ***(M1)(A1)***

Note: Accept "x" instead of PV. Award ***(M1)*** for substitution into compound interest formula, ***(A1)*** for correct substitution.

OR

$N = 18$

$I\% = 3.6$

$FV = (\pm)35\,300$

$P/Y = 1$

$C/Y = 12$ ***(A1)(M1)***

Note: Award ***(A1)*** for $C/Y = 12$ seen, ***(M1)*** for all other correct entries.

OR

$N = 216$

$I\% = 3.6$

$FV = (\pm)35\,300$

$P/Y = 12$

$C/Y = 12$ ***(A1)(M1)***

Note: Award ***(A1)*** for $C/Y = 12$ seen, ***(M1)*** for all other correct entries.

$PV = 18483.03$ ***(A1)*** ***(C3)***

[3 marks]

b. $35\,300 = 9000\left(1 + \frac{3.2}{100 \times 4}\right)^{4 \times n}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution into compound interest formula and equating to $35\,300$, ***(A1)*** for correct substitution.

OR

$I\% = 3.2$

$PV = (\pm)9000$

$FV = (\mp)35\,300$

$P/Y = 1$

$C/Y = 4$ ***(A1)(M1)***

Note: Award ***(A1)*** for $C/Y = 4$ seen, ***(M1)*** for all other correct entries.

OR

$I\% = 3.2$

$PV = (\pm)9000$

$FV = (\mp)35\,300$

$P/Y = 4$

$C/Y = 4$ ***(A1)(M1)***

Note: Award ***(A1)*** for $C/Y = 4$ seen, ***(M1)*** for all other correct entries.

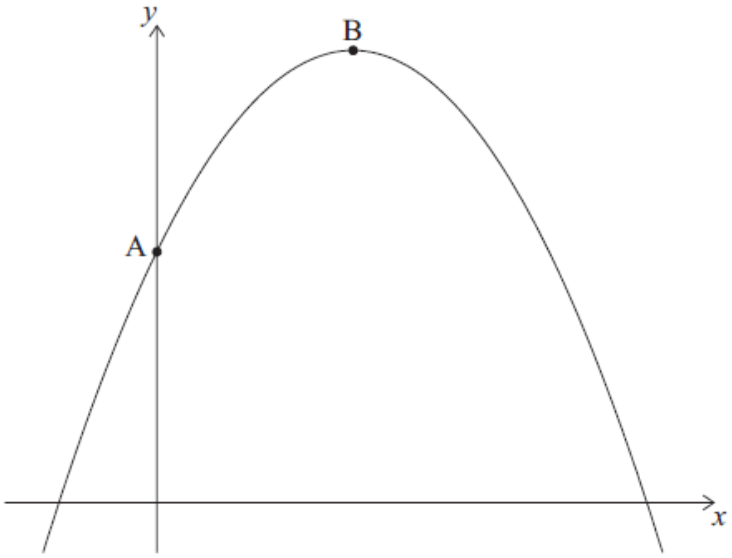
$n = 43$ ***(A1)*** ***(C3)***

[3 marks]

Examiners report

a. [N/A]
b. [N/A]

The graph of the quadratic function $f(x) = c + bx - x^2$ intersects the *y*-axis at point A(0, 5) and has its vertex at point B(2, 9).



a. Write down the value of *c*. [1]

b. Find the value of *b*. [2]

c. Find the *x*-intercepts of the graph of *f* . [2]

d. Write down $f(x)$ in the form $f(x) = -(x - p)(x + q)$. [1]

Markscheme

a. 5 ***(A1)*** ***(C1)***

b. $\frac{-b}{2(-1)} = 2$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in axis of symmetry formula.

OR

$y = 5 + bx - x^2$

$9 = 5 + b(2) - (2)^2$ ***(M1)***

Note: Award ***(M1)*** for correct substitution of 9 and 2 into their quadratic equation.

$(b =)4$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (a).

c. 5, –1 ***(A1)*****(ft)*****(A1)*****(ft)** ***(C2)***

Notes: Follow through from parts (a) and (b), irrespective of working shown.

d. $f(x) = -(x - 5)(x + 1)$ ***(A1)*****(ft)** ***(C1)***

Notes: Follow through from part (c).

Examiners report

a. Many candidates did not see the connection between the *x*-intercepts and the factored form of a quadratic function. The syllabus explicitly sates that the graphs of quadratics should be linked to solutions of quadratic equations by factorizing and vice versa. This was one of the most challenging questions for candidates.

b. Many candidates did not see the connection between the *x*-intercepts and the factored form of a quadratic function. The syllabus explicitly sates that the graphs of quadratics should be linked to solutions of quadratic equations by factorizing and vice versa. This was one of the most challenging questions for candidates.

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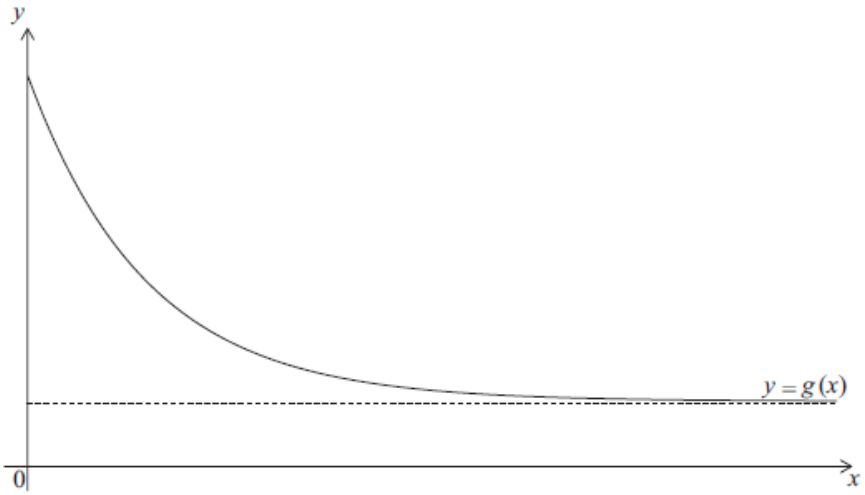
The function $g(x)$ is defined as $g(x) = 16 + k(c^{-x})$ where $c > 0$.

The graph of the function *g* is drawn below on the domain $x \geqslant 0$.



The graph of g intersects the y-axis at $(0, 80)$.

a. Find the value of k . [2]

b. The graph passes through the point (2, 48) . [2]

Find the value of c .

c. The graph passes through the point (2, 48) . [2]

Write down the equation of the horizontal asymptote to the graph of $y = g(x)$.

Markscheme

a. $80 = 16 + k(c^0)$ ***(M1)***

$k = 64$ ***(A1)*** ***(C2)***

[2 marks]

b. $48 = 16 + 64(c^{-2})$ ***(M1)***

Note: Award ***(M1)*** for substitution of their k and (2, 48) into the equation for $g(x)$.

$c = \sqrt{2}$ (1.41) $(1.41421\ldots)$ ***(A1)*****(ft)** ***(C2)***

Notes: Award ***(M1)(A1)*****(ft)** for $c = \pm\sqrt{2}$. Follow through from their answer to part (a).

[2 marks]

c. $y = 16$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for $y =$ a constant, ***(A1)*** for 16.

[2 marks]

Examiners report

a. This was perhaps the most difficult question on the paper. Being the last question some candidates may have felt that they were under pressure to complete and many scripts showed no attempt at an answer to this question. The response by the upper quartile of candidates was quite encouraging with many achieving at least 4 of the 6 marks available. For the rest, many fell at the first hurdle and were unable to obtain a value of k. This, in turn, led to problems in finding c. For a large number of candidates the only mark that they achieved was identifying that the asymptote was a linear equation in y.

b. This was perhaps the most difficult question on the paper. Being the last question some candidates may have felt that they were under pressure to complete and many scripts showed no attempt at an answer to this question. The response by the upper quartile of candidates was quite encouraging with many achieving at least 4 of the 6 marks available. For the rest, many fell at the first hurdle and were unable to obtain a value of k. This, in turn, led to problems in finding c. For a large number of candidates the only mark that they achieved was identifying that the asymptote was a linear equation in y.

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Let $p = \frac{2\cos x - \tan x}{\sqrt{y} - z}$.

a. Calculate the value of p when $x = 45^\circ$, $y = 8192$ and $z = 64$. Write down your full calculator display. [2]

b. Write down your answer to part (a) [4]

(i) correct to two decimal places;

(ii) correct to four significant figures;

(iii) in the form $a \times 10^k$, where $1 \leqslant a < 10,\ k \in \mathbb{Z}$.

Markscheme

a. $\frac{2\cos 45^\circ - \tan 45^\circ}{\sqrt{8192} - 64}$ ***(M1)***

$= 0.015625$ ***(A1)*** ***(C2)***

Notes: Accept $\frac{1}{64}$ and also 1.5625×10^{-2}.

[2 marks]

b. (i) 0.02 ***(A1)*****(ft)**

(ii) 0.01563 ***(A1)*****(ft)**

Notes: For parts (i) and (ii), accept equivalent standard form representations.

