

Markscheme

November 2020

Mathematics

On-screen examination

21 pages

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The markscheme may make use of the following abbreviations:

RM Assessor has the following annotations that should be used to award marks:

A0 only use to award a zero mark for an answer that has no merit e.g. awarded for the candidate that has a wrong answer with no working

NR only use when the candidate has not made any response also stamp the response with 

 Marks awarded by stamping the tick

 Seen; must be stamped on all blank response areas and on concatenated responses

 unclear

- Bullet notation means award 1 mark – see example 1 below

ECF Marks that can be awarded as **error carried forward** from previous results in the question

BOD Benefit of the doubt

MR misread

NWS no working shown

SC special case

OE or equivalent

WTTE or words to that effect or accept incomplete calculator display

AG Answer given

Example 1

- 1 mark awarded and corresponding notes are aligned

b	<ul style="list-style-type: none">• Show clear line of reasoning in the method• 4	45 & 49 seen OE eg, $49 = 45 + x$	2
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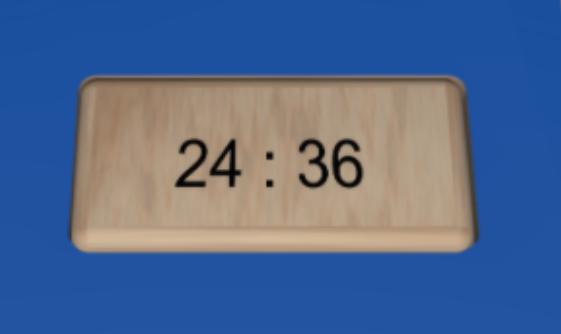
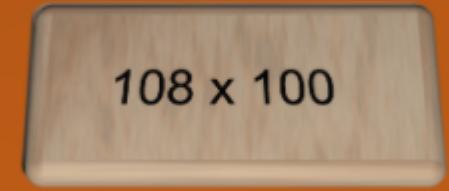
Error Carried Forward (ECF) marks

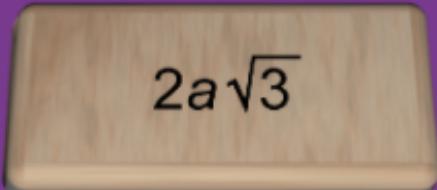
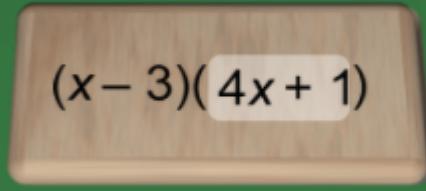
Errors made at any step of a solution affect all working that follows. In general, **Error Carried Forward (ECF)** marks are awarded after an error.

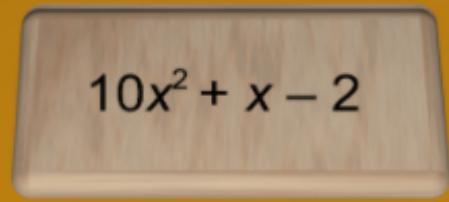
- a) **ECF** applies from one part of a question to a subsequent part of the question and also applies within the same part.
- b) If an answer resulting from **ECF** is inappropriate (eg, negative distances or $\sin x > 1$) then subsequent marks should not be awarded.
- c) If a question is transformed 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) 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.
- c) Where candidates have written two solutions to a question, mark the response that deserves more marks.
- d) 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 $\frac{x}{2}$ or $x \div 2$
- e) 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.
- g) Special case marks **SC** can be allocated instead of but not in addition to the marks prescribed in the markscheme. **Accept seeing equation not in-line**,
- h) **Accept notation errors in intermediate steps**,
- i) When a calculator screenshot is taken, accept not seeing the whole operation

Question	Answers		Notes	Total
1 a	 24 : 36			1
b	 108 x 100			1
c	 a^6			1

	d				1
	e				1
	f				1

	g	 A digital calculator screen displays the quadratic expression $10x^2 + x - 2$. The screen has a light beige background with a dark grey border around the display area. The expression is centered on the screen.					1
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Question	Answers	Notes	Total
2 a	<ul style="list-style-type: none"> •1 correctly identify the x-coordinate of vertex •2 correctly substitute their x into $f(x)$ •3 correctly calculate their value of $f(2.5)$ after substitution of $2 < \text{their } x < 3$ 	<ul style="list-style-type: none"> •1 2.5 OE seen as a result of substituting in $-\frac{b}{2a}$ or when substituting x in $f(x)$ •2 – their2.5(their2.5 – 5) Accept only if $2 < \text{their}2.5 < 3$ •3 their 6.25 OE 	3
b	2		1
c	<p>AM1</p> <ul style="list-style-type: none"> •1 correct one factor •2 correct second factor AND negative sign <p>AM2</p> <ul style="list-style-type: none"> •1 correctly write $g(x)$ in terms of $f(x)$ •2 correctly write $g(x)$ 	<p>AM1</p> <ul style="list-style-type: none"> •1 $(x - 2)$ or $(x - 7)$ seen •2 $(g(x) =) - (x - 2)(x - 7)$ OE $(g(x) =) - (x - 2)(x - 7)$ OE without working award 2 marks <p>AM2</p> <ul style="list-style-type: none"> •1 $f(x - 2)$ •2 $- (x - 2)(x - 7)$ OR $-(x - 4.5)^2 + 6.25$ OE 	2
d	correctly reflect their quadratic $g(x)$ in the x -axis	$(h(x) =) \text{their } (x - 2)(x - 7)$	1
e	opposite value of their positive maximum from (a)	their – 6.25 ACCEPT only if negative	1

Standard (9 marks)

Question	Answers	Notes	Total
3 a	•1 seeing 40(%) •2 multiply their 40 % by 25 % AG 0.1	•1 0.4, ACCEPT 40(%) on the diagram •2 0.4×0.25 OE	2
b	Correctly write 3 as the answer		1
c	•1 correctly place their 3 and their 27 in 'First donor' •2 correct probabilities for their O- second branches •3 correct probabilities for their Not O- second branches	<p style="text-align: center;">First donor Second donor</p> <p>.1 ACCEPT their 3 only if positive integer $0 < \text{their3} < 30$.2 or .3 ACCEPT only $0 < \text{their probability} < 1$</p>	3
d	•1 correctly calculate the probability first O- and second not O- from their tree diagram •2 correctly calculate the probability first not O- and second O- from their tree diagram	<ul style="list-style-type: none"> •1 $\frac{\text{their3}}{30} \times \frac{\text{their27}}{\text{their29}}$ or $\frac{27}{290}$ or 0.093(103...) seen •2 $\frac{\text{their27}}{30} \times \frac{\text{their3}}{\text{their29}}$ or $\frac{27}{290}$ or 0.093(103...) seen •3 $\frac{27}{145}$ or 0.186(2...) OE 	3

		<p>•3 correctly add their two products of probabilities above</p>	<p>.3 ACCEPT 0.19 or 19% .3 DO NOT ACCEPT 0.18 or decimal number that rounds to 0.18 .3 DO NOT ACCEPT 1dp rounding (ex: 0.2 or 20%)</p>	
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Pool Question	Answers	Notes	Total
4 a	<ul style="list-style-type: none"> •1 correctly substitute 1.3 and 4 into the correct volume formula •2 multiply their capacity by 0.9 OR subtract 10% of their capacity from their capacity •3 correctly calculate their volume before rounding 58.8 AG 	<ul style="list-style-type: none"> •1 $V = \pi \times 16 \times 1.3$ or $V = \pi \times 4^2 \times 1.3$ or 20.8π or 65.3(45....) •2 their 65.3(45..) x 0.9 OR their 65.3(45..) - 6.53(45..) •3 their 58.81(....) ACCEPT only if their answer rounds to 58.8 	3
b	<ul style="list-style-type: none"> •1 divide their 58800 by 11 200 or their 58.8 by 11.2 •2 5.25 (hours) •3 correctly write their time as hours and minutes 	<ul style="list-style-type: none"> •1 $\frac{\text{their 58800 OE}}{11200}$ •2 5.25 (hours) or 315 (minutes) seen •3 their 5 hours and 15 min 5 hours and 15 min without working award 2 marks <p>SC seeing $5.25 \times 11.2 = 58.8$ AWARD .1 and .2</p>	3
c	<ul style="list-style-type: none"> •1 correctly substitute 4 into the correct area of circle formula •2 correctly substitute 4 into the correct circumference of a circle formula •3 multiply their circumference of circle by 0.3 •4 correctly add their •1 and •3 •5 correctly round their .4 to the nearest square metre 	<ul style="list-style-type: none"> •1 $\pi \times 16$ or $\pi \times 4^2$ or 50.27 or 50.24 (using 3.14) •2 $\pi \times 8$ or $2 \times \pi \times 4$ or 25.1(327...) •3 their $\pi \times 8 \times 0.3$ or their $2 \times \pi \times 4 \times 0.3$ or 7.5(398...) •4 their 57.8(05...) •5 their 58 ACCEPT earlier all correct rounding 	5
d	correctly multiply their 57.8(05...) or their 58 by 3.4	<p>their (\$196.52 or (\$197.2</p> <p>ACCEPT their 196.52 without working</p> <p>DO NOT ACCEPT their 57.8(05...) x 3.4 incorrectly rounded in d)</p>	1

Question	Answers	Notes	Total
5 a	<ul style="list-style-type: none"> •1 correctly determine 1.95 •2 correct trig ratio used •3 correctly write their answer before rounding or correct inverse trig ratio AG 70° 	<ul style="list-style-type: none"> •1 $12.55 - 10.6$ •2 $\cos y = \frac{1.95}{5.7}$ accept not seeing this step •3 $y = \cos^{-1} \frac{1.95}{5.7}$ or $69.99(480991)$ Accept only if their answer rounds to 70 	3
b	<p>AM1</p> <ul style="list-style-type: none"> •1 double the 70 •2 correctly subtract 140 from 180 <p>AM2</p> <ul style="list-style-type: none"> •1 subtract 70 from 90 or 160 from 180 •2 correctly double 20 	<p>AM1</p> <ul style="list-style-type: none"> •1 2×70 or 140 seen •2 40 <p>AM2</p> <ul style="list-style-type: none"> •1 $90 - 70$ or 20 seen •2 40 <p>40 without working AWARD 2 marks Accept correct answer on the canvas in part (a)</p>	2
c	<p>AM1</p> <ul style="list-style-type: none"> •1 correct trig ratio used with 10.6 OR correctly substitute into sine rule •2 correctly rearrange their trig ratio for v •3 correctly calculate their v after dividing by their trig ratio 	<p>AM1</p> <ul style="list-style-type: none"> •1 $\cos 70 = \frac{10.6}{v}$ or $\sin 20 = \frac{10.6}{v}$ OE OR $\frac{v}{\sin 70} = \frac{21.2}{\sin 40}$ OE •1 ACCEPT 10.6 and $\cos 70$ or $\sin 20$ seen •2 their $(v =) \frac{10.6}{\cos 70}$ or their $(v =) \frac{10.6}{\sin 20}$ or their $(v =) \frac{21.2 \times \sin 70}{\sin 40}$ •3 their $30.99(23\dots)$ or 31 or $31.2(11\dots)$ ACCEPT only if .1 or .2 is awarded 	3

