Markscheme

November 2021

Extended mathematics

On-screen examination

25 pages

• Bullet notation means award 1 mark – see example below

Example 1
.1 mark awarded and corresponding notes are aligned

b	.1 Show clear line of reasoning in the method .2 4	.1 45 & 49 seen **OE** *eg*, $49 = 45 + x$ .2 **Accept** $45 + X/10 = 4.9$ **and** Ans 4	**2**

Error Carried Forward (ECF) marks

Errors made at any step of a solution affect all working that follows. In general, **Error Carried Forward (ECF)** marks are awarded after an error.

a) **ECF** applies from one part of a question to a subsequent part of the question and also applies within the same part.
b) If an answer resulting from **ECF** is inappropriate (*eg*, negative distances or sin$x$ > 1) then subsequent marks should not be awarded.
c) If a question is transformed by an error into a **simpler question** then **ECF** may not be fully awarded.
d) To award **ECF** marks for a question part, **there must be working present for that part**.
e) **ECF** is only applied to working which is correct. This means that all working subsequent to an error must be checked for accuracy.
f) A misread (**MR**) is an error**. ECF** is normally awarded.

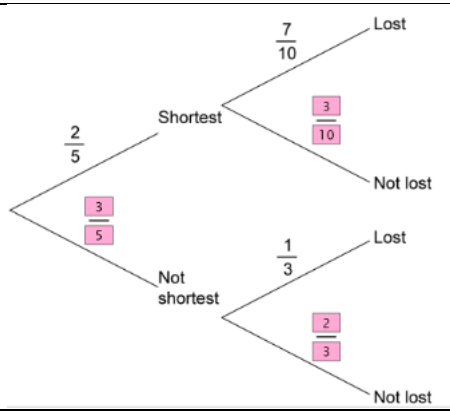
General points

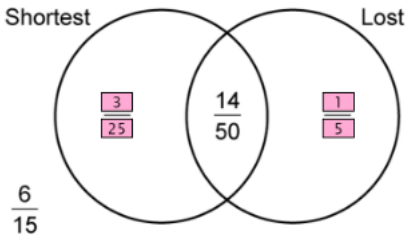
a) As this is an international examination, accept all alternative forms of **notation,** for example 1.9 and 1,9 or 1 000 or 1.000. However **DO NOT ACCEPT** incorrect mathematical notation e.g x^2 for x^2 unless noted otherwise in the MS.
b) Accept notation errors in intermediate steps.
c) Ignore further working after a correct answer **unless** it indicates a lack of mathematical understanding **i.e. if the further working contradicts the correct answer,** then the last mark cannot be awarded.
d) In the case when a correct result is obtained using incorrect seen method, do not award the mark for the result.
e) Where candidates have written two solutions to a question, mark the first solution.
f) In the markscheme, equivalent examples of **numerical** and **algebraic** forms or **simplified** answers will generally be written in the notes preceded by **OE** (or equivalent) e.g. $\frac{1}{2}$ **OR** 1/2 **OR** $1 \div 2$ and $\frac{x}{2}$ $x / 2$ **OR** $x \div 2$
g) In the markscheme, information provided in brackets indicate detail that may be seen in a candidate response but is not necessary to award the marks.
h) Special case marks **SC** can be allocated instead of but not in addition to the marks prescribed in the markscheme.
i) Accept seeing equation not in-line.
j) Calculator screenshots are accepted as working steps. And when a calculator screenshot is taken, accept not seeing the whole operation.
k) In task 2 and 3 where the markscheme is set out in a table then, unless noted otherwise, awarding the highest mark in a category includes all the lower marks in that category. It is probably best to look for the top category mark answer and if you don't find it look at the next mark down.
l) ACCEPT using the correct values regardless their previous result