(iii) 1.5625×10^{-2} ***(A2)*****(ft)** ***(C4)***

Notes: Award ***(A1)(A0)*** for correct mantissa, between 1 and 10, with incorrect index.

Follow through from their answer to part (a).

Where the candidate has correctly rounded their mantissa from part (a) and has the correct exponent, award ***(A0)(A1)***

Award ***(A0)(A0)*** for answers of the type: 15.625×10^{-3}.

[4 marks]

Examiners report

a. [N/A]
b. [N/A]

Jackson invested 12 000 Australian dollars (AUD) in a bank that offered simple interest at an annual interest rate of r %. The value of Jackson's investment doubled after 20 years.

Maddison invests 15 000 AUD in a bank that offers compound interest at a nominal annual interest rate of 4.44 %, **compounded quarterly**.

Calculate the number of years that it will take for Maddison's investment to triple in value.

Markscheme

$45000 = 15000\left(1 + \frac{4.44}{400}\right)^{4n}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted compound interest formula, ***(A1)*** for a correctly substituted formula and correctly equated to 45 000.

OR

$3 = \left(1 + \frac{4.44}{400}\right)^{4n}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted compound interest formula, ***(A1)*** for a correctly substituted formula and correctly equated to 3.

n = 25 years ***(A1)*** ***(C3)***

Notes: Award ***(A1)(M0)(A0)*** if 24.9 or 24.88 seen as a final answer, with no working seen. Award, at most, ***(A1)(M1)(A0)*** if working is seen and a final answer of 24.9 or 24.88 is given.

[3 marks]

Examiners report

In part (b), writing down any substituted form of the compound interest formula led to a significant number of candidates scoring at least 1 mark for method here. Often, however, the formula was incorrectly substituted or was not correctly equated to 45 000 and subsequent marks were then lost.

The equation of a line L_1 is $2x + 5y = -4$.

a. Write down the gradient of the line L_1. [1]

b. A second line L_2 is perpendicular to L_1. [1]

Write down the gradient of L_2.

c. The point (5, 3) is on L_2. [2]

Determine the equation of L_2.

d. Lines L_1 and L_2 intersect at point P. [2]

Using your graphic display calculator or otherwise, find the coordinates of P.

Markscheme

a. $\frac{-2}{5}$ ***(A1)*** ***(C1)***

b. $\frac{5}{2}$ ***(A1)*****(ft)** ***(C1)***

Note: Follow through from their answer to part (a).

c. $3 = \frac{5}{2} \times 5 + c$ ***(M1)***

Notes: Award ***(M1)*** for correct substitution of their gradient into equation of line. Follow through from their answer to part (b).

$y = \frac{5}{2}x - \frac{19}{2}$ ***(A1)(ft)***

OR

$y - 3 = \frac{5}{2}(x - 5)$ ***(M1)(A1)*****(ft)** ***(C2)***

Notes: Award ***(M1)*** for correct substitution of their gradient into equation of line. Follow through from their answer to part (b).

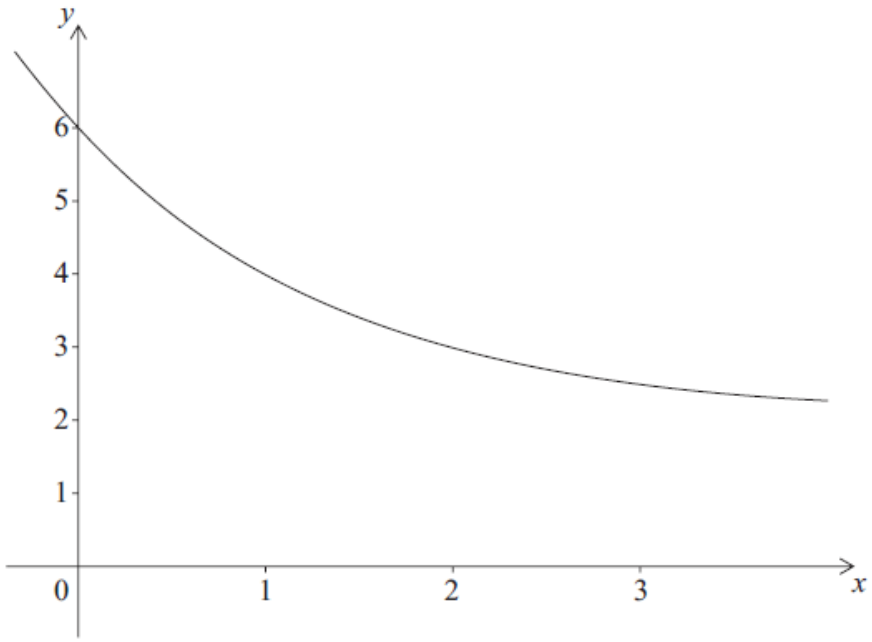
d. (3, –2) ***(A1)*****(ft)*****(A1)*****(ft)** ***(C2)***

Notes: If parentheses not seen award at most ***(A0)(A1)*****(ft)**. Accept $x = 3$, $y = -2$. Follow through from their answer to part (c), even if no working is seen. Award ***(M1)(A1)*****(ft)** for a sensible attempt to solve $2x + 5y = -4$ and their $y = \frac{5}{2}x - \frac{19}{2}$ or equivalent, simultaneously.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]
d. [N/A]

Consider the function $f(x) = p(0.5)^x + q$ where p and q are constants. The graph of $f(x)$ passes through the points $(0, 6)$ and $(1, 4)$ and is shown below.



a. Write down two equations relating p and q. [2]

b. Find the value of p and of q. [2]

c. Write down the equation of the horizontal asymptote to the graph of $f(x)$. [2]

Markscheme

a. $p + q = 6$ ***(A1)***

$0.5p + q = 4$ ***(A1)*** ***(C2)***

Note: Accept correct equivalent forms of the equations.

[2 marks]

b. $p = 4, q = 2$ ***(A1)(A1)*****(ft)** ***(C2)***

Notes: If both answers are incorrect, award ***(M1)*** for attempt at solving simultaneous equations.

[2 marks]

c. $y = 2$ ***(A1)(A1)*****(ft)** ***(C2)***

Notes: Award ***(A1)*** for "y = a constant", ***(A1)*****(ft)** for 2. Follow through from their value for q as long as their constant is greater than 2 and less than 6.

An equation must be seen for any marks to be awarded.

[2 marks]

Examiners report

a. A significant number of candidates found it difficult to identify and write two equations that relate p and q. Many of those who wrote the equations were unable to solve them or use their GDC to find the values of p and q in part b). Although the question in part c) was quite standard, there were many errors in the responses. Many students wrote $x = 2$ or only 2 instead of $y = 2$.

b. A significant number of candidates found it difficult to identify and write two equations that relate p and q. Many of those who wrote the equations were unable to solve them or use their GDC to find the values of p and q in part b). Although the question in part c) was quite standard, there were many errors in the responses. Many students wrote $x = 2$ or only 2 instead of $y = 2$.

c. A significant number of candidates found it difficult to identify and write two equations that relate p and q. Many of those who wrote the equations were unable to solve them or use their GDC to find the values of p and q in part b). Although the question in part c) was quite standard, there were many errors in the responses. Many students wrote $x = 2$ or only 2 instead of $y = 2$.

---

a. Eva invests $\text{USD}2000$ at a nominal annual interest rate of 8% **compounded half-yearly**. [3]

Calculate the value of her investment after 5 years, correct to the nearest dollar.

b. Toni invests $\text{USD}1500$ at an annual interest rate of 7.8% **compounded yearly**. [3]

Find the number of **complete** years it will take for his investment to double in value.

Markscheme

a. $2000(1.04)^{10}$ ***(M1)(A1)***

Note: ***(M1)*** for substitution into CI formula. ***(A1)*** for correct substitution.

2960 ***(A1)***

Note: Award the final ***A1*** for rounding their answer correctly to the nearest Yuan.

OR

$2000\left(1+\frac{8}{200}\right)^{10}-2000$ ***(M1)(A1)***

Note: ***(M1)*** for substitution into CI formula. ***(A1)*** for correct substitution.

2960 ***(A1)*** ***(C3)***

Note: Award the final ***A1*** for rounding their answer correctly to the nearest Yuan.

b. $1500(1.078)^n = 3000$ ***(M1)(M1)***

Note: ***(M1)*** for correct substitution in CI formula, ***(M1)*** for 3000 seen.

$n = 10$ years *(*$n = 9.23$ years *not accepted)* ***(A1)***

OR

$1500(1.078)^n - 1500 = 1500$ ***(M1)(M1)***

Note: ***(M1)*** for correct substitution in CI formula, ***(M1)*** for 1500 seen.

$n = 10$ years *(*$n = 9.23$ years *not accepted)* ***(A1)***

OR

(M2) *for list or graph.* ***(M2)***

$n = 10$ years *(*$n = 9.23$ years *not accepted)* ***(A1)***

Note: If simple interest formula is used in both parts **(a)** and **(b)** then award ***(M0)(M0)(A0)*** in **(a)** and

(b) $1500 = \frac{1500(7.8)n}{100}$ ***(M1)(A1)***

(M1) for substitution in SI formula or lists, ***(A1)*** for correct substitution.