	<p>AM2</p> <ul style="list-style-type: none"> •1 correct trig ratio used with 12.55 OR correctly substitute into sine rule •2 correctly calculate their hypotenuse •3 correctly calculate their v after subtracting 5.7 from their calculated hypotenuse <p>AM3</p> <ul style="list-style-type: none"> •1 seeing evidence of using similar triangles correctly •2 correctly rearrange for v OR correctly apply their scale factor •3 correctly calculate their v after dividing their product 	<p>AM2</p> <ul style="list-style-type: none"> •1 $\cos 70 = \frac{12.55}{\text{hyp}}$ OR $\frac{a}{\sin 70} = \frac{25.1}{\sin 40}$ OE •2 their 36.69(37...) ACCEPT ($\text{hyp} = \frac{12.55}{\cos 70}$) •3 their 30.99(23....) or 31 or 31.2(11..) ACCEPT only if .1 or .2 is awarded <p>AM3</p> <ul style="list-style-type: none"> •1 seeing $\frac{12.55}{1.95}$ or $\frac{10.6}{12.55}$ OE or $\frac{v}{10.6} = \frac{v+5.7}{12.55}$ OE •2 $10.6 \times \frac{5.7}{1.95}$ OR $1.95v = 60.42$ •3 their 30.99(23....) or 31 or 31.2(11..) ACCEPT only if .1 or .2 is awarded 	
d	<ul style="list-style-type: none"> •1 correctly substitute their v or their $v+5.7$ into correct area of circle formula •2 subtract their areas of circles •3 multiply at least one area by their $40/360$ •4 correctly calculate their area after multiplying $40/360$ by their difference of areas 	<ul style="list-style-type: none"> •1 $\pi \times \text{their } 36.7^2$ or $\pi \times \text{their } 31^2$ seen •2 $\pi \times \text{their } 36.7^2 - \pi \times \text{their } 31^2$ OE •3 $\text{their area} \times \text{their } \frac{40}{360}$ •4 their 134.6(...) or 134.7(...) or 135 	4
e	<p>AM1</p> <ul style="list-style-type: none"> •1 correctly calculate the material wasted •2 correctly write their fraction of material wasted •3 correctly calculate percentage of their fraction of area <p>AM2</p> <ul style="list-style-type: none"> •1 correctly calculate the fraction area of material used •2 Subtract their fraction from 1 •3 correctly write their difference above as percentage 	<p>AM1</p> <ul style="list-style-type: none"> •1 $(25.1 \times 7.6 - \text{their } 134.6 =)$ their 56.16 ACCEPT [55.7 , 56.2] •2 $\frac{\text{their } 56.16}{\text{their } 25.1 \times 7.6}$ •3 their 29(....) (%) <p>AM2</p> <ul style="list-style-type: none"> •1 $\frac{\text{their } 134.6}{\text{their } 25.1 \times 7.6}$ •2 $1 - \text{their } 0.705(...)$ •3 their 29(....) (%) 	3

Question	Answers	Notes	Total
6	a	<ul style="list-style-type: none"> •1 correctly drag three heights •2 correctly drag the other three heights <p>SC: All six bars correct and thinner award 1 mark</p>	2
	b	<p>A valid statement including both 1990 and 2016</p> <p>DO NOT ACCEPT a comment on only one interval Ex: in 1990, 3 countries had E between 0 and 10 while in 2016 there are 8 Ex: Highest in 1990 is 17 while highest in 2016 is 24</p> <p>ACCEPT Overall correct comment ex: Less particulates or less exposure in the air in 2016 than 1990 OE Comments including more than one interval. Ex: In 2016 no countries had E more than 40 but in 1990 there were</p>	1
	c	<ul style="list-style-type: none"> •1 seeing two correct midpoints and two correct frequencies •2 Add their four products of midpoints and frequencies •3 Divide the sum of their products by 39 •4 Correctly write their mean before rounding <p>AG 15.3 ($\mu\text{g}/\text{m}^3$)</p>	4
	d	<ul style="list-style-type: none"> •1 $(a =) -\frac{1}{5}$ OE •2 $(b =) 18$ 	2

6	e	Mark	1	2	3	
		F Identification of Factors	<p>One factor mentioned from: The model/equation used to predict. or Whether the data will follow same trend or not or Acknowledge the E is decreasing or The fact that these are models based on scatter plots.</p> <p>ACCEPT factors affecting the trend like more data in the last 5 years collected or using electric cars or new technology that affects the environment or using solar power instead of petrol or air pollution or control of particular matter</p> <p>DO NOT ACCEPT only saying many factors</p>			
		PL (Prediction from line)	<p>Attempt to calculate the E in 2030 using their line equation</p> <p>Ex: Substitute 40 in the equation and make incorrect calculation</p> <p>OR</p> <p>Substitute 2030 into the equation and make correct calculation</p> <p>OR</p> <p>Attempt to use the drop every 5 years to predict the drop in 2030 from the graph</p> <p>OR</p> <p>Describe the trend in words and predict it will reach below 13</p>	<p>Correctly calculate the E in 2030 using their line equation</p> <p>Ex: their $(-0.15(40) + 18 =)12$</p> <p>OR</p> <p>correctly use the drop every 5 years to predict the drop in 2030 from the graph</p>		10

	PE (Prediction from Exponential)	<p>Attempt to calculate the E in 2030 using the exponential equation</p> <p>Ex: Substitute 40 in the equation $(6 \times 0.91^{40} + 13.8)$ and make incorrect calculation</p> <p>OR</p> <p>Substitute 2030 into the equation and make correct calculation</p> <p>OR</p> <p>Attempt to use the drop every 5 years to predict the drop in 2030 from the graph</p> <p>OR</p> <p>Describe the trend in words and predict it will not reach 13</p>	<p>Correctly calculate the E in 2030 using the exponential equation $(6 \times 0.91^{40} + 13.8 =) 13.9(379)$, accept 14</p> <p>OR</p> <p>use the drop every 5 years to predict the drop in 2030 from the graph</p> <p>ACCEPT if they mention that the exponential will never reach 13 and refer to horizontal asymptote being $E = 13.8$</p>		
	D degree of accuracy	<p>Inaccurate with weak reason (Interpolating)</p> <p>Example: inaccurate because I used line of best fit</p> <p>Inaccurate because of sudden increase of pollution happening</p> <p>OR</p> <p>Accurate with valid reason</p> <p>Example: accurate because I used my line of best fit to estimate and made correct calculations</p> <p>OR</p> <p>Rounding to a whole number used for their estimated year</p> <p>Ex: 14 for the E from exponential DO NOT ACCEPT if they just write down a year without any reference or calculations</p> <p>DO NOT ACCEPT accurate or inaccurate without reason</p>	<p>Inaccurate with a valid reason related to variables affecting the future (extrapolating)</p> <p>Ex:</p> <p>The prediction I made not very accurate because many factors may vary in the future</p> <p>or</p> <p>predictions using line of best fit for the future not guaranteed</p> <p>or</p> <p>The prediction using the line equation not very accurate because it is taking only a window or isolated time</p> <p>or</p> <p>The prediction using the line equation not very accurate because it assumes the future follows same pattern</p> <p>OR</p> <p>My predictions not very accurate because a disaster may happen and affect pollution</p>		

		J Justifying the model	<p>Selecting the Exponential model (even implicitly ex: substituting only in exponential model) without justification</p> <p>OR Select the line with acceptable justification Ex: it passes through more points</p> <p>OR comparison comment without selection</p> <p>Ex: Line will decrease in a short time while exponential will take longer</p> <p>OE</p>	<p>Selecting the Exponential model (even implicitly) with general justification (no explicit data)</p> <p>Ex: I advise using graph 2 because it takes most of the points into account or Line will decrease in a short time while exponential will take longer or exponential more fitting</p>	<p>Selecting the Exponential model (even implicitly) With good justification involving data in the last years</p> <p>Ex: graph 2 is better because in the last years, the E did not vary much or it is nearly constant in the last years and it takes this into account while graph 1 doesn't or the decrease in the line is constant while E is not and the exponential does not have constant decrease rate</p>	
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Answers			Notes	Total
7	a	adding the four sides 12 AG	4 x 3 or 3 + 3 + 3 + 3	1
	b	•1 correctly place 44 •2 correctly place 52		2
	c	•1 correctly describe one pattern in words •2 correctly describe a second pattern in words	ACCEPT (P) goes up by 8 ...WTTE , ACCEPT expands They are all even numbers or divisible by 2 or multiples of 2 The difference is constant It is linear or arithmetic DO NOT ACCEPT The rule in words ex: 8 times n then add 4 P is four times L P = 4L n goes up by 1 It is increasing general rules in terms of n, example: P = 8n + 4	2

	d	<ul style="list-style-type: none"> •1 The correct general rule •2 The correct simplified general rule with correct notation 	<ul style="list-style-type: none"> •1 $8n + 4$ or $12+8(n - 1)$ or $Un = 8n + 4$ OE •2 $P = 8n + 4$, ACCEPT $P = 4(2n + 1)$ <p>DO NOT ACCEPT description in words</p>	2
	e	<ul style="list-style-type: none"> •1 correctly substitute $n \geq 5$ into their rule •2 correctly calculate their value of P after substitution $n \geq 5$ •3 recognize that their result is the same as their predicted value 	<ul style="list-style-type: none"> •1 Ex: $8 \times 5 + 4$ •2 Ex: 44 (for the $n = 5$) •3 Same as value I predicted in table (and we find the candidate has 44 in the table for $n = 5$) OR same as when we continue the pattern and explains how 44 is obtained from pattern of adding 8 to 36 •3 ACCEPT seeing the 44 in the table and seeing their calculated $P = 44$ when $n = 5$ <p>SC for 1 mark Correctly test by applying the steps of verification mentioned in the left column with a value of $n \leq 4$ SC for 1 mark Correctly verify their described pattern or rule (e.g. recursive rule)</p>	3