Question 1		Answers	Notes	Total
	a	.1 add the correct vectors .2 correctly calculate both components	.1 $-\begin{pmatrix}4\\-0.5\end{pmatrix}+\begin{pmatrix}6\\3\end{pmatrix}$ or $\begin{pmatrix}-4\\0.5\end{pmatrix}+\begin{pmatrix}6\\3\end{pmatrix}$ or $\begin{pmatrix}6\\3\end{pmatrix}-\begin{pmatrix}-4\\0.5\end{pmatrix}$; ACCEPT BA+AC or AC-AB. .2 $\begin{pmatrix}2\\3.5\end{pmatrix}$ .2 DO NOT ACCEPT if not in column vector form	**2**
	b	**AM1** .1 correctly double the vector AB .2 add their correct vectors .3 correctly calculate both components **AM2** .1 correctly double the vector AB OR route seen .2 correct horizontal component seen in column form .3 correct vertical component seen in column form	**AM1** .1 $\begin{pmatrix}8\\-1\end{pmatrix}$ seen .2 $\begin{pmatrix}6\\3\end{pmatrix}$ – their $\begin{pmatrix}8\\-1\end{pmatrix}$ or $\begin{pmatrix}4\\-0.5\end{pmatrix}$ +their $\begin{pmatrix}2\\3.5\end{pmatrix}$ – their $\begin{pmatrix}8\\-1\end{pmatrix}$; ACCEPT AC+CD or AC-DC or AB+BC+CD or AC-2AB .3 $\begin{pmatrix}-2\\4\end{pmatrix}$ ACCEPT $\begin{pmatrix}\text{their}-2\\\text{their}4\end{pmatrix}$ only if .2 is awarded .3 DO NOT ACCEPT if not in column vector form **AM2** .1 $\begin{pmatrix}8\\-1\end{pmatrix}$ seen OR AC+CD or AC-DC or AB+BC+CD or AC-2AB .2 $\begin{pmatrix}-2\\\text{their}4\end{pmatrix}$ .3 $\begin{pmatrix}\text{their}-2\\4\end{pmatrix}$ **ACCEPT the working being not in column form in any AM**	**3**

	c	.1 evidence of using the dot product between the correct vectors .2 correct operation for the dot product of their vectors .3 correctly calculate the dot product AG they are perpendicular	.1 $\begin{pmatrix}6\\3\end{pmatrix}$ • their $\begin{pmatrix}-2\\4\end{pmatrix}$; ACCEPT AC • AD .1 ACCEPT using x instead of • or just not putting any sign between multiplied vectors .2 Their(6 x -2 + 3 x 4) , ACCEPT their(-12 + 12) .3 (6 x-2 + 3 x 4 =)0 or (-12 + 12 =) 0 (and hence perpendicular) .3 DO NOT ACCEPT if their dot product is not equal to 0	**3**

Question		Answers	Notes	Total
2		**AM 1 (using symbols implies the use of AM1)** .1 correctly write one equation .2 correctly write the other equation .3 correctly step towards solving the two equations .4 correctly reduce to one equation in one unknown .5 correctly identify the x value being 30 **AM 2 (Using values instead of symbols wasn't used by any student so can be removed)** .1 Seeing three numbers that fit the first equation .2 equate the correct operation with 160 .3 seeing three numbers that fit the second equation .4 equate the correct operation with 70 .5 correctly identify the x value being 30	**AM 1** .1 $t + 2c + b = 160$ .2 $t + b - c = 70$ .3 *Attempt* to subtract equations or add •1 to double of •2 equation OR substitute c in terms of t and b into the other equation OR double equation of .2 .4 $3c = 90$ OE ACCEPT $3(t + b) = 300$ .5 $c = 30$, DO NOT ACCEPT their c value **AM 2** .1 Ex: 100 and 10 and 40 .2 Ex: $100 + 2 \times 10 + 40 = 160$ .3 Ex: 90 and 40 and 60 .4 Ex: $90 + 40 - 60 = 70$ .5 $c = 30$, DO NOT ACCEPT their c value ACCEPT using the word "carton" or any symbol to represent it	**5**