$n = 13$ ***(A1)*** ***(C3)***

Note: Correct answer only. If 9.23 seen without working award ***(A2)***.

Note: If calculator notation is used in either part with correct unrounded answer award ***(A1)*****(d)** only if ***(FP)*** is applied in **(a)** or ***(AP)*** in **(b)**. Otherwise ***(A2)*****(d)** if penalty has already been applied in a previous question.

Examiners report

a. The use of the TVM solver, and consequent lack of working, was a source of concern; candidates are advised still to write down substituted formulas prior to using the TVM solver.

The use of 8% in the second part was a common error. The compounding period was again a discriminator for the candidature.

b. The use of the TVM solver, and consequent lack of working, was a source of concern; candidates are advised still to write down substituted formulas prior to using the TVM solver.

The use of 8% in the second part was a common error. The compounding period was again a discriminator for the candidature.

---

1 Brazilian Real (BRL) = 2.607 South African Rand (ZAR). Giving answers **correct to two decimal places**,

(i) convert 300 BRL to ZAR,

(ii) find how many Real it costs to purchase 300 Rand.

Markscheme

Financial accuracy penalty (FP) is applicable where indicated in the left hand column.

1 BRL = 2.607 ZAR

(FP) (i) $300 \times 2.607 = 782.10 \text{ ZAR}$ ***(A1)***

Note: 782.1 is ***(A0)(FP)***

(FP) (ii) $300 \times \frac{1}{2.607} = 115.07 \text{ BRL}$ ***(A1)*****(ft)**

Note: Follow through only if processes are reversed. ***(C2)***

[2 marks]

Examiners report

a) Was well done, though many were awarded financial penalty with an answer of 782.1 for a(i).

Consider the numbers 3, –5 , $\sqrt{7}$, 2^{-3} and 1.75.

Complete the table below, placing a tick (✓) to show which of the number sets, $\mathbb{N}, \mathbb{Q}$ and $\mathbb{R}$ these numbers belong to. The first row has been completed as an example.

	$\mathbb{N}$	$\mathbb{Q}$	$\mathbb{R}$
3	✓	✓	✓
–5			
$\sqrt{7}$			
2^{-3}			
1.75			

Markscheme

	$\mathbb{N}$	$\mathbb{Q}$	$\mathbb{R}$
-5		✓	✓
$\sqrt{7}$			✓
2^{-3}		✓	✓
1.75		✓	✓

(A1) for $\mathbb{N}$ column correct.

(A2) for $\mathbb{R}$ column correct, award ***(A1)*** if one ✓ is missing, award ***(A0)*** if two or more ✓ missing.

(A3) for $\mathbb{Q}$ column correct, award ***(A2)*** for two correctly placed ✓ and no extra entries, award ***(A1)*** for one correctly placed ✓ and no extra entries or ✓ placed in all entries. ***(A6)*** ***(C6)***

Examiners report

[N/A]

Ben inherits \$6500. Ben invests his money in a bank that pays compound interest at a rate of 4.5% per annum.

Calculate the value of **Ben's** investment at the end of 6 years. Give your answer **correct to 2 decimal places**.

Markscheme

$\text{Ben Amount} = 6500\left(1+\frac{4.5}{100}\right)^{6}$ ***(M1)(A1)***

$= \$8464.69$ ***(A1)***

(M1)(A1)(A0) *if interest only found (=\$1964.69)* ***(C3)***

[3 marks]

Examiners report

This question was also well done. However many candidates only gave the interest instead of the total investment. Some also lost a mark by failing to give the answer to part (b) to two decimal places.

Jenny invested \$20 000 in a bank account that paid 3.5 % annual simple interest. She withdrew her investment from the account when its value was \$31 200.

Ramón invests $18 000 in a bank account that pays 3.4 % nominal annual interest, **compounded quarterly**.

Find the minimum number of years that Ramón must invest the money for his investment to be worth $27 000.

Markscheme

$27000 = 18000\left[1 + \frac{3.4}{100 \times 4}\right]^{4n}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted compound interest formula, ***(A1)*** for correct substitutions.

$(n =)12$ ***(A1)*** ***(C3)***

Note: Correct answer only. If 11.976… seen award ***(A2)***.

Examiners report

Although this question was late in the paper there were a number of candidates who scored fullmarks. Others were able to do simple interest but not compound interest or vice versa. However there were a large number that scored zero.

A hotel has a rectangular swimming pool. Its length is x metres, its width is y metres and its perimeter is 44 metres.

a. Write down an equation for x and y. [1]

b. The area of the swimming pool is 112m^2. [1]

Write down a second equation for x and y.

c. Use your graphic display calculator to find the value of x and the value of y. [2]

d. An Olympic sized swimming pool is 50 m long and 25 m wide. [2]

Determine the area of the hotel swimming pool as a percentage of the area of an Olympic sized swimming pool.

Markscheme

a. $2x + 2y = 44$ ***(A1)*** ***(C1)***

Note: Accept equivalent forms.

b. $xy = 112$ ***(A1)*** ***(C1)***

c. $8, 14$ ***(A1)*****(ft)*****(A1)*****(ft)*** ***(C2)***

Notes: Accept $x = 8, y = 14$ **OR** $x = 14, y = 8$

Follow through from their answers to parts (a) and (b) only if both values are positive.

d. $\frac{112}{1250} \times 100$ ***(M1)***

Note: Award ***(M1)*** for 112 divided by 1250.

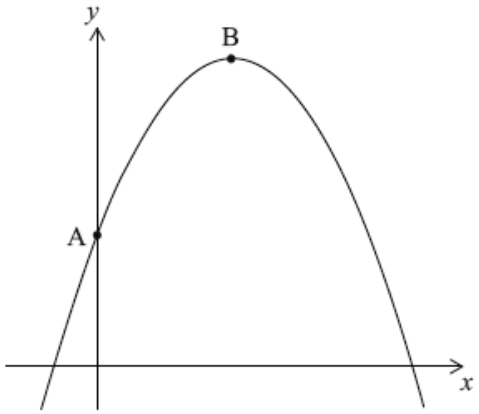
$= 8.96$ ***(A1)*** ***(C2)***

Note: Do not penalize if percentage sign seen.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]
d. [N/A]

The graph of the quadratic function $f(x) = ax^2 + bx + c$ intersects the y-axis at point A (0, 5) and has its vertex at point B (4, 13).



a. Write down the value of c. [1]

b. By using the coordinates of the vertex, B, or otherwise, write down **two** equations in a and b. [3]

c. Find the value of a and of b. [2]

Markscheme

a. 5 ***(A1)*** ***(C1)***

[1 mark]

b. *at least one of the following equations required*

$a(4)^2 + 4b + 5 = 13$

$4 = -\frac{b}{2a}$

$a(8)^2 + 8b + 5 = 5$ ***(A2)(A1)*** ***(C3)***

Note: Award ***(A2)(A0)*** for one correct equation, or its equivalent, and ***(C3)*** for any two correct equations.

Follow through from part (a).

The equation $a(0)^2 + b(0) = 5$ earns no marks.

[3 marks]

c. $a = -\frac{1}{2},\ b = 4$ ***(A1)*****(ft)*****(A1)*****(ft)*** ***(C2)***

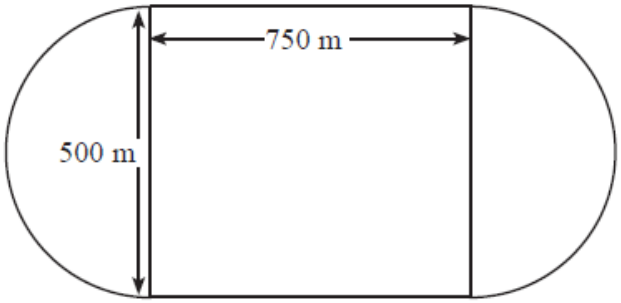
Note: Follow through from their equations in part (b), but only if their equations lead to unique solutions for a and b.

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

A race track is made up of a rectangular shape 750 m by 500 m with semi-circles at each end as shown in the diagram.



Michael drives around the track once at an average speed of $140\ \text{kmh}^{-1}$.

a. Calculate the distance that Michael travels. [2]

b. Calculate how long Michael takes in **seconds**. [4]

Markscheme

a. *Unit penalty **(UP)** may apply in this question.*

$\text{Distance} = \pi \times 500 + 2 \times 750$ ***(M1)***

(UP) $= 3070\ \text{m}$ ***(A1)*** ***(C2)***

[2 marks]

b. *Unit penalty **(UP)** may apply in this question.*

$140\ \text{kmh}^{-1} = \frac{140 \times 1000}{60 \times 60}\ \text{ms}^{-1}$ ***(M1)***

$= 38.9\ \text{ms}^{-1}$ ***(A1)***

$\text{Time} = \frac{3070}{38.889}$ ***(M1)***

(UP) $= 78.9$ seconds *(accept* 79.0 *seconds)* ***(A1)*****(ft)** ***(C4)***

[4 marks]

Examiners report

a. Candidates generally answered part (a) well. A usual mistake was taking 500 as the radius. Some candidates worked out the area rather than the circumference. A good number of candidates correctly answered part (b). Others seemed to get lost in the conversion with multiplication by 3600 and not multiplying by 1000 being common errors. Again follow through marks could be awarded from the candidate's answer to part (a) provided working was shown.