7	f	Mark	1	2	3	4	
		Predictions (P)	Correctly predict one value for A	Correctly predict two values for A			
		Description (D)	<p>Attempt to describe a pattern in words or to write a rule Ex: Comment on difference, all are odd numbers OR Correctly describe one pattern in words for L OR Correctly describe in words their pattern for A OR Attempt to write down a general rule for L, example: $2n$</p>	<p>Correctly describe one pattern in words for A Ex: A has second difference constant A is quadratic A is square numbers DO NOT ACCEPT the general rule in words OR Correctly write down general rule for L in terms of n. Rule: $(L=)2n + 1$ OR</p>	<p>Correctly describe one pattern in words for A AND Acceptable attempt to write down a general rule for A OR Correctly write down general rule for A in terms of n. $(2n + 1)^2$ OE OR Correctly describe one pattern in words for A AND correctly write down general rule for L</p>	<p>Correctly describe one pattern in words for A AND Correctly write down the general rule for A in terms of n For notation see N</p>	20

		<p>OR Weak attempt to write down a general rule for A, example: n^2</p> <p>DO NOT ACCEPT L or A is increasing n goes up by 1</p>	Acceptable attempt to write down a general rule for A, example: $2n+1^2$ or recursive rule For notation see N			
	Testing (T)	<p>Attempt to test their general rule for A using $n \leq 4$</p> <p>Ex: correctly substitute in their general rule value of $n \leq 4$</p> <p>Ex: substitute in their general rule value of $n \leq 4$</p> <p>OR</p> <p>Correctly test their described pattern or their rule (e.g. recursive rule)</p>	<p>Correctly test their general rule for A using $n \leq 4$</p> <p>Ex: Correctly calculate their value for A in their general rule using $n \leq 4$</p> <p>AND Recognise that their correctly calculated value for A is the same as the given value.</p> <p>ACCEPT seeing their correctly calculated value for A and the given value in the table being equal</p>			
	Verifying (V)	<p>Attempt to verify their general rule for A using $n \geq 5$</p> <p>Ex: correctly substitute in their general rule value of $n \geq 5$</p> <p>OR</p> <p>Correctly verify their described pattern or their rule (e.g. recursive rule)</p>	<p>Correctly calculate their value of A using their $n \geq 5$ in their general rule</p>	<p>Correctly calculate their value for A in their general rule using $n \geq 5$ AND Recognise that their correctly calculated value for A is the same as their predicted value obtained by continuing the pattern</p> <p>ACCEPT seeing their correctly calculated value for A and their predicted value in the table being equal</p>		

	Justify/proof (J)	<p>Weak attempt to justify their described pattern or their general rule</p> <p>Examples: trying at least two more values and arguing as justification that they are the same or rule works OR Just seeing their rule as $(2n + 1)^2$ without any explanation OR Assuming Quadratic model and valid attempt to find coefficients</p> <p>DO NOT ACCEPT if D2 not achieved</p>	<p>Good attempt to justify their general rule for A</p> <p>Examples: Assuming Quadratic model and get correct values of coefficients using any method OR squaring incorrect rule for L with a comment on squaring sides</p>	<p>correctly justify the correct general rule for A in relation to geometry</p> <p>Examples: Writing in words OE that squaring the side we get the area if their L rule is $L = 2n + 1$ and their general rule is $(2n + 1)^2$</p> <p>J3 automatically gains T2 and V3</p>	
	Notation and terminology (N)	<p>Correct notation of <u>their</u> rule OR Correct terminology describing a pattern</p> <p>DO NOT ACCEPT if they don't have any rules and they don't describe any patterns correct</p>	<p>Correct notation of <u>the general</u> rule for A OR The notation of <u>the general</u> rule includes errors AND Correct terminology describing pattern in words for A</p> <p>DO NOT ACCEPT if they don't have a general rule</p>	<p>Correct notation of <u>the general</u> rule for A AND Correct terminology describing pattern in words for A</p> <p>ACCEPT using U_n instead of A only if they mention that $A = U_n$</p> <p>For notation of the general rule, DO NOT ACCEPT $(2n+1)^2$ or $(2xn+1)^2$ or $4xn^2+4n+1$ or The rule for A is $(2n + 1)^2$ Or non simplified rules ex: $A = (n + n + 1)^2$</p>	

		Communication (L)	<p>Very weak communication More than two lines of communication that lacks organisation and coherence OR Only calculations or algebraic steps</p>	<p>Weak communication At least three lines of communication with an attempt of organisation but lacks coherence</p>	<p>Good communication More than three lines of communication with acceptable organisation and coherence Can be awarded only if J2 is achieved</p>		
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Stage number (n)	Side length (L)	Area of square (A)
1	3	9
2	5	25
3	7	49
4	9	81
5	11	121
6	13	169
7	15	225
8	17	289

General rules:

$$L = 2n + 1$$

$$A = (2n + 1)^2 \text{ or } 4n^2 + 4n + 1$$

Markscheme

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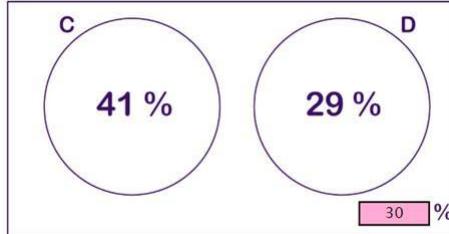
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- f) A misread (**MR**) is an error. **ECF** is normally awarded.

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 $\frac{x}{2}$ **OR** $x/2$ **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	Answers	Notes	Total
1 a	.1 correctly place $y + x = 6$.2 correctly place $2y - 3x = 6$		2
b	.1 correctly write equation of L2 as $(y =)0.5x + 4$ OE .2 correctly write equation of L3 as $(y =)-2x + 7$ OE		2

Question	Answers	Notes	Total
2 a	<p>AM1 (adding volumes)</p> <p>.1 correct Volume for one part .2 correct Volume for second part .3 correctly add their volumes</p> <p>AM2 (Subtracting volumes)</p> <p>.1 correct volume including empty part .2 correct volume of empty part .3 correctly subtract their volumes</p> <p>AM3 (Area x depth)</p> <p>.1 correct Area for one part .2 correct Area for the face .3 correctly multiply the total of their areas by 30</p>	<p>AM1 (adding volumes)</p> <p>.1 $50 \times 20 \times 30 (=30000)$ OR $35 \times 20 \times 30 (=21000)$.2 $20 \times 15 \times 30 (=9000)$ OR $40 \times 15 \times 30 (=18000)$.3 $(their30000+their9000)$ OR $(their21000+their18000) =39000 (\text{ft}^3)$</p> <p>AM2 (Subtracting volumes)</p> <p>.1 $50 \times 40 \times 30 (=60000)$.2 $35 \times 20 \times 30 (=21000)$.3 $(their60000-their21000) =39000 (\text{ft}^3)$</p> <p>AM3 (Area x depth)</p> <p>.1 $50 \times 20 (=1000)$ OR $20 \times 15 (=300)$.2 $(50 \times 20 + 20 \times 15) = 1300$.3 $(their1300 \times 30) =39000 (\text{ft}^3)$</p>	3
b	<p>.1 add employees .2 divide by 5 .3 correct result after dividing the sum by 5</p>	<p>.1 $105+70+90+75+60 (=400)$.2 $their400 / 5$.3 80</p>	3
c	<p>.1 correctly substitute their39000 and their80 .2 correctly calculate their P after their substitution involving at least one multiplication in numerator</p>	<p>.1 $(P =) \frac{(6 \times their39000 + 500 \times their80)}{9000}$.2 their $30(.444\dots)$</p>	2

Question		Answers	Notes	Total
3	a	correctly place 30 %		1
	b	correctly state a reason for mutually exclusive related to sets representation	No intersection ACCEPT they are separate or apart WTTE $A \cap B = 0 \text{ or } \emptyset$ DO NOT ACCEPT No girl selected both	1
	c	sum of percentages add up to more than 100%	ACCEPT 20% selected both	1
	d	.1 correct working step .2 correct value of intersection .3 correct value of cat only .4 correct value of dog only	.1 $39 + 50 - 69$ or $39+50+31-100$ or $50-20=30$ and $39-20=19$.1 ACCEPT seeing this step in 3c 2 20 3 19 4 30	4
	e	.1 0.69 seen .2 probability of adopt from both branches seen .3 correct result after adding their multiplied values	.1 ACCEPT 69 seen on tree diagram .2 $0.6 \times 0.7 (=0.42)$ OE and $0.4 \times 0.69 (=0.276)$, ACCEPT 0.28 OE .3 their 0.696 OE, ACCEPT 0.7 OE only if .2 seen	3

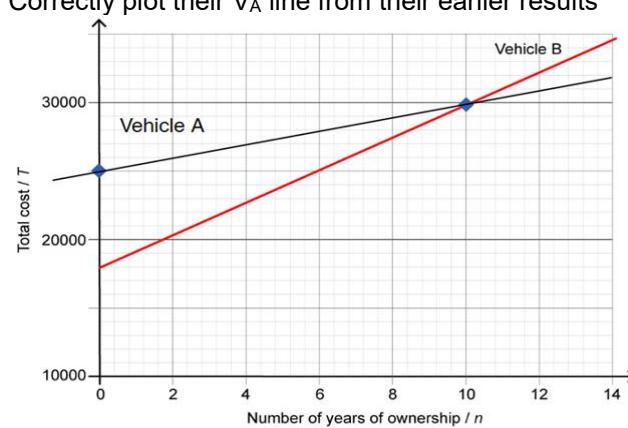
Question		Answers	Notes	Total
4	a	multiply 140 by 5 and divide by 7 AG 100	$\frac{140}{7} \times 5$, ACCEPT $\frac{5}{7} = \frac{100}{140}$ OE ACCEPT $5 \times 20 : 7 \times 20 (= 100 : 140)$ ACCEPT $100 / 20 = 5$ and $140 / 20 = 7$	1
	b	.1 correctly substitute 1 and 0.5 .2 correct answer	.1 $140 \times 1 + 100 \times 0.5$.2 190	2
	c	.1 correct working step .2 correct result after adding the three ratios multiplied by value .3 correctly divide 1760 by 11 OR multiply 1760 by 9 .4 multiply ratios by their 160 OR divide their15840 by 11 .5 correctly calculate their number of coins	.1 $2n \times 0.5 + 4n \times 1 + 3n \times 2$ or $2 \times 0.5 + 4 \times 1 + 3 \times 2$.1 ACCEPT 9 seen .2 $11n$ or 11 .3 $(\frac{1760}{11}) = 160$ or $(9 \times 1760) = 15840$.4 $2x\text{their}160$ and $4x\text{their}160$ and $3x\text{their}160$ or $320,640,480$ or $9x\text{their}160$ OR $15840/11$. ACCEPT their160 being $1760/9$.5 their1440 DO NOT ACCEPT .4 or .5 if their160 is not the same number	5