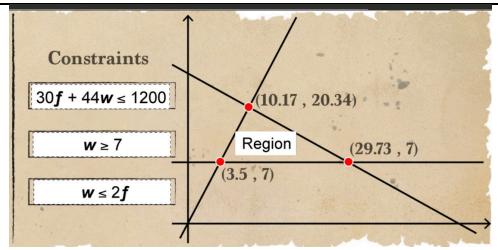
Question		Answers	Notes	Total
		Note: If their probability used is greater than 1 then do not award the bullet point		
3	a	• $\frac{3}{5}$ or 0.6 OE		**1**
	b	correctly write 3/5 and 3/10 and 2/3 in the appropriate place		**1**
	C	.1 multiply $\frac{2}{5}$ by their Not Lost .2 multiply their Not shortest by their Not Lost .3 correctly calculate their result after adding their multiplied fractions	.1 $\frac{2}{5}\times \textit{their}\ \frac{3}{10}$ or 0.12 OE .2 $\textit{their}\ \frac{3}{5}\times \textit{their}\ \frac{2}{3}$ .3 $(\frac{2}{5}\times \textit{their}\ \frac{3}{10}+\textit{their}\ \frac{3}{5}\times \textit{their}\ \frac{2}{3}=)$their $\frac{13}{25}$ OE , DO NOT ACCEPT 0.5	**3**
	d	.1 correctly probability of shortest and not lost explicitly seen OR divide a probability by $\textit{their}\ \frac{13}{25}$ .2 correctly calculate their result after dividing their correct probability of shortest and not lost by $\textit{their}\ \frac{13}{25}$	.1 $\frac{2}{5}\times \textit{their}\ \frac{3}{10}$ or 0.12 OE OR $\frac{\textit{a probability}}{\textit{their}\ \frac{13}{25}}$ .2 $\textit{their}\ \frac{3}{13}$ or their0.23(07…) OE DO NOT ACCEPT $\textit{their}\ \frac{3}{13}$ without working	**2**

	e	.1 correct working for probability of Shortest and Not Lost OR Not shortest and lost .2 correctly place their probability of Shortest and Not Lost on the diagram .3 correctly place their probability of Not Shortest and Lost on the diagram	 .1 $\frac{2}{5}\times$ *their* $\frac{3}{10}$ or *their* $\frac{13}{25}-\frac{6}{15}$ OR *their* $\frac{3}{5}\times\frac{1}{3}$ .2 their $\frac{3}{25}$ OE correctly placed on the diagram .3 their $\frac{1}{5}$ OE correctly placed on the diagram .3 DO NOT award unless the total of probabilities is 1	**3**

Question		Answers	Notes	Total
4	a	.1 correctly substitute 10 and -2 .2 correctly use log laws to show that k=-1 (*k* =)-1 AG	.1 $-2 = k\log_3(10-1)$ ACCEPT $-2 = -1\times\log_3(10-1)$ .2 $\frac{1}{9} = 9^k$ or -2 = 2*k* seen after correct steps ACCEPT $-2 = \log_3 9^k$	**2**
	b	.1 correct expression for the distance .2 correctly apply addition law for logs .3 correctly expand	.1 $\log_3(5x+7) - -\log_3(x-1)$ ACCEPT *f*(*x*) – *g*(*x*) or |*g*(*x*)-*f*(*x*)| .2 (*d* =) $\log_3(5x+7)(x-1)$ .3 (*d* =) $\log_3(5x^2+2x-7)$	**3**
	c	**AM1** .1 correctly substitute 4 into their $\log_3(5x^2+2x-7)$ .2 correctly calculate their result after using log **AM2** .1 correctly calculate f(4) and g(4) .2 correctly determine 4 as the vertical distance between the two y-coordinates	**AM1** .1 (*d* =) $\log_3(5x4^2+2x4-7)$ OE .2 their 4 ACCEPT their 4 only if their $\log_3(5x^2+2x-7)$ includes log base 3 of a quadratic **AM2** (ACCEPTED even though it is not hence because this is a determine question but note that .2 has to be 4 not their 4) .1 f(4)=3 and g(4)=-1 .2 4 DO NOT ACCEPT 4 without working	**2**
	d	.1 correctly eliminate the log .2 correctly substitute their coefficients into quadratic formula .3 correctly calculate their positive root .4 correctly write their positive answer only to 1dp	.1 1 = their $5x^2+2x-7$ DO NOT ACCEPT if their $\log_3(5x^2+2x-7)$ doesn't include log .2 their $\frac{-2\pm\sqrt{2^2-4(5)(-8)}}{2(5)}$ ACCEPT even if their $\log_3(5x^2+2x-7)$ doesn't include log .3 (*x* =)their1.0806… .4 (*x* =) their1.1 DO NOT ACCEPT if their 1.0806… is a whole number	**4**