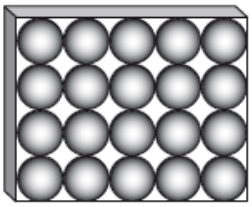
b. Candidates generally answered part (a) well. A usual mistake was taking 500 as the radius. Some candidates worked out the area rather than the circumference. A good number of candidates correctly answered part (b). Others seemed to get lost in the conversion with multiplication by 3600 and not multiplying by 1000 being common errors. Again follow through marks could be awarded from the candidate's answer to part (a) provided working was shown.

Chocolates in the shape of spheres are sold in boxes of 20.
Each chocolate has a radius of 1 cm.

a. Find the volume of 1 chocolate. [2]

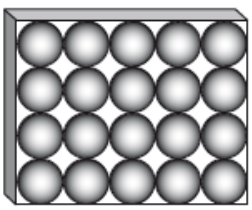
b. Write down the volume of 20 chocolates. [1]

c. The diagram shows the chocolate box from above. The 20 chocolates fit perfectly in the box with each chocolate touching the ones around it or the sides of the box. [2]



Calculate the volume of the box.

d. The diagram shows the chocolate box from above. The 20 chocolates fit perfectly in the box with each chocolate touching the ones around it or the sides of the box. [1]



Calculate the volume of empty space in the box.

Markscheme

a. ***The first time a correct answer has incorrect or missing units, the final (A1) is not awarded.***

$\frac{4}{3}\pi(1)^3$ ***(M1)***

Notes: Award ***(M1)*** for correct substitution into correct formula.

$= 4.19 \left(4.18879\ldots, \frac{4}{3}\pi\right) \text{ cm}^3$ ***(A1)*** ***(C2)***

[2 marks]

b. ***The first time a correct answer has incorrect or missing units, the final (A1) is not awarded.***

$83.8 \left(83.7758\ldots, \frac{80}{3}\pi\right) \text{ cm}^3$ ***(A1)*****(ft)** ***(C1)***

Note: Follow through from their answer to part (a).

[1 mark]

c. ***The first time a correct answer has incorrect or missing units, the final (A1) is not awarded.***

$10 \times 8 \times 2$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into correct formula.

$= 160 \text{ cm}^3$ ***(A1)*** ***(C2)***

[2 marks]

d. ***The first time a correct answer has incorrect or missing units, the final (A1) is not awarded.***

$76.2 \left(76.2241\ldots, \left(160 - \frac{80}{3}\pi\right)\right) \text{ cm}^3$ ***(A1)*****(ft)** ***(C1)***

Note: Follow through from their part (b) and their part (c).

[1 mark]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]
d. [N/A]

An iron bar is heated. Its length, L, in millimetres can be modelled by a linear function, $L = mT + c$, where T is the temperature measured in degrees Celsius (°C).

a. At 150°C the length of the iron bar is 180 mm. [1]

Write down an equation that shows this information.

b. At 210°C the length of the iron bar is 181.5 mm. [1]

Write down an equation that shows this second piece of information.

c. At 210°C the length of the iron bar is 181.5 mm. [4]

Hence, find the length of the iron bar at 40°C.

Markscheme

a. $180 = 150m + c$ (or equivalent) ***(A1)*** ***(C1)***

b. $181.5 = 210m + c$ (or equivalent) ***(A1)*** ***(C1)***

c. $m = 0.25,\ c = 176.25$ ***(A1)(A1)*****(ft)**

Note: Follow through from part (a) and part (b), irrespective of working shown.

$L = 0.025(4) + 176.25$ ***(M1)***

Note: Award ***(M1)*** for substitution of their m, their c and 40 into equation.

$L = 177 \quad (177.25)\ (\text{mm})$ ***(A1)*****(ft)** ***(C4)***

Note: Follow through, within **part (c)**, from their m and c only if working shown.

Examiners report

a. The equations in part (a) and (b) were given correctly by the vast majority of the candidates.

b. The equations in part (a) and (b) were given correctly by the vast majority of the candidates.

c. Part (c) was in most cases either completely correct or awarded no marks at all. Only few were able to find the values of *m* and *c*, and therefore the length at 40°C. Part (c) was often left open or answered incorrectly. A common answer was *L = 40m + c* . Very few partial correct responses were given. Some candidates managed a correct 3 sf answer by intelligent guessing. As the question was not structured asking for the m and c values explicitly, not many candidates made an attempt to find those values. Very few seemed to realize they could find those values using their GDC. An attempt to use simultaneous equations was the most common approach.

---

a. Complete the truth table. [2]

p	q	$\neg p$	$\neg p \vee q$
T	T		
T	F		
F	T		
F	F		

b. Consider the propositions *p* and *q*: [2]

p: x is a number less than 10.

q: x2 is a number greater than 100.

Write in words the compound proposition $\neg p \vee q$.

c. Using part (a), determine whether $\neg p \vee q$ is true or false, for the case where x is a number less than 10 and x^2 is a number greater than 100. [1]

d. Write down a value of x for which $\neg p \vee q$ is false. [1]

Markscheme

a.

p	q	$\neg p$	$\neg p \vee q$
T	T	**F**	**T**
T	F	**F**	**F**
F	T	**T**	**T**
F	F	**T**	**T**

(A1) for third column and ***(A1)*(ft)** for fourth column ***(A1)(A1)*(ft)** ***(C2)***

b. x is greater than or equal to (not less than) 10 or x^2 is greater than 100. ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for "greater than or equal to (not less than) 10", ***(A1)*** for "or x^2 is greater than 100".

c. True ***(A1)*(ft)** ***(C1)***

Note: Follow through from their answer to part (a).

d. Any value of x such that $-10 \leqslant x < 10$. ***(A1)*(ft)** ***(C1)***

Note: Follow through from their answer to part (a).

Examiners report

a. This was provocative in the G2 and the comments indicate that candidates found the wording confusing. Candidates were able to write in words the compound proposition $\neg p \vee q$ and following from their truth table the candidates could state if this was true or false.

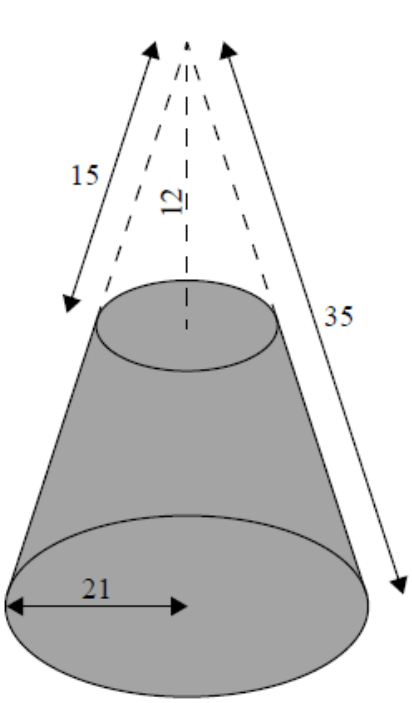
b. This was provocative in the G2 and the comments indicate that candidates found the wording confusing. Candidates were able to write in words the compound proposition $\neg p \vee q$ and following from their truth table the candidates could state if this was true or false. In part (c) many candidates either stated the correct answer "true" or stated an answer consistent with their truth table and received follow-through marks. Candidates had difficulty writing down a value of x for which $\neg p \vee q$ is false.

c. This was provocative in the G2 and the comments indicate that candidates found the wording confusing. Candidates were able to write in words the compound proposition $\neg p \vee q$ and following from their truth table the candidates could state if this was true or false. In part (c) many candidates either stated the correct answer "true" or stated an answer consistent with their truth table and received follow-through marks. Candidates had difficulty writing down a value of x for which \(\neg p \vee q\]) is false.

d. This was provocative in the G2 and the comments indicate that candidates found the wording confusing. Candidates were able to write in words the compound proposition $\neg p \vee q$ and following from their truth table the candidates could state if this was true or false.

A solid right circular cone has a base radius of 21 cm and a slant height of 35 cm.

A smaller right circular cone has a height of 12 cm and a slant height of 15 cm, and is removed from the top of the larger cone, as shown in the diagram.



a. Calculate the radius of the base of the cone which has been removed. [2]

b. Calculate the curved surface area of the cone which has been removed. [2]

c. Calculate the curved surface area of the remaining solid. [2]

Markscheme

a. $\sqrt{15^2 - 12^2}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into Pythagoras theorem.

OR

$\frac{\text{radius}}{21} = \frac{15}{35}$ ***(M1)***

Note: Award ***(M1)*** for a correct equation.