Question		Answers	Notes	Total
5	a	(0,12)	ACCEPT 0,12 x=0, y=12 0;12 DO NOT ACCEPT 12 C=12	1
	b	.1 correctly set equation to solve .2 correctly factorize their equation or substitute into quadratic formula .3 correct coordinates of their point A .4 correct coordinates of their point B	.1 $x^2 - 8x + 12 = 0$.2 their $(x - 2)(x - 6)$.3 (A=) their (2,0) .3 DO NOT ACCEPT if negative .4 (B=) their (6,0) .4 DO NOT ACCEPT if negative	4
	c	correctly write coordinates of their point B after reflection on the y-axis	ACCEPT their-6,0 x=their-6 , y=0 DO NOT ACCEPT -6 Their(-6,0) if positive	1

Question	Answers	Notes	Total
6 a	180 – 140	ACCEPT 360 – 90 – 90 – 140 140 and 40 are complementary or add up to 180 Starting with X0Y=40 and reach XSY=140	1
b	.1 correctly substitute 40 and 6372 into arc formula .2 correctly calculate their answer after substitution into arc length formula	.1 $\frac{40}{360} 2\pi(6372)$ OE .2 their 1416π or 4448.495...	2
c	AM1 (using only trig ratios) .1 select the angle to be used for trig ratio .2 correctly substitute 20 into the trig ratio .3 correctly rearrange their trig ratio for ON .4 correctly calculate their result after rearranging trig ratio .5 correctly round their answer to the nearest km AM2 (using Pythagoras) .1 correctly substitute XN and r correctly into trig ratio .2 correctly rearrange for XN .3 correctly substitute their r and their XN into Pythagoras or use tan70 .4 correctly calculate their result after using Pythagoras .5 correctly round their answer to the nearest km	AM1 (using only trig ratios) .1 20 or 70 seen .2 $\cos 20 = \frac{ON}{6372}$ or $\sin 70 = \frac{ON}{6372}$.3 (ON=)6372cos20 or 6372sin70 .4 Their 5 987.7(21...) .4 DO NOT ACCEPT using sin70 or cos20=0.9 .4 Award as ecf only if their ON is less than 6372 .5 Their 5 988 AM2 (using Pythagoras) .1 $\frac{XN}{6372} = \sin 20$ or $\cos 70$.2 (XN =)6372sin20 or 6372cos70 or [2166,2179.4] .3 (ON =) $\sqrt{6372^2 - \text{their } 2179.35^2}$.3 ACCEPT their 2179.35 not in [2166,2179.4] only if there is working .4 Their 5 987.7(21...) .4 DO NOT ACCEPT using sin20 or cos70=0.3 .4 Award as ecf only if their ON is less than 6372 .5 Their 5 988	5
d	correctly subtract their ON from 6372 answer	(6372 – their 5988 =) 384 ACCEPT answers in the range [382, 384.3] Award as ecf only if positive	1

	e	<p>.1 correctly substitute their MN and 6372 into the surface area of spherical cap formula</p> <p>.2 correctly calculate their result after substitution into the surface area of spherical cap formula</p> <p>.3 correctly write their answer rounded to 2 sf and in standard form</p>	<p>.1 $2\pi \times 6372 \times$ their 384 or their 4893696π ACCEPT using $\pi = \frac{22}{7}$ or 3.14</p> <p>.2 their 15 384 154(.37...)</p> <p>.2 ACCEPT answers in the range [15 286 173, 15 386 011]</p> <p>.3 their 1.5×10^7</p>	3
	f	<p>.1 correctly substitute 6372 into the Surface Area of sphere formula</p> <p>.2 divide their 7e by their surface area of sphere</p> <p>.3 correctly calculate their ratio as percentage</p>	<p>.1 $4\pi \times 6372^2$ or 510 224 605(.2..)</p> <p>.2 $\frac{\text{their } 1.5 \times 10^7}{\text{their } 510 \ 224 \ 605}$ OE e.g. $\frac{\text{their } 1.5}{\text{their } 51}$ or their 0.029</p> <p>.3 their 2.9(...) ACCEPT 3(%)</p>	3

Question	Answers	Notes	Total
7	a AM1 .1 recognise 80 .2 multiply 80 % by 31250 .3 correctly calculate their result after multiplying 31250 by their percentage AM2 .1 multiply 20 % by 31250 .2 subtract 31250×0.2 from 31250 .3 correctly calculate their result after subtraction of their reduction from 31250	AM1 .1 80 or 0.8 seen .2 0.8×31250 OE .3 their25000 AM2 .1 31250×0.2 or 6250 seen .2 $31250 - 31250 \times 0.2$ or $31250 - 6250$.3 their25000	3
	b .1 multiply 14000 by 0.035 .2 correct answer	.1 14000×0.035 seen .2 490	2
	c .1 multiply 1190 by 7 or 8330 seen .2 add 18 000 AG £26 330		2
	d $T = 490n + 25000$.1 their25 000 as the y intercept .2 their490 as the gradient	ACCEPT $y = 490x + 25000$, $y = (14000 \times 0.035)x + 25000$	2

7	e	(1 mark)	(2 marks)	10
		Factors (F) Two factors from: Vehicle cost; ACCEPT Total cost Fuel (cost or usage of per mile) The number of miles driven per year Number of years of ownership or distances travelled maintenance cost or long term cost Effect on the environment	Three factors from: Vehicle cost; ACCEPT Total cost Fuel (cost or usage of per mile) The number of miles driven per year Number of years of ownership or distances travelled maintenance cost or long term cost Effect on the environment	
		Graph (G) Attempt to plot their V_A line from earlier results Ex: correct slope or T-intercept from their earlier results or At least two points plotted satisfy their earlier results with acceptable accuracy	Correctly plot their V_A line from their earlier results  ACCEPT T-intercept $\in [24000, 26000]$ and n at intersection $\in [9.5, 10.5]$	
		Number of years (N) Attempt to determine after how many years their V_A and V_B will have the same total cost Ex: Attempt to solve simultaneously or trial and improvement OR Correctly calculate the total cost after a specific number of years for both vehicles	Correctly determine after how many years their V_A and V_B will have the same total cost Ex: Correctly calculate $n=10$ after solving simultaneously or trial and improvement OR $n=10$ and their graph intersects at $n=10$	
		Justify (J) Weak justification Ex: V_A is better for the environment even if its initial cost is more OR V_A is better for the environment AND it will cost less on the long run or overall cost will be less OR	Good justification Ex: V_A is better for the environment AND V_A is better if years of ownership are more than their n at point of intersection or V_B is better if years of ownership are less than their n point of intersection on the graph	

		V _A is better for the environment AND a justification matching their graph OR V _B is better as their calculations show V _B costs less even if not good for environment		
	Comment on Accuracy (A)	Not very accurate with weak reason. Ex: I rounded the number of years to get the total cost Didn't include other factors of owning a vehicle e.g. running costs OR Accurate with good reason. Ex: The values did not require rounding so the total cost is accurate. The values were whole numbers OR Sensible rounding used	Not very accurate with good reason. Ex: Average mileage 14 000 may vary and will affect the total cost	

Question	Answers	Notes	Total														
8 a	.1 identify the base of the triangle .2 add the squares of base and height .3 square root the sum of squares AG 5	.1 4-1 or 3 seen .1 ACCEPT triangle indicated on diagram .2 $3^2 + 4^2$ seen .3 $\sqrt{25}$, ACCEPT $3^2 + 4^2 = 5^2$	3														
b	correctly place 13 and 16	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Stage (n)</th> <th>Side (S)</th> </tr> </thead> <tbody> <tr><td>1</td><td>1</td></tr> <tr><td>2</td><td>4</td></tr> <tr><td>3</td><td>7</td></tr> <tr><td>4</td><td>10</td></tr> <tr><td>5</td><td>13</td></tr> <tr><td>6</td><td>16</td></tr> </tbody> </table>	Stage (n)	Side (S)	1	1	2	4	3	7	4	10	5	13	6	16	1
Stage (n)	Side (S)																
1	1																
2	4																
3	7																
4	10																
5	13																
6	16																
c	correctly describe one pattern for S in words with correct terminology	<p>ACCEPT adding 3 OE difference 3 OE</p> <p>DO NOT ACCEPT The rule in words ex: subtract 2 from triple of stage OE $S = 3n - 2$ S is increasing odd even odd even arithmetic linear</p> <p>Note: DO NOT ACCEPT more than one pattern if any is incorrect Ex: Add 3 so they are all odd Add 3, they are multiples of 3 ACCEPT more than one pattern if all correct Ex: Add 3 so $3n - 2$ S is increasing, difference is 3</p>	1														

	d	.1 the correct general rule .2 the correct simplified general rule with correct notation	.1 $3n - 2$ or $S = 3 \times n - 2$ or $y = 3x - 2$ or $S = 1 + 3(n - 1)$.2 $S = 3n - 2$, ACCEPT $S_n = 3n - 2$ DO NOT ACCEPT description in words SC if NR in 8d and $(S =)3n - 2$ is seen in 8c award 1 mark	2
	e	.1 correctly substitute $n \geq 5$ into their general rule .2 correctly calculate their value of S after substituting $n \geq 5$.3 recognise that their correctly calculated value of S is the same as their predicted value	.1 Ex: $3 \times 5 - 2$.2 Ex: 13 (for $n=5$) .3 same as value I predicted in table (and we find the candidate has 13 in the table for $n = 5$) OR same as when we continue the pattern and explains how 13 is obtained from pattern of adding 3 to 10 .3 ACCEPT seeing the 13 in the table in 8b and seeing their calculated $S = 13$ when $n = 5$	3

8	g	Mark	1	2	3	4	
		Predictions (P)	Correctly predict two terms for P ACCEPT whether in the table or in the response box	Correctly predict four terms for P ACCEPT whether in the table or in the response box			
		Description (D)	<p>Attempt to describe a pattern in words for P OR a rule in words Ex: Constant/same difference Common difference Arithmetic sequence They are all even add 8 to 6 times n</p> <p>OR</p> <p>Attempt to describe pattern for T as general rule Ex for rule attempt: $(P =) 6n$ or $(P=)an+8$</p> <p>OR</p> <p>Correctly describe in words their pattern</p>	<p>Correctly describe one pattern in words for P Ex: increases by 6 adding 6 every time difference is always 6 arithmetic sequence with $d=6$</p> <p>OR</p> <p>Correctly describe the pattern for P as a general rule $P = 6n + 8$</p> <p>ACCEPT the rule is $6n + 8$ ACCEPT non-simplified rules Ex: $4 + (3(n + 1) - 2) + 5 + 3n - 2$</p>	<p>Correctly describe one pattern in words for P</p> <p>AND</p> <p>Correctly describe the pattern for P as a general rule $P = 6n + 8$</p> <p>ACCEPT the rule is $6n + 8$ ACCEPT non-simplified rules Ex: $4 + (3(n + 1) - 2) + 5 + 3n - 2$</p>		20
		Testing (T)	<p>Attempt to test their general rule for P using $n \leq 4$ Ex: correctly substitute in their general rule value of $n \leq 4$</p> <p>OR</p>	<p>Correctly test their general rule for P using $n \leq 4$ Ex: Correctly calculate their value for P in their general rule using $n \leq 4$</p> <p>AND</p> <p>Recognise that their correctly calculated value for P is the same as the given value.</p>			