Question		Answers	Notes	Total
5	a	.1 correctly substitute in distance formula OR add distances .2 correct distance before rounding 1170 AG	.1 $(D=)500\times\frac{140}{60}$ OE OR $500+500+\frac{20}{60}\times500$ OE .1 ACCEPT $(D=)500\times2.3(...)$ .1 ACCEPT $(\text{speed}=)\frac{1170}{(140/60)}$ or $\frac{1170}{2.3(...)}$ .2 1166.66 ACCEPT [1165,1167]	**2**
	b	.1 correctly divide 5760 by 900 .2 correctly convert their time to minutes	.1 6.4 .2 $(their 6.4\times60)=their 384$	**2**
	c	**AM1 using distance as unknown** .1 correctly write one time in terms of x (distance) .2 correctly write the other time in terms of x (distance) .3 correctly calculate the value of x (distance) .4 correctly calculate the time in hours .5 correctly write their time after 7:00 **AM2 using time as unknown** .1 correctly write one distance expression .2 correctly write the other distance expression .3 equate the correct expressions .4 correctly calculate the time in hours .5 correctly write their time after 7:00 **AM3 (trial and improvement)** .1 correctly calculate time for plane from Seoul to Tokyo or Tokyo to Seoul until the same value of x .2 correctly calculate more times for plane from Seoul to Tokyo until same values of x .3 correctly reach the value of x (distance) .4 correctly calculate the time in hours .5 correctly write their time after 7:00	**AM1** .1 x/500 or (1170-x)/436 ACCEPT a number/500 or a number/ 436 .2 x/500 and (1170-x)/436 .3 (x =) 625 .4 (625/500 =) 1.25 OE .5 their 8 :15 **AM2** .1 (d =) 436t or (d =) 500t ACCEPT 436x a number or 500x a number .2 1170–500t or 1170–436t .3 436t = 1170-500t or 500t =1170–436t .4 (t =) 1.25 OE .5 their 8 :15 **AM3 (trial and improvement)** .1 Ex: time at x= 585 or at 170 and 1000 ACCEPT only if both distances sum is 1170 .2 ACCEPT averaging the times they obtain .3 (x=)625 .4 (t =) 1.25 OE .5 their 8 :15	**5**

	d	.1 evidence of correct gradient .2 correctly substitute (80,2400) into $h(x) = 60x + c$ .3 correct $h(x)$	.1 60 seen as gradient .2 2400=60(80)+c .3 $h(x) = 60x-2400$	**3**
	e	.1 correctly substitute 700 into $q(x)$ .2 correct $p(x)$ .3 correct deduction after subtracting their11580 from 12000	.1 ($q(x)$=) -40(700) +39580 .2 ($p(x)$=) 11580 .3 (Safe) because their420 > 300. WTTE .3 ACCEPT their420 being the result of any calculation they make DO NOT ACCEPT their 420 if less than 300	**3**

Question		Answers	Notes	Total
6	a	.1 correctly place two inequalities .2 correctly place the third inequality and region.	 DO ACCETPT ECF for their region from their constraints DO NOT ACCEPT their region placed in-between regions	**2**
	b	.1 select 10 and 20 .2 correctly substitute their10 and their20 .3 correctly calculate their maximum weight.	.1 10 and 20 seen .2 their10x(30)+their20x(44) .2 ACCEPT their 10 and their 20 only if they are whole numbers or they are (10.17 , 20.34) .3 Their 1180 (lb) ACCEPT their 1180 only if less than 1200	**3**
	c	**AM1** .1 evidence of substituting into the cosine rule .2 correctly substitute into the cosine rule .3 correctly calculate their BC^2 from cosine rule .4 correctly calculate their BC after square root	**AM1** .1 Ex: substitute incorrectly into cosine rule .2 $(BC^2 =)1^2 + 1.5^2 - 2\times1\times1.5\times\cos120$ OE .3 $(BC^2 =)$their 4.75 .4 their [2.179…, 2.2]	**4**

	d	correctly add their BC to 1.5	Their [3.6794…,3.7]	**1**

e

Mark	1	2	3	4		
Identify factors (F)	Explicitly state two factors from: - Length of route - Number of days for the trip - Availability of food and water - Amount of goods they are able to carry for trading - Terrain features (mountain or crossing river,..etc) Ignore additional irrelevant factors DO NOT ACCEPT factors embedded in working	Explicitly state three factors				
Calculations (L)	Correct two values 7 days for $4 \leq D < 8$ Modal class ACCEPT $8 < D < 12$ or 8 to 12 or 8-12 ACCEPT median [9,10[Estimate mean =8.769.. ACCEPT 8.8 Total number of days = 26 Estimate for total distance travelled = 228 **In all, allow ecf from their number of days for** $4 \leq D < 8$	Correct three values	Correct four values	Correct six values		**10**