= 9 (cm) ***(A1) (C2)***

[2 marks]

b. $\pi \times 9 \times 15$ ***(M1)***

Note: Award ***(M1)*** for their correct substitution into curved surface area of a cone formula.

$= 424 \text{ cm}^2 \quad (135\pi,\ 424.115...\text{cm}^2)$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (a).

[2 marks]

c. $\pi \times 21 \times 35 - 424.115...$ ***(M1)***

Note: Award ***(M1)*** for their correct substitution into curved surface area of a cone formula and for subtracting their part (b).

$= 1880 \text{ cm}^2 \quad (600\pi,\ 1884.95...\text{cm}^2)$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (b).

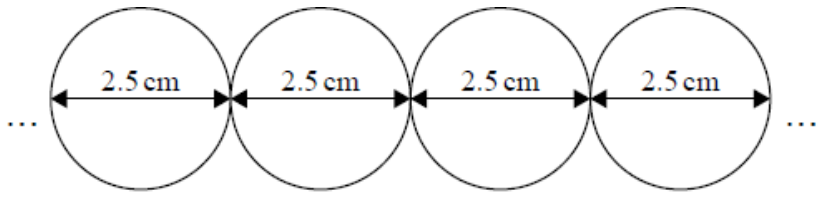
[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

Last year a South American candy factory sold 4.8×10^8 spherical sweets. Each sweet has a diameter of 2.5 cm.

The factory is producing an advertisement showing all of these sweets placed in a straight line.



The advertisement claims that the length of this line is *x* times the length of the Amazon River. The length of the Amazon River is 6400km.

a. Find the length, in cm, of this line. Give your answer in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [3]

b.i. Write down the length of the Amazon River in cm. [1]

b.ii. Find the value of x. [2]

Markscheme

a. $4.8 \times 10^8 \times 2.5$ ***(M1)***

Note: Award ***(M1)*** for multiplying by 2.5.

1.2×10^9 (cm) ***(A1)(ft)(A1)(ft) (C3)***

Note: Award ***(A0)(A0)*** for answers of the type 12×10^8.

[3 marks]

b.i. 640000000 (cm) $(6.4 \times 10^8$ (cm)) ***(A1)***

[1 mark]

b.ii. $\frac{1.2\times10^9}{6.4\times10^8}$ ***(M1)***

Note: Award ***(M1)*** for division by 640000000.

= 1.88 (1.875) ***(A1)(ft) (C3)***

Note: Follow through from part (a) and part (b)(i).

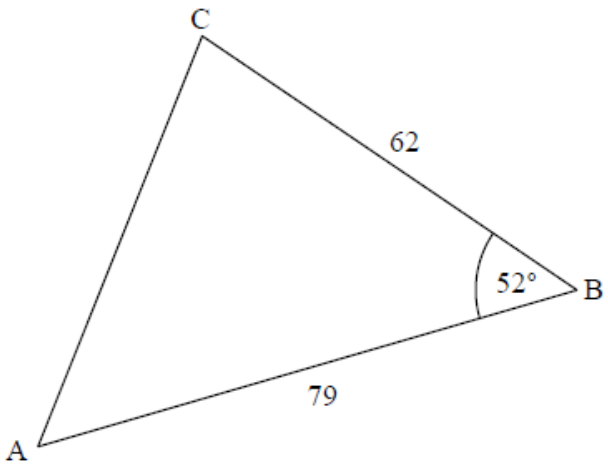
[2 marks]

Examiners report

a. [N/A]
b.i. [N/A]
b.ii. [N/A]

A park in the form of a triangle, ABC, is shown in the following diagram. AB is 79km and BC is 62km. Angle $A\hat{B}C$ is 52°.

diagram not to scale



a. Calculate the length of side AC in km. [3]

b. Calculate the area of the park. [3]

Markscheme

a. $(AC^2 =) 62^2 + 79^2 - 2 \times 62 \times 79 \times \cos(52°)$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituting in the cosine rule formula, ***(A1)*** for correct substitution.

63.7 (63.6708…) (km) ***(A1) (C3)***

[3 marks]

b. $\frac{1}{2} \times 62 \times 79 \times \sin(52°)$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituting in the area of triangle formula, ***(A1)*** for correct substitution.

1930 km^2 (1929.83…km^2) ***(A1) (C3)***

[3 marks]

Examiners report

a. [N/A]
b. [N/A]

---

a. Consider the numbers 2, $\sqrt{3}$, $-\frac{2}{3}$ and the sets $\mathbb{N}$, $\mathbb{Z}$, $\mathbb{Q}$ and $\mathbb{R}$. [3]

Complete the table below by placing a tick in the appropriate box if the number is an element of the set, and a cross if it is not.

		$\mathbb{N}$	$\mathbb{Z}$	$\mathbb{Q}$	$\mathbb{R}$
(i)	2				
(ii)	$\sqrt{3}$				
(iii)	$-\frac{2}{3}$				

b. A function f is given by $f(x) = 2x^2 - 3x$, $x \in \{-2, 2, 3\}$. [1]

Write down the range of function f.

Markscheme

a.

	$\mathbb{N}$	$\mathbb{Z}$	$\mathbb{Q}$	$\mathbb{R}$
2	✓	✓	✓	✓
$\sqrt{3}$	✗	✗	✗	✓
$-\frac{2}{3}$	✗	✗	✓	✓

(A1)(A1)(A1) ***(C3)***

Note: Accept any symbol for ticks. Do not penalise if the other boxes are left blank.

[3 marks]

b. $\text{Range} = \{2, 9, 14\}$ ***(A1)*****(ft)** ***(C1)***

Note: Brackets not required.

[1 mark]

Examiners report

a. There was a lack of familiarity with number systems and mappings - it was surprising to see how few knew what a mapping diagram involved.

Part (c) (range) was also poorly answered with many giving an interval although they had correctly worked out the values for the function.

b. There was a lack of familiarity with number systems and mappings - it was surprising to see how few knew what a mapping diagram involved.

Part (b) (range) was also poorly answered with many giving an interval although they had correctly worked out the values for the function.

Fabián stands on top of a building, T, which is on a horizontal street.

He observes a car, C, on the street, at an angle of depression of 30°. The base of the building is at B. The height of the building is 80 metres.

The following diagram indicates the positions of T, B and C.

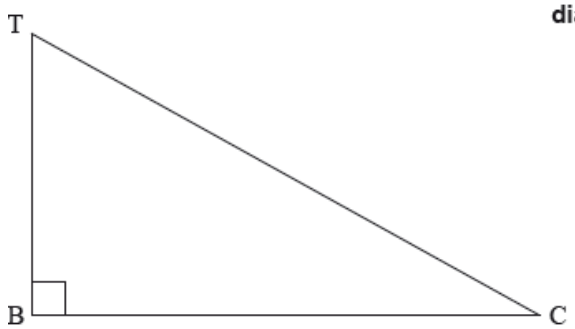


diagram not to scale

a. Show, in the appropriate place on the diagram, **the values** of [2]

(i) the height of the building;

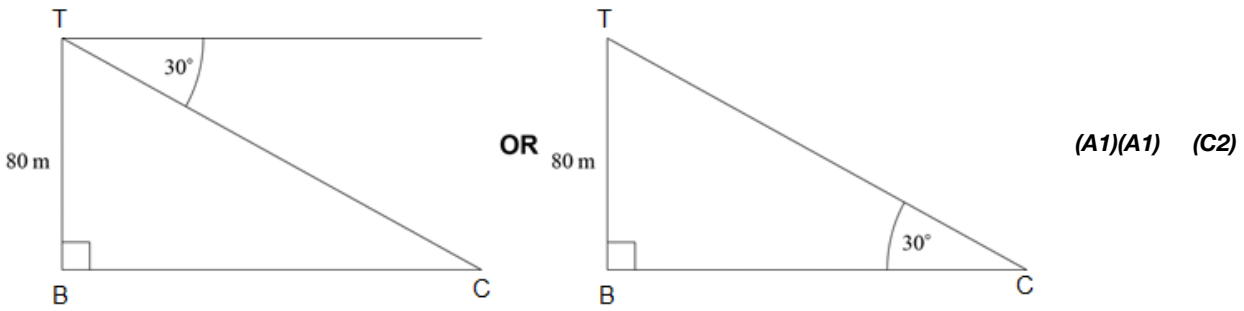
(ii) the angle of depression.

b. Find the distance, BC, from the base of the building to the car. [2]

c. Fabián estimates that the distance from the base of the building to the car is 150 metres. Calculate the percentage error of Fabián's estimate. [2]

Markscheme

a.



(A1)(A1) ***(C2)***

Notes: Award ***(A1)*** for 80 m in the correct position on diagram.

Award ***(A1)*** for 30° in a correct position on diagram.

b. $\tan 30^\circ = \frac{80}{\text{BC}}$ **OR** $\tan 60^\circ = \frac{\text{BC}}{80}$ **OR** $\frac{80}{\sin 30^\circ} = \frac{\text{BC}}{\sin 60^\circ}$ ***(M1)***

Note: Award ***(M1)*** for a correct trigonometric or Pythagorean equation for BC with correctly substituted values.