		<p>Correctly test their described pattern or their rule (e.g. recursive rule)</p>	<p>ACCEPT seeing their correctly calculated value for P and the given value in the table being equal</p>		
	Verifying (V)	<p>Attempt to verify their general rule for P using $n \geq 5$ Ex: correctly substitute in their general rule value of $n \geq 5$</p> <p>OR</p> <p>Correctly verify their described pattern or their rule (e.g. recursive rule)</p>	<p>Correctly calculate their value for P in their general rule using $n \geq 5$</p>	<p>Correctly calculate their value for P in their general rule using $n \geq 5$ AND Recognise that their correctly calculated value for P is the same as their predicted value obtained by continuing the pattern</p> <p>ACCEPT seeing their correctly calculated value for P and their predicted value in the table being equal</p>	
	Justify/proof (J)	<p>Attempt to justify their described pattern or their general rule Ex: trying at least two more values and arguing as justification that they are the same or rule works or It is linear or arithmetic seen as justification</p>	<p>Justify their general rule arithmetically Ex: It is an arithmetic sequence with difference 6 and first term 14 or $14+(n-1)6$</p> <p>OR</p> <p>Attempt to justify their general rule geometrically Ex: Since the side increases by 3 and we added another side that increases by 3 so the increase is 6 or the lengths of the rectangle increase by 3 each or</p>	<p>Good attempt to justify the general rule for P geometrically by using incorrect four lengths in terms of n $4 + 3n - 2 + 5 + 3n - 2$ or $3 + 4 + 5 + 2(3n)$ OE</p>	<p>Correctly justify the general rule for P geometrically by using correct lengths in terms of n</p> <p>$4 + (3(n + 1) - 2) + 5 + 3n - 2$ or $3 + 4 + 5 + 2(3n - 2)$ OE</p> <p>J4 automatically gains T2 and V3</p>

			weak attempt to get perimeter using three lengths in terms of n			
	Notation and terminology (N)	Correct notation of <u>their</u> rule OR Correct terminology describing at least one pattern DO NOT ACCEPT if they don't have any rules and they don't describe any patterns	Correct notation of <u>the general</u> rule for P OR The notation of <u>the general</u> rule includes errors AND Correct terminology describing at least one pattern DO NOT ACCEPT if they don't have a general rule	Correct notation of <u>the general</u> rule for P AND Correct terminology describing at least one pattern The general rule: $P = 6n + 8$ For notation of general rule, DO NOT ACCEPT $P = 6 \times n + 8$ The rule for P is $6n + 8$ Correct non simplified rules, Ex: $4 + (3(n + 1) - 2) + 5 + 3n - 2$		
	Communication (L)	Very weak communication Two or three lines of communication OR Only calculations or algebraic steps	Weak communication More than three lines of communication but lack coherence	Good communication More than three lines of coherent communication Can be awarded only if J2 is achieved		

Predictions

Stage (n)	Side (S)	Perimeter (P)
1	1	14
2	4	20
3	7	26
4	10	32
5	13	38
6	16	44
7	19	50
8	22	56

Markscheme

November 2018

Mathematics

On-screen examination

22 pages

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The following are the annotations available to use when marking responses.

Annotation	Explication	Annotation	Explication	Shortcut
	Unclear		Award 0 marks	Alt+0
	Special case		Award 1 mark	Alt+1
	Misread		Award 2 marks	Alt+2
NWS	No working shown		Award 3 marks	Alt+3
	Error carried forward		Award 4 marks	Alt+4
	Words to that effect		Award 5 marks	Alt+5
	Benefit of the doubt		Award 6 marks	Alt+6
	Answer Given		Award 7 marks	Alt+7
	Highlight tool		Award 8 marks	Alt+8
	Ellipse tool		Award 9 marks	Alt+9
	On page comment tool		Award 10 marks	
	Seen		Award 11 marks	
	Caret - Omission		Award 12 marks	
	Wavy underline tool			

The markscheme may make use of the following abbreviations:

RM Assessor has the following annotations that should be used to award marks:

A0 only use to award a zero mark for an answer that has no merit e.g. awarded for the candidate that has a wrong answer with no working

NR only use when the candidate has not made any response also stamp the response with **SEEN**

Marks awarded by stamping the tick

SEEN Seen; must be stamped on all blank response areas and on concatenated responses

unclear

ECF Marks that can be awarded as **error carried forward** from previous results in the question

BOD Benefit of the doubt

MR misread

NWS no working shown

SC special case

OE or equivalent

WTTE or words to that effect or accept incomplete calculator display

AG Answer given

The markscheme makes use of the following abbreviations:

- Bullet notation means award 1 mark – see example below

		<p>Example 1</p> <ul style="list-style-type: none">• 1 mark awarded and corresponding notes are aligned	
b	<ul style="list-style-type: none">•¹ Show clear line of reasoning in the method•² 4	<ul style="list-style-type: none">• 45 & 49 SEEN OE eg, $49 = 45 + x$•² Accept $45 + X/10 \leftarrow 4.9$ 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.
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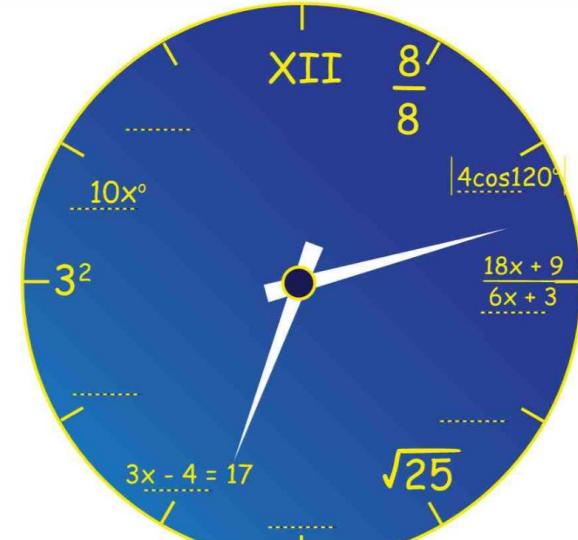
General points

- 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 in final answers 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.
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- e) Where candidates have written two solutions to a question, mark the response that deserves more marks.
- 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 $\frac{x}{2}$ or $x/2$ or $x \div 2$
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- h) Special case marks **SC** can be allocated instead of but not in addition to the marks prescribed in the markscheme..
- g) When a calculator screenshot is taken, accept not seeing the whole operation.
- h) Accept seeing an equation not in-line

General note for marking open-ended response questions:

In cases in Task 2 and 3 where the markscheme is set out in a table then awarding the highest box includes all the lower boxes. So if for example you see at J4 in Task 3 that they have correctly proved their general rule, then J4 is awarded. That is the 4 (full) marks. You don't need to look at the other J criteria. It is probably best to look for the top box answer and if you don't find it look at the next box down. So if they don't get D4 then look at their attempt at a general rule and they might gain D3. If you don't see that look to see if they described a pattern and so on.

Task 1

		Answers	Notes	Total
1	a	<ul style="list-style-type: none">•¹ first correctly place•² second correctly placed•³ third correctly placed•⁴ fourth correctly placed		4

2	a	$\frac{16}{48}$ OE ACCEPT 0.3 OE ACCEPT 16 out of 48	1
	b	<ul style="list-style-type: none"> •¹ probability of MYP year 1 •² (statement is) incorrect with valid reason <p>$\bullet^1 \frac{16}{72}$ OE</p> <p>\bullet^2 (statement is) false because the probabilities are different OR because the total number of students (in each grade) is different WTTE</p> <p>\bullet^2 ACCPET false and comparing incorrect percentages or probabilities</p> <p>SC for 2 marks (statement is) incorrect since Number of students chose gaming (or Numerators) are the same but the total of students (or denominators) are different WTTE</p> <p>SC for 1 mark incorrect because total in each grade (or Denominators) are different so probability not the same WTTE</p>	2
	c std	<ul style="list-style-type: none"> •¹ number of students not choosing sports •² divide by 120 <p>Alternative method (AM1)</p> <ul style="list-style-type: none"> •¹ probability of choosing sport •² subtract $\frac{54}{120}$ from 1 <p>$\bullet^1 120 - 54$ or 66</p> <p>$\bullet^2 \frac{66}{120}$ OE</p> <p>Alternative method (AM1)</p> <ul style="list-style-type: none"> •¹ $\frac{54}{120}$ OE •² $(1 - \frac{54}{120}) = \frac{66}{120}$ OE <p>$\frac{66}{120}$ OE without working award 2 marks</p> <p>66 out of 120 without working award 1 mark</p>	2

Answers			Notes	Total
3	a	<ul style="list-style-type: none"> •¹ substitute correctly in Pythagoras •² 15 	<ul style="list-style-type: none"> •¹ $12^2 + 9^2$ •² ACCEPT root(225) <p>15 or $\sqrt{225}$ without working award 2 marks ACCEPT seeing 15 or $\sqrt{225}$ on the diagram</p>	2
	b	<ul style="list-style-type: none"> •¹ cos 30 or sin 60 seen •² correct use of cosine or sin ratio •³ rearranging correctly their trig ratio and $10\sqrt{3}$ $10\sqrt{3}$ AG □ <p>Alternative method 1 (AM1)</p> <ul style="list-style-type: none"> •¹ determine the length of CD correctly •² correct substitution in Pythagoras •³ rearranging correctly their trig ratio and $10\sqrt{3}$ $10\sqrt{3}$ AG <p>Alternative method 2 (AM2)</p> <ul style="list-style-type: none"> •¹ correct substitution in Pythagoras •² correct algebraic steps leading to $x^2 = \text{their } 75$ •³ and $10\sqrt{3}$ and $10\sqrt{3}$ $10\sqrt{3}$ AG 	<ul style="list-style-type: none"> •¹ cos30 or sin 60 •² $\cos 30 = \frac{(\text{their } 15)}{AD}$ or $\sin 60 = \frac{(\text{their } 15)}{AD}$ •³ ($AD =) \frac{\text{their } 15}{\cos 30}$ and $10\sqrt{3}$ <p>Alternative method 1 (AM1)</p> <ul style="list-style-type: none"> •¹ ($\tan 30 = \frac{CD}{\text{their } 15}$, $CD =) \sqrt{75}$ OE •² $(\text{their } \sqrt{75})^2 + (\text{their } 15)^2 = AD^2$ •³ ($AD =) \sqrt{300}$ and $10\sqrt{3}$ <p>Alternative method 2 (AM2)</p> <ul style="list-style-type: none"> •¹ $(2x)^2 = x^2 + 15^2$ OR $4x^2 = x^2 + 225$ OR $3x^2 = 225$ •² $x^2 = 75$ •³ ($AD =) 5\sqrt{3} \times 2 = 10\sqrt{3}$ <p>Award •³ only if their result is equivalent to $10\sqrt{3}$</p>	3