		Comapriso n (C)	Compare statistical values: Correctly compare at least two statistical values Example: Mean and number of days and total distance are less in Cimarron route **MUST compare using a word like less, more, on the other hand, while,..etc** OR State at least three statististical values for each route without explicit word for comparison **OR** Correctly compare nature of the two routes Example: comparing the roughness of the two routes OR Realise that the objective of the journey is to trade and the mountain route allows more space for trading goods	Compare statistical values: Correctly compare at least two statistical values Example: Mean and number of days and total distance are less in Cimarron route **MUST compare using a word like less, more, on the other hand, while,..etc** OR State at least three statististical values for each route without explicit word for comparison **AND** Correctly compare nature of the two routes Example: comparing the roughness of the two routes OR Realise that the objective of the journey is to trade and the mountain route allows more space for trading goods				
		Justify accuracy (A)	inaccurate with weak justification **Concerning the maths** Inaccurate because rounding used OR these are approximate calculations and not accurate OR mean and median are just estimates **OR**	inaccurate with good justification **Concerning the maths** The mean and total distance travelled are just estimates since we are using mid-interval class. OR The use of mid-class in calculations makes it an estimate **OR**				

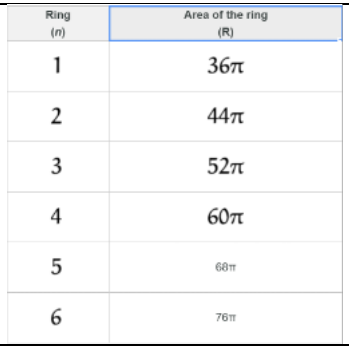
			Concerning the context Anything related to hazards or things unaccounted for that families may face OR because families cannot report exact distances every day OR we cannot know for sure how they measure their distances travelled DO NOT ACCEPT: my results are accurate with any reason WTTE	**Concerning the maths:** mean and median are just estimates **AND Concerning the context** Anything related to hazards or things unaccounted for that families may face OR because families cannot report exact distances every day OR we cannot know for sure how they measure their distances travelled				

Distance travelled (D) in miles	Number of days (N)
$0 \le D < 4$	3
$4 \le D < 8$	7
$8 \le D < 12$	12
$12 \le D < 16$	3
$16 \le D < 20$	1

Measures of central tendency for the distance travelled by Family Fry			Total number of days	Estimate for the total distance travelled
Modal class	Estimate for the median	Estimate for the mean		
8<D<12	9	8.769...	26	228

Mountain Route

Measures of central tendency for the distance travelled by Family Kane			Total number of days	Estimate for the total distance travelled
Modal class	Estimate for the median	Estimate for the mean		
$12 \le D < 16$	13.5	12.87	39	502

Question		Answers	Notes	Total
7	a	correctly place 68π and 76π OE		**1**
	b	.1 correctly describe one pattern for A only in words with acceptable terminology	Examples of suitable patterns and acceptable terminology: Increases by 8π WTTE DO NOT ACCEPT Increasing by 8 Multiples of 8 even numbers	**1**
	c	.1 the correct general rule .2 the correct simplified general rule with correct notation	•1 (R=) $28\pi + 8n\pi$ ACCEPT (R=) $28\pi + 8\times n\pi$ ACCEPT R= $28 + 8n$ Accept one incorrect coefficient e.g (A=) $48\pi + 8n\pi$ •2 R = $28\pi + 8n\pi$ ACCEPT $R = 36\pi + (n-1)8\pi$ DO NOT ACCEPT description in words DO NOT ACCEPT incorrect notation on its own	**2**
	d	.1 correctly substitute $n \geq 5$ into their general rule .2 correctly calculate their value of C after substituting $n \geq 5$ .3 recognize that their correctly calculated value of C is the same as their predicted value	.1 Ex : $28\pi + 8x5\pi$ .2 68π (for $n = 5$) .3 Same as value I predicted in table (and we find the candidate has 68π in the table for $n = 5$) **OR** same as when we continue the pattern and explains how 68π is obtained from pattern of adding 8π to 60π	**3**

	e	.1 Set equation for area ring = 6x area pink tile + 12 x area blue tile OR 24 seen in denominator .2 divide 36π by 24 AG $\frac{3}{2}\pi$	.1 $36\pi = 6(2x) + 12(x)$ or $36\pi = 24x$ OE ACCEPT not seeing this step .2 $\frac{36\pi}{24}$ **ACCEPT using decimals provided they write** $\frac{3}{2}\pi = 4.71(2....)$	**2**