$(\text{BC} =) \ 139 \ (\text{m}) \quad (138.564\ldots \ (\text{m}))$ ***(A1)*****(ft)** ***(C2)***

Notes: Accept an answer of $80\sqrt{3}$ which is the exact answer.

Follow through from part (a).

Do not penalize use of radians unless it leads to a negative answer.

c. $\left|\frac{150-138.564\ldots}{138.564\ldots}\right| \times 100$ ***(M1)***

Notes: Award ***(M1)*** for their correct substitution into the percentage error formula.

$= 8.25(\%) \quad (8.25317\ldots\%)$ ***(A1)*****(ft)** ***(C2)***

Notes: Accept $7.91(\%)$ ($7.91366\ldots$ if 139 is used.

Accept $8.23(\%)$ ($8.22510\ldots$ if 138.6 is used.

Follow through from their answer to part (b).

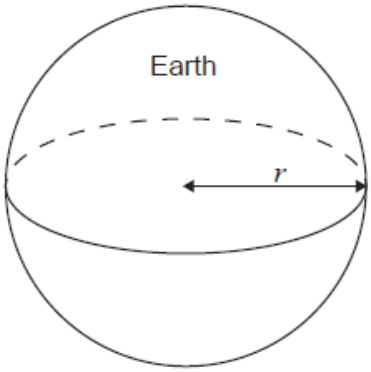
If answer to part (b) is 46.2, answer to part (c) is 225%, award ***(M1)(A1)*****(ft)** with or without working seen. If answer to part (b) is negative, award at most ***(M1)(A0)***.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

---

a. Assume that the Earth is a sphere with a radius, r , of $6.38 \times 10^3 \, \text{km}$. [4]



i) Calculate the surface area of the Earth in km^2.

ii) Write down your answer to part (a)(i) in the form $a \times 10^k$, where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$.

b. The surface area of the Earth that is covered by water is approximately $3.61 \times 10^8 \text{km}^2$. [2]

Calculate the percentage of the surface area of the Earth that is covered by water.

Markscheme

a. i) $4\pi(6.38 \times 10^3)^2$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into the surface area of a sphere formula.

$= 512\,000\,000 \;\; (511506576, \;\; 162\,817\,600\pi)$ ***(A1)*** ***(C2)***

Note: Award at most ***(M1)(A0)*** for use of 3.14 for π, which will give an answer of $511\,247\,264$.

ii) $5.12 \times 10^8 \;\; (5.11506... \times 10^8, \;\; 1.628176\pi \times 10^8)$ ***(A1)*****(ft)*****(A1)*****(ft)*** ***(C2)***

Note: Award ***(A1)*** for 5.12 and ***(A1)*** for $\times 10^8$.
Award ***(A0)(A0)*** for answers of the type: 5.12×10^7.
Follow through from part (a)(i).

b. $\frac{3.61 \times 10^8}{5.11506... \times 10^8} \times 100$ **OR** $\frac{3.61}{5.11506...} \times 100$ **OR** $0.705758... \times 100$ ***(M1)***

Note: Award ***(M1)*** for correct substitution. Multiplication by 100 must be seen.

$= 70.6\,(\%) \;\; (70.5758...\,(\%))$ ***(A1)*****(ft)*** ***(C2)***

Note: Follow through from part (a). Accept the use of 3 sf answers, which gives a final answer of $70.5\,(\%) \;\; (70.5758...\,(\%))$.

Examiners report

a. Question 1: Surface area of a sphere; scientific notation and percentage.

The weakest candidates were unable to square a number given in scientific notation or write the answer in scientific notation. Weaker candidates used the area of a circle formula rather than the surface area of a sphere. Premature rounding caused some candidates to obtain an incorrect final answer. Many candidates confused percentage of a quantity with percentage error or found the reciprocal of the correct answer. Overall this question was well attempted.

b. Question 1: Surface area of a sphere; scientific notation and percentage.

The weakest candidates were unable to square a number given in scientific notation or write the answer in scientific notation. Weaker candidates used the area of a circle formula rather than the surface area of a sphere. Premature rounding caused some candidates to obtain an incorrect final

answer. Many candidates confused percentage of a quantity with percentage error or found the reciprocal of the correct answer. Overall this question was well attempted.

Consider the numbers $-1,\ 4,\ \frac{2}{3},\ \sqrt{2},\ 0.35$ and -2^2.

Complete the following table by placing a tick (✓) to indicate if the number is an element of the number set. The first row has been completed as an example.

	$\mathbb{N}$	$\mathbb{Z}$	$\mathbb{Q}$	$\mathbb{R}$
-1		✓	✓	✓
4				
$\frac{2}{3}$				
$\sqrt{2}$				
0.35				
-2^2				

Markscheme

	$\mathbb{N}$	$\mathbb{Z}$	$\mathbb{Q}$	$\mathbb{R}$
-1		✓	✓	✓
4	✓	✓	✓	✓
$\frac{2}{3}$			✓	✓
$\sqrt{2}$				✓
0.35			✓	✓
-2^2		✓	✓	✓

(A1)(A1)(A1)(A1)(A2) (C6)

Note: **Row 1** has been given in the question.
Row 2 to row 5: Award ***(A1)*** for each correct row.
Row 6: Award ***(A1)*** for both $\mathbb{N}$ **not** selected **and** $\mathbb{Z}$ selected; award ***(A1)*** for both $\mathbb{Q}$ **and** $\mathbb{R}$ selected. Do not penalize if crosses (or similar) appear in

the empty cells.

Examiners report

Question 2: Classification of numbers.

Stronger candidates were able to correctly identify if a number was rational, real or natural with the weaker candidates not recognizing that all rational numbers are real or perhaps these candidates lacked familiarity with the mathematical notation. Only the best candidates knew that $\frac{2}{3} \in ¤$, $\sqrt{2} \notin ¤$ and that $-2^2 \in ¥$ but $-2^2 \in ¢$.

$U = \{x | x \text{ is an integer}, 2 < x < 10\}$

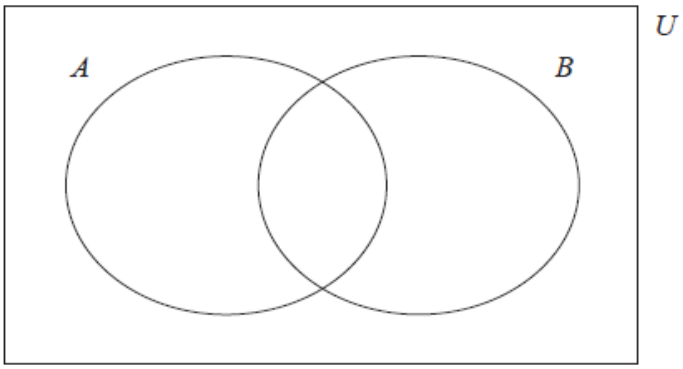
A and B are subsets of U such that $A = \{\text{multiples of } 3\}$, $B = \{\text{factors of } 24\}$.

a. List the elements of [2]

(i) U ;

(ii) B .

b. Write down the elements of U on the Venn diagram. [3]



c. Write down $n(A \cap B)$. [1]

Markscheme

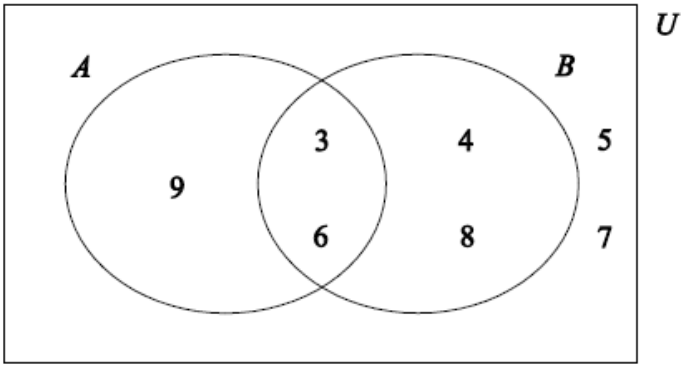
a. (i) 3, 4, 5, 6, 7, 8, 9 ***(A1)***

(ii) 3, 4, 6, 8 ***(A1)*****(ft)** ***(C2)***

Notes: Follow through from part (a)(i).

[2 marks]

b.



***(A1)*(ft)** for their 3, 6
***(A1)*(ft)** for their 4, 8, 9
(A1)*(ft)** for their 5, 7 ***(A1)*(ft)*(A1)*(ft)*(A1)*(ft)** ***(C3)

Note: Follow through from their universal set and set B in part (a).

[3 marks]

c. 2 ***(A1)*(ft)** ***(C1)***

Note: Follow through from their Venn diagram.