c	<ul style="list-style-type: none"> •¹ correct use of tangent ratio •² their arctan calculated correctly •³ their value approximated correctly to the nearest degree <p>Alternative method 1 (AM1)</p> <ul style="list-style-type: none"> •¹ correct length of AD and correct use of sin or cos ratio •² their arcsin or arccos calculated correctly •³ their value approximated correctly to the nearest degree 	<ul style="list-style-type: none"> •¹ ($\tan DAE = \frac{20}{10\sqrt{3}}$) •² their 49.1066.... •³ their 49 <p>Alternative method 1 (AM1)</p> <ul style="list-style-type: none"> •¹ ($AE = \sqrt{700}$ or 26.475... OE and $(\sin DAE = \frac{20}{\sqrt{700}}$ or $(\cos DAE = \frac{10\sqrt{3}}{\sqrt{700}}$) •² their 49.1066.... •³ their 49 <p>•³ DO NOT ACCEPT if their value from •² is a whole number 49.1066... without working award 1 mark 49 without working award 2 marks ACCEPT seeing 49.1066.... or 49 on the diagram</p>	3
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Answers			Notes	Total
4	a	<ul style="list-style-type: none"> •¹ multiples of 6 and 8 seen OR after 4 laps OR after 3 laps •² 24 	<ul style="list-style-type: none"> •¹ 6,12,16 and 8,16 •¹ ACCEPT $6 \times 8 (=48)$ <p>24 without working award 2 marks</p>	2
	b	<ul style="list-style-type: none"> •¹ correct expression for the length of 6 semi-circles •² adding $8r$ to their expression above •³ equating their expression with 15000 or 15 •⁴ taking the r as common factor from their expression •⁵ correct value of r that rounds to 560 <p>560 AG</p>	<ul style="list-style-type: none"> •¹ $6\pi r$ or $3 \times 2\pi r$ OE •² their $6\pi r + 8r$ •³ their $6\pi r + 8r = 15000$ •⁴ e.g. $r(\text{their } 6\pi + \text{their } 8)$ •⁵ 558.668.. and 560 <p>•⁵ ACCEPT if they use 3.14 instead of π and get a result of 558.867...</p> <p>For •¹, •² and •³ ACCEPT seeing the $r=560$</p> <p>SC for 3 marks</p> <p>Using $r=560$ and calculating the length of the track as 15035.75... when using π or 15030.4 using 3.14</p>	5
	c	<ul style="list-style-type: none"> •¹ correct area of rectangle •² adding area of one circle to their area of rectangle •³ their result correct after adding their area of rectangle to their area of circles or semicircles 	<ul style="list-style-type: none"> •¹ $4r \times 6r$ or $24r^2$ or 600 (mm^2) •² their $600 + \pi r^2$ OR $600 + 78.5398\dots$ OE <p>•² ACCEPT seeing they add four semicircles and subtract two semi-circles</p> <p>•³ 678.5398... or 678.5 or 679</p> <p>678.5398... or 678.5 or 679 without working award 2 marks</p>	3

Answers			Notes	Total
5	a	<ul style="list-style-type: none"> •¹ a vertical stretch/dilation/enlargement/compression of (factor) 4 OR horizontal stretch/dilation/enlargement/compression of (factor) $\frac{1}{2}$ •² a reflection about/on x axis. •³ a horizontal translation of 2 units left •⁴ a vertical translation of 1 unit upwards 	<ul style="list-style-type: none"> •¹ ACCEPT in y direction instead of vertical •¹ ACCEPT in x direction instead of horizontal •² ACCEPT seeing reflection and x-axis •² ACCEPT mirror about/on x axis. •³ ACCEPT seeing left and 2 •³ ACCEPT shift 2 left or move left and 2 or 2 units in the $-x$ direction or -2 units in the x direction •⁴ ACCEPT seeing up and 1 •⁴ ACCEPT 1 unit in the y-axis <p>ACCEPT seeing answers in any order ACCEPT seeing multiple transformations in same box</p>	4
	b	$a = -2$ and $b = 1$	(-2,1)	1
	c	<ul style="list-style-type: none"> •¹ recognise axis of symmetry •² their horizontal difference from their axis of symmetry •³ sum of their $\frac{-1}{2}$ and their -2 •⁴ their correct value of the other solution <p>Alternative method 1 (AM1)</p> <ul style="list-style-type: none"> •¹ attempt to expand $g(x) = 0$ •² correctly expanding •³ correctly factorize or substitute correctly into formula •⁴ their correct value of the other solution 	<ul style="list-style-type: none"> •¹ their -2 seen •² their $1/2$ seen •² ACCEPT “half step” in context, maybe be seen on the diagram •³ $(x =)$ their-2 - their$\frac{1}{2}$ •⁴ their $\frac{-5}{2}$ OE <p>Alternative method 1 (AM1)</p> <ul style="list-style-type: none"> •¹ $-4(x^2 + 4x + 4) + 1 = 0$ •² $-4x^2 - 16x - 15 = 0$ or $-4x^2 - 16x - 15 = 0$ •³ $(2x + 5)(2x + 3) = 0$ or $\frac{16 \pm \sqrt{16^2 - 4(-4)(-15)}}{2(-4)}$ OE 	4

	<p>Alternative method 2 (AM2)</p> <ul style="list-style-type: none">•¹ attempt to solve•² square root both sides correctly•³ sum of their $\frac{-1}{2}$ and -2•⁴ their correct value of the other solution	<ul style="list-style-type: none">•⁴ their $\frac{-5}{2}$ OE <p>Alternative method 2 (AM2)</p> <ul style="list-style-type: none">•¹ $-4(x + 2)^2 = -1$ or $(x + 2)^2 = \frac{1}{4}$•² $x + 2 = \pm\frac{1}{2}$•³ $(x =) -2 \pm\frac{1}{2}$•⁴ $(c =)$ their $\frac{-5}{2}$ OE•⁴ DO NOT ACCEPT if their result ≥ 0 <p>$\frac{-5}{2}$ OE without working award 3 marks</p> <p>$\frac{-5}{2}$ OE with one working step award 4 marks</p>
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Answers			Notes	Total
6	a	the correct result before rounding AG 197 bpm	196.8	1
	b	• ¹ multiply maximum heart beat by 80 % • ² their 157.6 correctly rounded to the nearest beat	• ¹ 0.8 x 197 or 157.6 • ¹ ACCEPT 0.8 x 196.8 or 157.44 • ² their 158 • ² DO NOT ACCEPT if their incorrect value from • ¹ is a whole number 158 without working award 2 marks 157 without working award 1 mark	2
	c	(k =)3		1
	d	• ¹ substitute 11 correctly into the correct formula • ² their result correct after substituting into the correct formula • ³ correctly approximated their result to the nearest beat	• ¹ ($h_1(11) = 70(1.04)^{11}$) • ² 107.7(617839...) • ³ 108 (bpm) • ³ DO NOT ACCEPT if their incorrect value from • ² is a whole number 108 with bp1 or bp 2 award 3 marks 108 without working award 2 marks 107 or 109 or 110 without working award 1 mark	3
	e	• ¹ correct comment on safety • ² seeing 80% of maximum heart rate • ³ comment on effectiveness of the exercise in relation to duration or time when 80% of maximum heart rate was achieved	• ¹ safe because it was below maximum heart rate or below 197 WTTE • ² reached their 158 or 80% of their H • ³ ineffective because it reached 80% of max heart rate for only few minutes or ineffective because it reached their 158 for only few minutes • ³ ACCEPT effective because heart rate reached 80% of maximum SC for 1 mark Correct description with acceptable terminology of the behaviour of the graph (e.g. increases then decreases, then increases)	3

Answers			Notes	Total
7	a	• ¹ percentage of carbohydrates • ² the correct result	• ¹ 55% or 0.55 seen • ¹ ACCEPT any 55 seen • ² $(180 \times 55/45) = 220$ (g) 220 without working award 2 marks Do not award • ² if their result is less than 180 (g)	2
	b	• ¹ identify the 12400 (kJ) as the total and adding ratios • ² correct calculation towards the result • ³ their result correctly rounded to nearest kJ	• ¹ identifying the 12400 (kJ) as the total and $2 + 3 + 4 = 9$ or $12400/9$ or seeing 1377.777... or 1378 $\frac{7 \times 12400}{9}$ • ² 9 or 9644.44.... or their 1378 $\times 7$ or 9639 • ² ACCEPT stating values of calories in mid-day meal and dinner meal separately eg. 5511.111....and 4133.333... • ³ their 9644 (kJ) or 9646 • ³ ACCEPT stating values of calories in mid-day meal and dinner meal separately eg. 5511 and 4133 OR 5512 and 4134 • ³ DO NOT ACCEPT if their incorrect value from • ² is a whole number 9644 or 9646 without working award 2 marks 5511 and 4133 without working award 2 marks 5511 or 4133 without working award 1 mark 9644.44... or 9639 without working award 1 mark	3
	c	• ¹ multiply 12 400 by 7 • ² subtract 77 790 from 86 800 OR add 77790 to 9010 and equate with 86800 AG 9010 (kJ)	• ¹ 86 800 (kJ) • ² $86\ 800 - 77\ 790 = 9010$ OR $77790 + 9010 = 86800$ SC for 2 marks $\frac{77790 + 9010}{7} = 12400$	2
	d	• ¹ add 1700s to 2700r • ² equate their total to 10000	• ¹ $1700s + 2700r$ • ² $1700s + 2700r = 10000$ OE • ² DO NOT ACCEPT $r+s=10000$	2