7	f	QIG8					22
Mark		**1**	**2**	**3**	**4**	**5**	
Predictions (P)		Correctly predict three terms for P or A ACCEPT whether in the table or in the response box ACCEPT typing errors like seeing $5/3\pi$ or using pi instead of π or missing the pi	Correctly predict four terms for P and A ACCEPT whether in the table or in the response box ACCEPT typing errors like seeing $5/3\pi$ or using pi instead of π or missing the pi				
Description (D)		Attempt to describe a pattern in words for A Ex: numerators and denominator are even numbers The up number increases by 8 or 8π The lower/bottom number increases by 6 The denominator increases by 6π The denominator is the number of pink tiles Linear sequence for numerator DO NOT ACCEPT A is linear **OR** Attempt to describe a rule in words for A **OR** Attempt to describe a pattern in words for A and	Attempt to describe pattern for A as general rule Ex: Correct general rule for numerator (8n+10) Or Correct general rule for denominator (6n) **OR** One correct pattern described in words for A Ex: Numerator increases by 8 or 8π Denominator increases by 6 **OR** Attempt to describe a pattern in words for A and correct rule for A not in terms of n only Ex: A=(R-12B)/P	Correctly describe the pattern for A as a general rule Rule: $A = \frac{8n+10}{6n}\pi$ OE **ACCEPT if the π is missing and penalize in notation** **ACCEPT rule for numerator=8n+10 and rule for denominator 6n and penalize in notation** **OR** Two correct patterns described in words for A (one for numerator and the other for denominator) **OR**	Correctly describe the pattern for A as a general rule **AND** one correct pattern described in words for A **ACCEPT if the π is missing and penalize in notation** **ACCEPT rule for numerator=8n+10 and rule for denominator 6n and penalize in notation** **OR** Attempt to describe pattern for A as general rule **AND** two correct patterns described in words for A (one for numerator and the other for denominator)	Correctly describe the pattern for A as a general rule **AND** two correct patterns described in words for A (one for numerator and the other for denominator) **ACCEPT if the π is missing and penalize in notation** **ACCEPT rule for numerator=8n+10 and rule for denominator 6n and penalize in notation**

	correct rule for A not in terms of n only Ex: A=(R-12B)/P **OR** A correct pattern described as general rule for P DO NOT ACCEPT A is increasing DO NOT ACCEPT any description for P in words		Correct general rule for numerator **AND** Two attempts to describe pattern in words **OR** Attempt to describe pattern for A as general rule **AND** one correct pattern described in words for A		
Testing (T)	Attempt to test their general rule for A using $n \leq 4$ **Ex:** Substitute in their general rule value of $n \leq 4$ **OR** Correctly test their described pattern or their rule (e.g. recursive rule)	Correctly test their general rule for *A* only in terms of *n* using $n \leq 4$ Ex: Correctly calculate their value for A in their general rule using $n \leq 4$ **AND** Recognise that their correctly calculated value for A is the same as the given value. ACCEPT seeing their correctly calculated value for *A* and the given value in the table being equal			
Verifying (V)	Attempt to verify their general rule for A using $n \geq 5$ Ex**:**	Correctly calculate their value for *A* in their general rule only in terms of *n* using $n \geq 5$	Correctly calculate their value for *A* in their general rule only in terms of *n* using $n \geq 5$ **AND** Recognise that their correctly calculated value		