[1 mark]

Examiners report

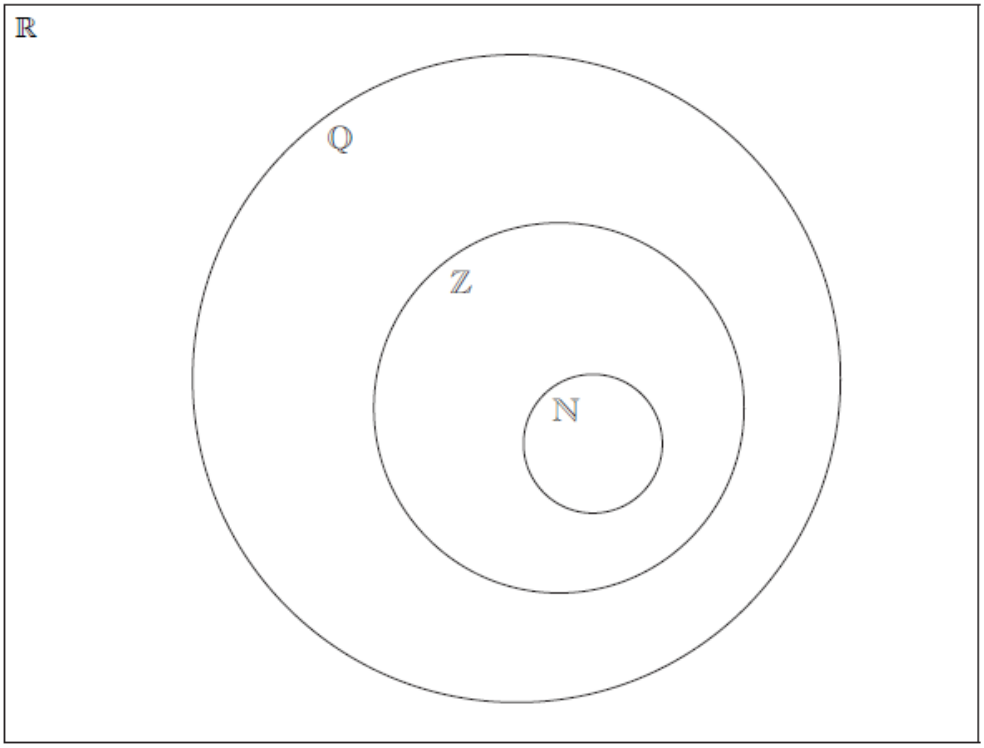
a. Many candidates were unable to write down correctly the universal set which was integers between 2 and 10. Some candidates did not read the direction “on the Venn diagram” so complained of lack of space for their answer. It is important candidates read the directions carefully. Many candidates listed the elements of the intersection rather than answering the question to specify the number of elements. The empty set for $(A \cup B)'$ was awarded a maximum of 2 marks as this has simplified the problem.

b. Many candidates were unable to write down correctly the universal set which was integers between 2 and 10. Some candidates did not read the direction “on the Venn diagram” so complained of lack of space for their answer. It is important candidates read the directions carefully. Many candidates listed the elements of the intersection rather than answering the question to specify the number of elements. The empty set for $(A \cup B)'$ was awarded a maximum of 2 marks as this has simplified the problem.

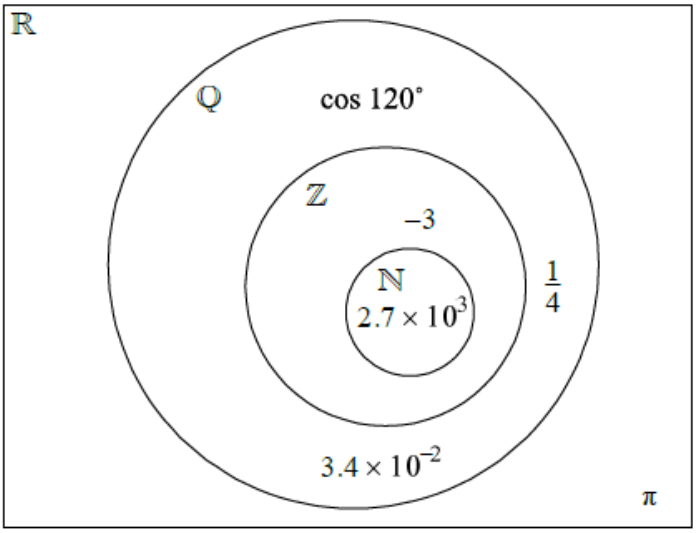
c. Many candidates were unable to write down correctly the universal set which was integers between 2 and 10. Some candidates did not read the direction “on the Venn diagram” so complained of lack of space for their answer. It is important candidates read the directions carefully. Many candidates listed the elements of the intersection rather than answering the question to specify the number of elements. The empty set for $(A \cup B)'$ was awarded a maximum of 2 marks as this has simplified the problem.

The Venn diagram shows the number sets $\mathbb{N}$, $\mathbb{Z}$, $\mathbb{Q}$ and $\mathbb{R}$. Place each of the following numbers in the appropriate region of the Venn diagram.

$\frac{1}{4}$, –3, π, cos 120°, 2.7×10^3, 3.4×10^{-2}



Markscheme



(A1)(A1)(A1)(A1)(A1)(A1) ***(C6)***

Note: Award ***(A1)*** for each number placed once in the correct section. Accept equivalent forms for numbers.

[6 marks]

Examiners report

About half of the students answered this question correctly. The placement of cos120 and π appeared to cause the most problems.

The following table shows four different sets of numbers: $\mathbb{N}$, $\mathbb{Z}$, $\mathbb{Q}$ and $\mathbb{R}$.

Set	Example of a number in the set
$\mathbb{N}$	
$\mathbb{Z}$	
$\mathbb{Q}$	
$\mathbb{R}$	

a. Complete the second column of the table by giving **one** example of a number from each set. [4]

b. Josh states: “Every integer is a natural number”. [2]

Write down whether Josh’s statement is correct. Justify your answer.

Markscheme

a.

Set	Example of a number in the set
$\mathbb{N}$	***Any natural number***
$\mathbb{Z}$	***Any integer***
$\mathbb{Q}$	***Any rational number***
$\mathbb{R}$	***Any real number***

(A1)(A1)(A1)(A1)(C4)

[4 marks]

b. Incorrect ***(A1)***

Natural numbers are positive integers. Integers can also be negative. (or equivalent) ***(R1) (C2)***

Note: Accept a correct justification. Do not award ***(R0)(A1)***.
Accept: a statement with an example of an integer which is not natural.

[2 marks]

Examiners report

a. [N/A]
b. [N/A]

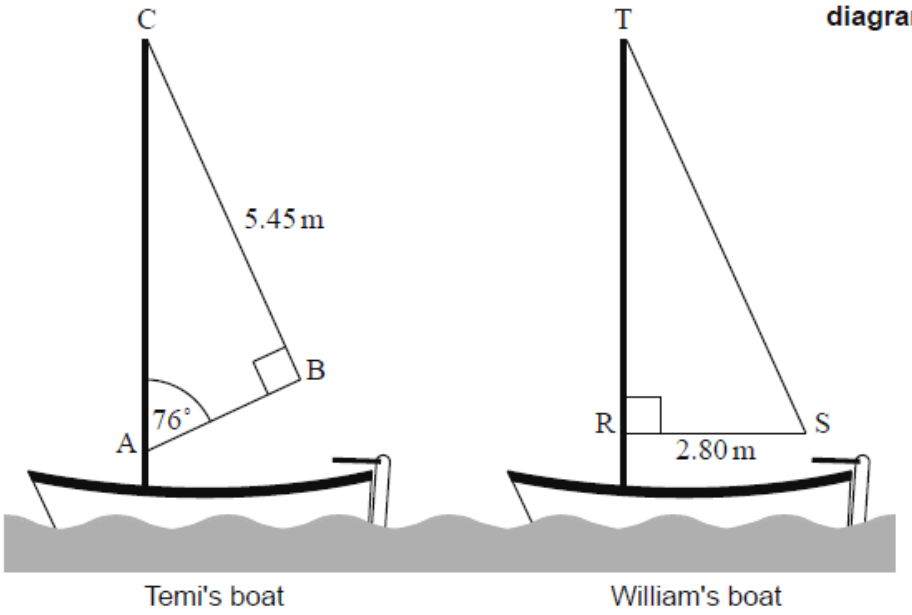
---

a. Temi’s sailing boat has a sail in the shape of a right-angled triangle, ABC. $\mathrm{BC} = 5.45\mathrm{m}$, [2]

angle $\mathrm{CAB} = 76^{\mathrm{o}}$ and angle $\mathrm{ABC} = 90^{\mathrm{o}}$.

Calculate AC, the height of Temi’s sail.

b. **diagram not to scale** [2]



William also has a sailing boat with a sail in the shape of a right-angled triangle, TRS. $\mathrm{RS} = 2.80\mathrm{m}$. The area of William's sail is $10.7\,\mathrm{m}^2$.

Calculate RT, the height of William's sail.

Markscheme

a. **Units are required in parts (a) and (b).**

$\sin 76^\circ = \frac{5.45}{\mathrm{AC}}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into correct trig formula.

$\mathrm{AC} = 5.62\mathrm{m}\ (= 5.61684...\mathrm{m})$ ***(A1) (C2)***

Note: The answer is $5.62\mathrm{m}$, **the units are required.**

[2 marks]

b. $\frac{1}{2} \times 2.80 \times \mathrm{RT} = 10.7$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into area of a triangle formula or equivalent.