e	<ul style="list-style-type: none"> •¹ reduce their two equations to one correct equation including one unknown •² their value for first unknown (r or s) correct •³ substitute correctly into one of their equations to calculate the value of the other unknown •⁴ their calculation for the other unknown correct <p>Alternative method for trial and error responses (AM1)</p> <ul style="list-style-type: none"> •¹ seeing two numbers with sum 5 •² seeing two numbers which satisfy their other equation •³ their r or their s correct •⁴ their r and their s correct 	<ul style="list-style-type: none"> •¹ $1700s + 2700r = 10000$ OR $1700(5-r)+2700r = 10000$ <li style="text-align: center;">$\begin{array}{r} 1700s + 1700r = 8500 \\ \hline 1000r = 1500 \end{array}$ •² $r = 1.5$ (h) OR $s = 3.5$ (h) •³ $1.5 + s = 5$ OR $r + 3.5 = 5$ •⁴ $r = 1.5$ (h) and $s = 3.5$ (h) <p>Alternative method for trial and error responses (AM1)</p> <ul style="list-style-type: none"> •¹ trial e.g. 3 and 2 •² trial e.g. 25 and 10 if their other equation is $2r+5s=100$ •³ their 1.5 or their 3.5 •⁴ their 1.5 and their 3.5 <p>1.5 and 3.5 without working award 3 marks Their 1.5 and their 3.5 without working award 1 mark</p>	4
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7	f	F: Identification of factors	C: Calculations	J: Justification of accuracy and makes sense	A: Advice for Gerry	S: How advice makes sense	10
1		<p>Two factors mentioned from:</p> <ul style="list-style-type: none"> - Total energy intake - proportion of the meals in a day - The meal is balanced or well balanced diet or healthy meal eg Fat:Carb:Protein - exercise or energy output - relevant factor not mentioned in video. <p>Example: duration of sleep, sleep time, reducing stress</p> <p>ACCEPT factors seen in calculations</p>	<p>Any attempt for one of the following calculations:</p> <ul style="list-style-type: none"> -Amount of output energy remaining for Saturday (10000-8300=1700) -Amount of intake energy remaining for Saturday (9010-6000=3010 OR $4 \times 9010 / 9 = 4004\dots4$) -Proportions of nutrition for the remaining meal (0.2xtheir3010 Protein, 0.25xtheir3010 Fat, and 0.55xtheir3010 Carbs) <p>ACCEPT 12400-9010=3390 as only attempt to calculate energy intake for Saturday and hence C1</p>	<p>Suitable rounding used in any element (example using 3000 instead of 3010)</p> <p>Or</p> <p>Realising not accurate with invalid reason</p>	<p>Advice related to one of:</p> <ul style="list-style-type: none"> -Keep or continue track of energy intake and energy burnt, or meals in the appropriate nutrition proportion or balanced diet/eating healthy - increase exercising hours to increase burning -Decrease intake energy because in many days he was more than average or eat the right amount every day 	<p>Reason supported by evidence related to information given:</p> <p>Examples:</p> <ul style="list-style-type: none"> -Balance between burning energy and energy intake for healthy lifestyle -Meal in the appropriate nutrition proportion or balanced diet makes him perform well 	

		2	Four factor mentioned from the above DO NOT ACCEPT if all factors seen in calculations	One of the above calculations correct	Realising not accurate with valid reason example: because he did not keep track of all other activities he does during the week He cannot achieve his daily meals proportion since $9010-6000$ is not equal to $4 \times 9010/9$	Advice related to two of the above Or A critical advice including balance like: -Should not have last day least energy intake and at the same time 1700 exercise out of 10000 needed		
		3		Two of the above calculations correct				

Answers			Notes	Total																								
8	a	<ul style="list-style-type: none"> •¹ two correct •² the other four correct <p>No ECF for column T allowed</p>	<p>Table Object</p> <table border="1"> <thead> <tr> <th>Row number (n)</th> <th>Number of up triangles (U)</th> <th>Number of down triangles (D)</th> <th>Total number of all triangles (T)</th> </tr> </thead> <tbody> <tr><td>1</td><td>1</td><td>0</td><td>1</td></tr> <tr><td>2</td><td>3</td><td>1</td><td>4</td></tr> <tr><td>3</td><td>6</td><td>3</td><td>9</td></tr> <tr><td>4</td><td>10</td><td>6</td><td>16</td></tr> <tr><td>5</td><td>15</td><td>10</td><td>25</td></tr> </tbody> </table>	Row number (n)	Number of up triangles (U)	Number of down triangles (D)	Total number of all triangles (T)	1	1	0	1	2	3	1	4	3	6	3	9	4	10	6	16	5	15	10	25	2
Row number (n)	Number of up triangles (U)	Number of down triangles (D)	Total number of all triangles (T)																									
1	1	0	1																									
2	3	1	4																									
3	6	3	9																									
4	10	6	16																									
5	15	10	25																									
	b	<ul style="list-style-type: none"> •¹ one pattern described correctly in words •² second pattern described correctly in words •³ third pattern described correctly in words <p>Allow ECF from their table in 8a</p>	<p>ACCEPT</p> <p>U goes up by 2,3,4 ...WTTE</p> <p>D goes up by 1,2,3 ...WTTE</p> <p>U is the same as D but with a shift</p> <p>T goes up by 3,5,7 ...WTTE</p> <p>Difference between U and n is D</p> <p>U is the sum of n and D</p> <p>it is the square numbers</p> <p>it is quadratic</p> <p>Quadratic sequence</p> <p>Second difference constant</p> <p>ACCEPT if they correctly describe in words their pattern</p> <p>DO NOT ACCEPT</p> <p>$U+D = T$</p> <p>n goes up by 1</p> <p>the difference is positive for any column</p> <p>U or D are triangular numbers</p> <p>general rules in terms of n, example: $n(n+1)/2$</p> <p>describing same pattern for U and D as two different patterns</p> <p>U or D or T is increasing</p>	3																								
	c	$(T=) n^2$	ACCEPT $n \times n$, $n * n$, n^2	1																								
	d	<ul style="list-style-type: none"> •¹ substitute $n \geq 3$ into their rule •² correctly calculate their value of T after substitution $n \geq 3$ •³ recognizing that their result is the same as their predicted value 	<ul style="list-style-type: none"> •¹ Ex: 3×3 •² Ex: 9 (for the $n= 3$) •³ Same as value I predicted in table (and we find the candidate has 9 in the table for $n = 3$) OR same as when we continue the pattern and explains how 9 is obtained from pattern of adding 3+2 to 4 	3																								

		<p>•³ ACCEPT seeing the 9 in the table and seeing their calculated T=9 when n=3</p> <p>SC for 1 mark</p> <p>If “tested” correctly with a value from the table. For example: testing with n = 2 to get T = 4</p>	
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8	e	Mark	1	2	3	4	5	
		Predictions (P)	Predict correctly two values	Predict correctly two rows or two columns up to n=6	Predict correctly all values up to n=6			
		Description (D)	<p>Attempt to describe a pattern in words Examples: Comment on difference OR Describe correctly in words their pattern OR attempt to write down a general rule. Example: $n(n+1)$ or n^2-1</p> <p>DO NOT ACCEPT $T=A+B+C$ or T is the sum of A,B, and C DO NOT ACCEPT is multiples of 1</p>	<p>Describe correctly one pattern in words Examples: T increases by 5,7,9 or has second difference 2 or has second difference constant or it is quadratic or C is same as n C increases by 1</p> <p>OR Write down correct general rule for A,B, or C in terms of n Without describing any pattern</p>	<p>Describe correctly two patterns in words Examples: T increases by 5,7,9 or has second difference 2 or has second difference constant or it is quadratic or C is same as n C increases by 1</p> <p>OR Write down correct general rule for A or B in terms of n AND Describe correctly one pattern in words</p> <p>OR Write down correct general rule for T in terms of n Without describing any pattern OR Attempt to write down correct general rule for T in terms of n AND</p>	<p>Attempt to write down correct general rule for T in terms of n ex: $T=n^2-1$ AND Describe correctly two patterns in words</p> <p>OR Write down correct general rule for A or B in terms of n AND Describe correctly two patterns in words</p> <p>OR Write down correct general rule for T in terms of n AND Describe correctly one pattern in words</p>	<p>Write down correct general rule for T in terms of n AND Describe correctly two patterns in words</p> <p>ACCEPT The rule is n^2+2n but award N1</p>	22

			Describe correctly one pattern in words			
	Testing (T)	attempt to use n from {1,2,3} in their described pattern or general rule Testing or verifying the $T=A+B+C$ allows only T1	Recognizing that their result is the same as value in table ACCEPT seeing their calculated T value from their general rule and the value in the table being equal			
	Verifying (V)	attempt to use $n \geq 4$ in their described pattern or general rule Using $T=A+B+C$ does not allow V marks	Calculate correctly their value of T using their $n \geq 4$ in their general rule	Recognizing that their result is the same as their predicted value ACCEPT seeing their calculated T value from their general rule and their predicted value in the table being equal		
	Justify/proof (J)	Weak attempt to justify their described pattern or their general rule Examples: trying at least two values and arguing as justification that they are the same or rule works	Correctly justify their general rule or pattern Examples: Add the incorrect general rules for A,B and C It is one less than square number minus 1 Assuming quadratic and solve equations correctly for coefficients	Attempt to prove the general rule for T Examples: Add incorrectly the correct general rules for A,B and C	Correctly prove the general rule for T Examples: Add correctly the correct general rules for A,B and C J4 automatically gains T2 and V3	
	Notation and terminology (N)	Notation or terminology is correct OR the notation and terminology have significant errors OR The general rule is correct but not in correct notation example: $U_n=n^2+2n$	The notation and terminology are correct Note: One minor error, not in general rule, can be overlooked Can be awarded only if they have a general rule ACCEPT using T_n			

			ACCEPT using U_n instead of T only if they mention that $T=U_n$ ACCEPT the use of x or $*$ for multiplication				
	Communication (L)	Very weak communication Two or three lines of communication OR Only calculations or algebraic steps	Weak communication More than three lines of communication but lack coherence	Good communication More than three lines of coherent communication Can be awarded only if J2 is achieved			

Table Object

Stage (n)	Number of triangles above the line (A)	Number of triangles below the line (B)	Number of triangles crossing the line (C)	Total number of triangles (T)
1	1	1	1	3
2	3	3	2	8
3	6	6	3	15
4	10	10	4	24
5	15	15	5	35
6	21	21	6	48
7	28	28	7	63
8	36	36	8	80

General rules:

$$C = n$$

$$A \text{ or } B = \frac{n(n+1)}{2}$$

$$T = n + n(n+1) = n^2 + 2n$$

Markscheme

November 2017

Mathematics

On-screen examination

21 pages

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The following are the annotations available to use when marking responses.