	substitute in their general rule value of $n \geq 5$ **OR** Correctly verify their described pattern or their rule (e.g. recursive rule)		for A is the same as their predicted value obtained by continuing the pattern ACCEPT seeing their correctly calculated value for A and their predicted value in the table being equal		
Justify/proof (J)	Attempt to justify any of their described patterns or their general rule Ex: Attempt to use the arithmetic sequence OR Substitute at least two other values of n in A and say they are the same or the rule works (regardless the π)	Justify their general rule correctly Ex: Use the arithmetic sequence for the numerator to show the rule. OR Weak attempt at geometrical justification Ex: Attempt to equate their R rule (area of ring) to the sum of their areas of pink and blue tiles Justify the general rule of A geometrically not in terms of n only	Attempt to justify geometrically the general rule Ex: Attempt to equate the correct R rule (area of ring) to the sum of correct areas of blue and pink tiles $8\pi n + 28\pi = 12(\frac{3}{2}\pi) + 6n \times A$ OE ACCEPT with our without π	Correctly justify geometrically the general rule Ex: Show that the correct general rule for A is equal The correct R rule – area of blue tiles and divide by the correct rule of number of pink tiles $\frac{8\pi n + 28\pi - 12(\frac{3}{2}\pi)}{6n}$ DO NOT ACCEPT without π	
Notation and terminology (N)	Correct notation of their general rule Ex: rule for numerator $A = (4n + 5)\pi$	Correct notation of the general rule for A $A = \frac{(8n + 10)\pi}{6n}$ OE	Correct notation of the general rule for A **AND**		

	OR The notation of the general rule includes errors Ex: the rule is $\frac{8n+10}{6n}$ or $A = \frac{4x+5}{3x}\pi$ or $\frac{8n+10}{6n}\pi$ or The rule for numerator is 8n+10 and rule for denominator is 6n $A_n = \frac{18 + (n-1)\,8}{6 + (n-1)\,6}\pi$ **OR** Correctly describe a pattern in words for A DO NOT ACCEPT if they don't have any rules and they don't describe any patterns	**OR** The notation of the general rule includes errors **AND** Correctly describe a pattern in words for A DO NOT ACCEPT if they don't have a rule	Correctly describe a pattern in words for A		
Communication (L) can be awarded even there are errors in their descriptions and working	**At least three** from the following are seen: - describe a pattern or rule in words - write a general rule - test their general rule or pattern - verify their general rule or pattern - justify their general rule or pattern	**At least four** of the following are seen: - describe a pattern or rule in words - write a general rule - test their general rule or pattern - verify their general rule or pattern - justify their general rule or pattern **AND**	DO NOT ACCEPT if D3 and J2 not awarded **At least four** of the following are seen: - describe a pattern or rule in words - write the general rule - test the general rule - verify the general rule - justify the general rule **AND** For coherence, they identify the processes		

		For coherence, they identify the processes correctly. **At least one** from the following: - test - verify - justify Ex: -For test: they say “test” and they test using value(s) of $n \leq 4$ only -For verify: they say “verify” and they verify using value(s) of $n \geq 5$ only -For test and for verify: they say ‘test **and** verify’ and they test using value(s) of $n \leq 4$ **and** then verify using value(s) of $n \geq 5$ -For justify: they say “justify” or "my rule works because" WTTE and their justification is seen -For justify: they substitute at least two values of n **and** say “the rule justified” or “it works” WTTE - For justify:	correctly. **At least two** from the following: - test - verify - justify Ex: -For test: they say “test” and they test using value(s) of $n \leq 4$ only -For verify: they say “verify” and they verify using value(s) of $n \geq 5$ only -For test and for verify: they say ‘test **and** verify’ and they test using value(s) of $n \leq 4$ **and** then verify using value(s) of $n \geq 5$ -For justify: they say “justify” or "my rule works because" WTTE and their justification is seen - For justify: They assume quadratic model (or 2nd diff 8 OE) and get values of coefficient(s) using any method - For justify: They justify the general rule for A geometrically		

		They assume quadratic model (or 2nd diff 8 OE) and get values of coefficient(s) using any method - For justify: They justify the general rule for A geometrically			

Ring (n)	Area of the ring (R)	Number of pink tiles (P)	Area of a pink tile (A)
1	36π	6	$\frac{18}{6}\pi$
2	44π	12	$\frac{26}{12}\pi$
3	52π	18	$\frac{34}{18}\pi$
4	60π	24	$\frac{42}{24}\pi$
5	68π	30	$\frac{50}{30}\pi$ or $\frac{5}{3}\pi$ OE
6	76π	36	$\frac{58}{36}\pi$ or $\frac{29}{18}\pi$ OE