Mathematics: applications and interpretation

Standard level

Paper 1

Markscheme

1. (a) (i) 18.3 (kg)	A2
Note: Award A1 for substitution into the formula for the mean e.g. 12.5+9.8+14.2+25.6+25.6+22.3	
(ii) 18.3 (kg) (18.25)	A1
(iii) 25,6 (kg)	A1
(iv) 25.6 – 9.8	(M1)
Note: Award <i>M1</i> for recognizing 25.6 and 9.8 as the critical values.	
15.8 (kg)	A1
(b) 18.65kg	A1

[Total marks: 7]

2. (a) 37	A1
(b) 18	A1
(c) $\frac{12}{37}$ (0.324, 0.324324, 32.4%)	A1

Note: For *A1*(ft) to be awarded, the numerator must be 34 and the denominator must be their answer to part (a).

(e) $P(F \cap N) \neq 0$ **OR** $n(F \cap N) \neq 0$

Note: Accept $P(F) + P(N) \neq P(F \cup N)$ provided probabilities are shown. Accept an equivalent statement in words such as "some (12) students read both". Condone $P(Fand N) \neq 0$ **OR** $n(F and N) \neq 0$

no, they are not mutually exclusive

Note: Do not award *ROA1*.

3. (a) attempt to substitute into geometric sequence formula for twelfth term *(M1)* $u_{12} = 100 \times 1.05^{12-1}$ or 100,105, 110.25.....

171 (171.0339...)

(b) (i) attempt to substitute into the geometric series formula **OR** a sum of at least the first three terms *(M1)*

 $S_{12} = \frac{100(1.05^{12}-1)}{1.05-1}$ or $100 + 105 + 110.25 + \dots$

Note: Award *M1* for $u_1 = 100$ and r = 1.05 seen as part of a geometric series formula, or *M1* for sigma notation and their u_n formula (condone missing limits), or *M1* for the sum of at least the **correct** first three terms of the sequence.

A1

[Total: 6 marks]

R1

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$S_{12} = 1590 (1591.712652....)$

A1

(ii) finding $S_{24} = 4450.199887 \dots$ or attempt to find the sum between u_{13} and u_{24} (M1)

Note: Award **M1** for $S_{24} = 4450.199887$ or sigma notation that includes correct limits and their u_n formula

$$4450 - 1590 = 2860.$$

A1

A1 [Total: 7 marks]

4. (a) correct substitution of $t = 0$	(A1)
$25 + 50 b^0 = 75$	A1

(b) correct substitution of $T = 55$ and $t = 1$	
$55 = 25 + 50 b^{-1} b = \frac{5}{2}$	A1





Note: Award **A1** for correct general shape (decreasing, concave up) passing through (1, 55) and continuing on, **A1** for a curve starting from (0, 75)

[Total: 7 marks]

5. (a) EITHER	
N = 12	
$PV = \pm 80000$	
$FV = \pm 84100$	
P/Y=12	
C/Y=12 (M1,)(A1)
OR	
N = 1	
<i>PV</i> =±80000	
$FV = \pm 84100$	
<i>P</i> / <i>Y</i> =1	
C/Y=12 (M1,)(A1)
ΓΗΕΝ	
<i>t</i> = 5.00 (5.0008416)	A1
V= 6	
% =5,8	
$PV = \pm 84100$	
$PMT = \pm 7000$	
P/Y=12	
C/Y=12 (M1,)(A1)
Note: Award <i>M1</i> for an attempt to use a financial app (at least 3 entries, not necessarily correct). Award <i>A1</i> for all entries correct in the financial app	

(condone missing -/+ sign if the correct final answer is seen).

FV = (\$) 44058

Note: Answer must be correct to nearest dollar to award the final *A1*. Award *(M1)(A1)A0* for an unsupported final answer to a greater degree of accuracy eg. (\$) 44057.778...

Award M1A1AO for a truncated answer of 44057 if no working is shown.

[Total: 6 marks]

6. (a)
$$y = \frac{1}{2}x + \frac{1}{2}$$

Note: Award **A1** for $\frac{1}{2}x$ and **A1** for $\frac{1}{2}$ (or equivalent equation). Award at most **A1A0** if the answer is not presented as an equation.

(b) G (6.778, 3.889)

(c)

Note: If both answers are not correct to 4 sig figs, award at most A1A0.



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A1A1

Note: Award marks as shown in the table below. Condone edges that do not extend to the sides of the graph or beyond the *x*-axis.