$\mathrm{RT} = 7.64\,\mathrm{m}\ \ (7.64285...\,\mathrm{m})$ ***(A1) (C2)***

Note: The answer is $7.64\,\mathrm{m}$, **the units are required.**

[2 marks]

Examiners report

a. Question 2: Trigonometry and area

The response to this question was mixed, with many fully correct attempts. Those failing to score 6 marks often either lost a mark due to the use of Pythagoras and premature rounding or due to an incorrect trigonometric ratio used in a right angled triangle. The use of sine and cosine rule often led to errors.

b. Question 2: Trigonometry and area

The response to this question was mixed, with many fully correct attempts. Those failing to score 6 marks often either lost a mark due to the use of Pythagoras and premature rounding or due to an incorrect trigonometric ratio used in a right angled triangle. The use of sine and cosine rule often led to errors.

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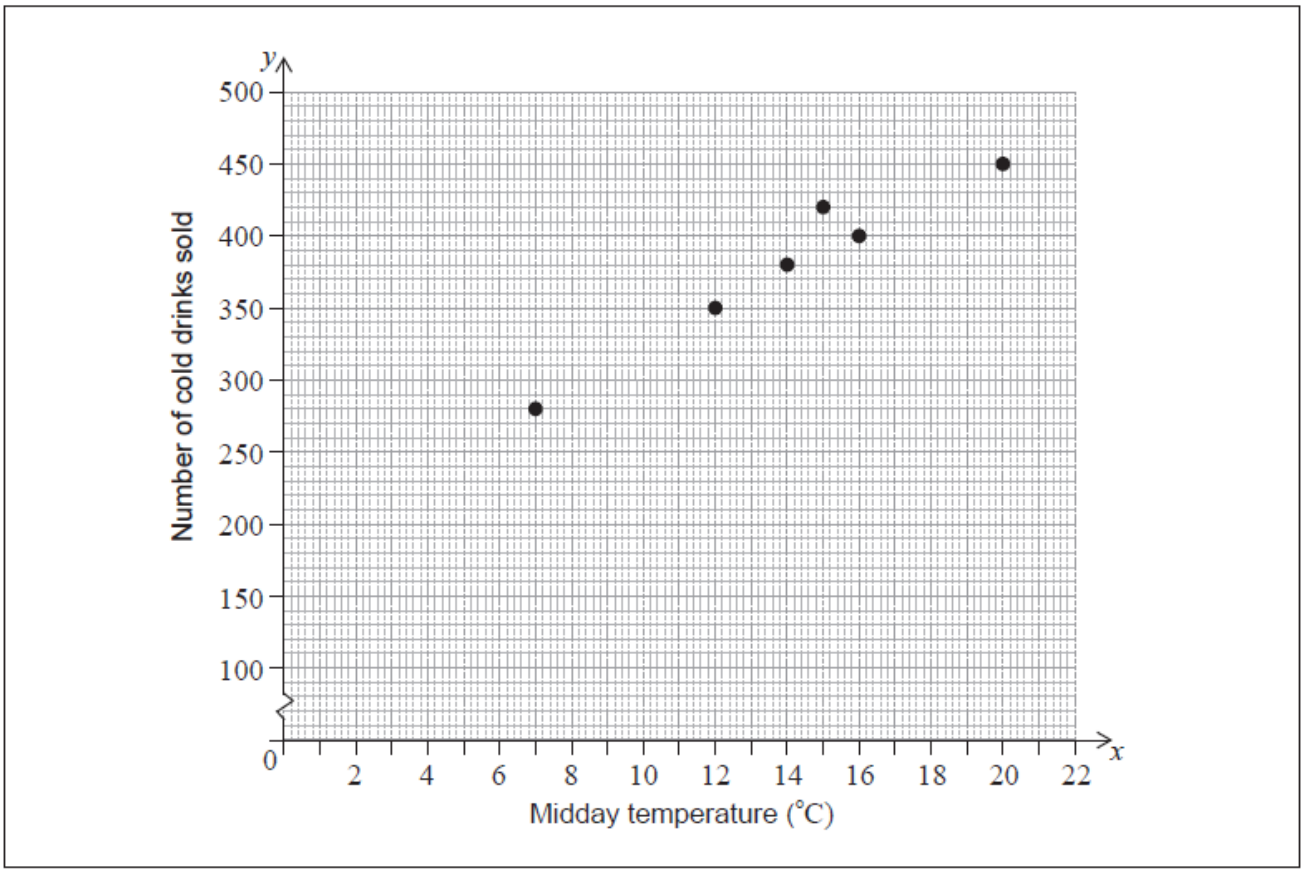
a. Each day a supermarket records the midday temperature and how many cold drinks are sold on that day. The following table shows the supermarket's data for the last 6 days. This data is also shown on a scatter diagram. [2]

Midday temperature, °C (x)	7	12	14	15	16	20
Number of cold drinks sold (y)	280	350	380	420	400	450



Write down

i) the mean temperature, $\bar{x}$;

ii) the mean number of cold drinks sold, $\bar{y}$.

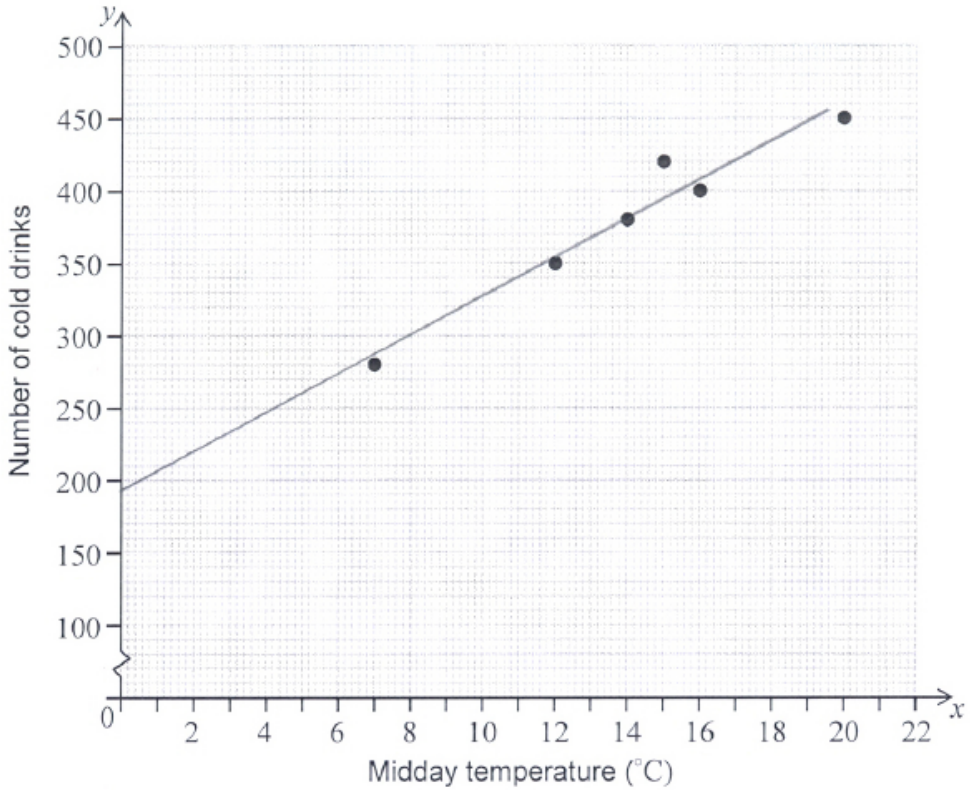
b. Draw the line of best fit on the scatter diagram. [2]

c. Use the line of best fit to estimate the number of cold drinks that are sold on a day when the midday temperature is $10\,^{\circ}\mathrm{C}$. [2]

Markscheme

a. i) 14 ***(A1)***

ii) 380 ***(A1)*** ***(C2)***

b. 

(A1)**(ft)*****(A1)*** ***(C2)***

Note: Award ***(A1)*****(ft)** for a **straight** line going through **their** mean point, ***(A1)*** for intercepting the y-axis between 160 and 220 inclusive. Follow through from part (a).

c. an attempt to use their line of best fit to find y value at $x = 10$ ***(M1)***

Note: Award ***(M1)*** for an indication of use of their line of best fit (dotted lines or some indication of mark in the correct place on graph).

OR

$13.4\,(10) + 192$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into the regression equation, $y = 13.4x + 192$.

$= 326$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (b). Accept answers between 310 and 340, inclusive.

Examiners report

a. Question 9: Linear regression.

The correct means were usually written down. Many candidates drew a line of best fit that did not go through their $(\bar{x},\ \bar{y})$. Almost all candidates were able to use the line of best fit (either the one they had drawn or the regression line found using their GDC) to make a reasonable estimate. Feedback from teachers suggests that many are using line of best fit and line of regression as synonyms. This is not the case; both are explicitly mentioned in the guide and candidates are expected to understand both terms.

b. Question 9: Linear regression.

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