Correct edges	Incorrect edges	Marks
3	0	A2
3	1	A1A0
3	2 or more	AOAO
2	0	A1A0
2	1	A1A0
2	2 or more	AOAO
1	0	A1A0
1	1 or more	AOAO

[Total: 6 marks]

7. (a) i) <i>Maximum height is 5.5m</i>	A1
(ii) $\frac{360}{30} = 12$ hours	(A1)
(iii) 3m	A1
(b) replacing t by 7	
$h(7) = 2.5co(30 \times 7) + 3 = 0.835m$	A1
(c) equating the equation to 4	(M1)
$2.5\cos(30t) + 3 = 4$	
<i>t</i> = 2.21	A1
	[Total: 6 marks]

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(M1)

8. (a) (i) attempt to rearrange to isolate S

$$S = \frac{1000}{1609} K$$
 or $S = \frac{1}{1.609} K$ A1

Note: If the answer is not written as an equation, award at most M1A0.

(ii)
$$S = \frac{1000}{1609} \times 100 = 62.2$$
 (62.1504039.....) **A1**

 (b) i) $K = 1.609 \times 65 \approx 105$ (104.585)
 A1

 ii) recognizing that the variance is the square of the standard deviation
 M1

 $\sigma^2 = (1.609 \times 8)^2$ A1

 $\sigma^2 \approx 166$ or (165.688......)
 A1

[Total: 6 marks]

9. (a) (i) recognizing that 0.15 is removed 30 times	(<i>M1</i>)
$8 - 0.15 \times 30 = 3.5mm$	A1
(ii) $V = 3.5^3 \approx 42.9$ (or 42.875)	A1
(b) attempt to use the power rule	(<i>M1</i>)
$V'(t) = -28.5 + 1.02 t - 0.0096 t^{2}$	A1
(c) recognizing need to find V '(30)	(<i>M1</i>)
$V'(30) = -28.5 + 1.02 \times 30 - 0.0096 \times 30^{2}$	
$=-6.54mm^{3}s^{-1}$	A1

(d) change in room temperature decreasing/change in surface area of the cube

Note: Award <i>R1</i> for a reasonable explanation of a change in I	rate
	[Total: 8 marks]
10. (a) (i) $V = c \times h^3$	(M1)
(ii) replacing $V = 8.75$ and $h = 7$ in their equation	A1
$8.75 = c \times 7^3$	
$c \approx 0.0255 (0.02551020)$	A1
$V = 0.0255 \times (6.5)^3$	A1
(b) Attempt to express the equation for the water uptake	(M1)
$W = \frac{m}{h^2}$	
Writing the ratio between the two trees	(M1)
$k = \frac{\frac{m}{10^2}}{\frac{m}{7^2}}$	A1
$k = \frac{49}{100}$	A1
	[Total: 8 marks]

11. (recognition that OE is a radius and the hypothenuse of triangle ODE) **A1**

$$\sqrt{6^2 + 10^2} = \sqrt{136}$$

(finding angle YOE)

correct calculation for finding
$$D\hat{O}E$$
 (A1)
 $D\hat{O}E = \arctan(\frac{10}{6})$ OR $\tan D\hat{O}E = \frac{10}{6}$
expressing $Y\hat{O}E$ as $90^\circ + D\hat{O}E$ (M1)

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R1

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$$\dot{YOE} = 59.0^{\circ}$$

substituting *their* radius and angle YOE correctly into arc length formula (M1)

$$Arc EY = \frac{59^{\circ}}{360^{\circ}} \times 2\pi \times \sqrt{136}$$
$$Arc EY = 12.0$$

12. (a) (i) use of expected value formula.

 $E(X) = 4 \times 0.45 + (-4) \times 0.15 + (-6) \times 0.25 + (-10) \times 0.15 = -1.8$

(ii) Any one of the following

- players are expected to/are more likely to lose \$1.80 (per game)
- this is the long-term expected average when playing the game many times
- the expected value/it does not equal 0, so the game is not fair

Do not accept:

- players will lose \$1.80 (per game)
- players will/are expected to win -\$1.80
- on average, players will lose money
- players are expected to lose money (per game)
- there is more chance of losing money than winning
- the game is not fair

(b) (i)
$$E(X) = 0$$
 (M1)

Either

Evidence of increasing the price (M1) $E(X) = (4 + (k - 1) \times 1) \times 0.45 + (-4) \times 0.15 + (-6) \times 0.25 + (-10) \times 0.15 = 0$

A1

(M1)



A1 A1

Or

$$E(X) = w \times 0.45 + (-4) \times 0.15 + (-6) \times 0.25 + (-10) \times 0.15 = 0$$
 (M1)

w = 8 then k = 5

[Total: 8 marks]