Annotation	Explication	Annotation	Explication	Shortcut
	Unclear		Award 0 marks	Alt+0
	Special case		Award 1 mark	Alt+1
	Misread		Award 2 marks	Alt+2
NWS	No working shown		Award 3 marks	Alt+3
	Error carried forward		Award 4 marks	Alt+4
	Words to that effect		Award 5 marks	Alt+5
	Benefit of the doubt		Award 6 marks	Alt+6
	Answer Given		Award 7 marks	Alt+7
	Highlight tool		Award 8 marks	Alt+8
	Ellipse tool		Award 9 marks	Alt+9
	On page comment tool		Award 10 marks	
	Seen		Award 11 marks	
	Caret - Omission		Award 12 marks	
	Wavy underline tool			

The markscheme may make use of the following abbreviations:

RM Assessor has the following annotations that should be used to award marks:

A0 only use to award a zero mark for an answer that has no merit eg, awarded for the candidate that has a wrong answer with no working



NR only use when the candidate has not made any response also stamp the response with



Marks awarded by stamping the tick



Seen; must be stamped on all blank response areas and on concatenated responses



unclear

ECF Marks that can be awarded as **error carried forward** from previous results in the question

BOD Benefit of the doubt

MR misread

NWS no working shown

SC special case

OE or equivalent

WTTE or words to that effect

AG Answer given

The markscheme makes use of the following abbreviations:

- Bullet notation means award 1 mark – see example below

Example 1

- 1 mark awarded and corresponding notes are aligned

b	<ul style="list-style-type: none">•¹ Show clear line of reasoning in the method•² 4	<ul style="list-style-type: none">•¹ 45 & 49 seen OE eg, $49 = 45 + x$•² Accept $45 + X/10 = 4.9$ <u>and</u> Ans 4	2
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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) 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.
- c) Where candidates have written two solutions to a question, mark the response that deserves more marks.
- d) 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 $\frac{x}{2}$ **OR** $x/2$ **OR** $x \div 2$
- e) 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.
- f) Special case marks (**SC**) can be allocated instead of but not in addition to the marks prescribed in the markscheme.
- g) Accept seeing equation not in-line.
- h) Accept notation errors in intermediate steps.
- i) When a calculator screenshot is taken, accept not seeing the whole operation.
- j) 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.

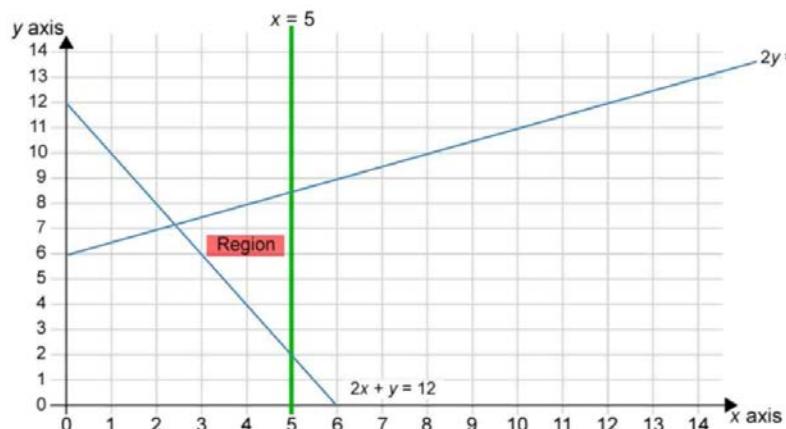
Question	Answers	Notes	Total
1 a	<ul style="list-style-type: none"> •¹ two correctly placed •² the other two correctly placed $\frac{6}{2}$ and $\frac{-\sqrt{36}}{3}$ AG (in red so ignore these in marking)	<p>The correct places are</p> <p>Z</p>	2
b	<ul style="list-style-type: none"> •¹ two correctly placed •² another two correctly placed •³ another two correctly placed 	<p>The correct places are</p> <p>Z</p> <p>Q</p> <p>R</p>	3
c	<ul style="list-style-type: none"> • $\square' \cap \square$ OR $\square \cap \square'$ 		1

Question	Answers	Notes	Total
2 a	<p>(translated horizontally) 3 units to the right (translated vertically) 2 units upwards</p> <ul style="list-style-type: none"> •¹ both translations mentioned without values or with incorrect values OR both values correct with incorrect transformations •² one transformation correctly described (with correct direction and value) •³ second transformation correctly described (with correct direction and value) 	<ul style="list-style-type: none"> •¹ Correct descriptions like: Horizontal and vertical shift or movement. ACCEPT down and left. ACCEPT horizontal enlargement 2 and vertical enlargement 3 •² To the right 3 (units) •³ Upwards 2 (units) 	3
b	<ul style="list-style-type: none"> •¹ equating with 11 •² one correct step to solve for a •³ their two values for a correct •⁴ selecting their correct value of a within the domain 	<ul style="list-style-type: none"> •¹ $11 = (a - 3)^2 + 2$. ACCEPT $11 = (x - 3)^2 + 2$ •² $\pm 3 = (a - 3)$. ACCEPT $\pm 3 = (x - 3)$ OR $x(x-6) = 0$ •³ (a =) 6 and (or) 0 their equation needs to have two values for a to award ECF •⁴ (Selects) $a = 6$ <p>6 without working award 3 marks 6 with one correct step or trial an error statement award 4 marks</p> <p>If they solve incorrectly and obtain two values for a outside domain then decide to take none of them award •⁴</p> <p>If they solve incorrectly and their solution allows only one value for a do not award •⁴</p> <p>If they solve incorrectly and obtain two values for a and select the one within the domain award •⁴</p>	4

Question	Answers	Notes	Total
3 a	<ul style="list-style-type: none"> •¹ two correct values OE •² the other two correct values OE 	<p>Insert image of the tree diagram stimulus</p> <pre> graph LR A((First ball)) -- even --> B1[] A -- odd --> B2[] B1 -- even --> C1[2/6] B1 -- odd --> C2[4/6] B2 -- even --> C3[3/6] B2 -- odd --> C4[3/6] </pre>	2
b	<ul style="list-style-type: none"> •¹ seeing their correct probabilities from (a) •² their result after multiplication of probabilities correct 	<ul style="list-style-type: none"> •¹ $\frac{3}{7}$ and their $\frac{2}{6}$ •² $\frac{1}{7}$ OE 1/7 OE without working award 2 marks their answer must be less than 1 to award ECF 	2
c	<ul style="list-style-type: none"> •¹ adding multiplied probabilities to their result in part (b) •² their calculation correct 	<ul style="list-style-type: none"> •¹ their $\frac{1}{7} + \frac{4}{7} \times \text{their } \frac{3}{6}$ •² $\frac{3}{7}$ OE (ACCEPT $\frac{18}{42}$ OR 0.42857... OR 43%) 3/7 OE without working award 2 marks SC calculating only odd-odd correctly ($\frac{4}{7} \times \text{their } \frac{3}{6} = \frac{2}{7}$) OE award 1 mark 	2

<p>d</p> $\frac{3+b}{2} = 5 \text{ or } 3+b = 10$ <p style="text-align: center;">AG 7</p>	<p>Accept $(3+7)/2=5$ Do not accept $3+7/2=5$</p>	1
<p>e</p> <ul style="list-style-type: none"> •¹ setting equation for range OR showing understanding of concept of range •² setting equation for mean OR showing understanding of concept of mean •³ simplifying correctly equation for mean •⁴ attempt to solve using substitution OR elimination •⁵ their value for a or c correct •⁶ the other value for a or c correct 	<ul style="list-style-type: none"> •¹ $c - a = 34$ OR difference between their a and c is 34 •² $\frac{a - 12 - 9 + 0 + 3 + 7 + 7 + 10 + 15 + c}{10} = 2.7$ •³ $a + c = 6$ •⁴ Attempt to solve simultaneously, adding OR substitution OR $2c = 40$ OR $2a = -28$ •⁵ $c = 20$ •⁶ $a = -14$ ALLOW ECF from one of their equations (a =) -14 without working award 2 marks (c =) 20 without working award 2 marks (a =) -14 with one correct step award 3 marks (c =) 20 with one correct step award 3 marks 	6

Question	Answers	Notes	Total
4 a	<ul style="list-style-type: none"> •¹ using Pythagoras correctly •² correct calculation 693 AG <p>Alternative method</p> <ul style="list-style-type: none"> •¹ using sine rule correctly •² correct calculation 693 AG <p>Alternative method</p> <ul style="list-style-type: none"> •¹ recognizing that $\angle ABC = 30^\circ$ and using tan ratio •² correct calculation 693 AG 	<ul style="list-style-type: none"> •¹ $800^2 = 400^2 + x^2$ OR $800^2 - 400^2$ •² $692.8203\dots$ OR $400\sqrt{3}$ OR $\sqrt{480000}$ OE <p>Do not award •² unless their result can be correctly rounded to 693</p> <ul style="list-style-type: none"> Alternative method $\bullet^1 \frac{x}{\sin 120} = \frac{400}{\sin 30}$ <ul style="list-style-type: none"> •² $692.8203\dots$ OR $400\sqrt{3}$ OR $\sqrt{480000}$ OE <p>SC Substituting x with 693 in Pythagoras OR Sine rule OR tan ratio then making correct calculations both sides award 1 mark</p>	2
b	<ul style="list-style-type: none"> •¹ recognizing that triangle OAC is equilateral OR substituting 400 correctly into circumference formula •² correct substitution in Arc length formula •³ their correct calculation 	<ul style="list-style-type: none"> •¹ ACCEPT seeing angle 30°, 60° or 120° OR $2\pi 400$ OR 800π •² $\frac{\text{their } 120}{360} \times 800\pi$ OR $\frac{120}{360} \times \text{their } 800\pi$ (Accept $(800/3) \times 3.14$ OR $(800/3) \times 22/7$ OE) •³ $837.758\dots$ (838 cm) OR $800\pi/3$ <p>•³ award as ECF only if •¹ OR •² is awarded and the calculation is of similar difficulty</p>	3

		837.758... (838 cm) OR $800\pi/3$ without working award 2 marks c adding 693 to their value in part (b)	693 + their 837.758... (838 cm) OR 1531 (cm) ACCEPT 692.820... OR $400\sqrt{3}$ OR $\sqrt{48000} +$ their 837.758	1
Question	Answers	Notes	Total	
5	<p>$x = 5$ given in the question see 1 on diagram</p> <ul style="list-style-type: none"> •¹ $2x + y = 12$ one intercept correct OR the line passes through two correct points •² $2x + y = 12$ y-intercept correct and crossing the line $x = 5$ at (5,2) •³ $2y = x + 12$ y-intercept correct OR the line passes through two correct points •⁴ $2y = x + 12$ y-intercept correct and crossing the line $x = 5$ at (5,8.5) 	 <p>To award the intercept (or intersection with $x = 5$) mark the line has to be ± 0.5 unit accurate</p> <p>Accept equations placed incorrectly</p> <p>•⁵ Their correct closed region (Most of the icon “region” has to be in the correct region in order to award the mark)</p>	5	

Question	Answers	Notes				Total																												
6 a	<ul style="list-style-type: none"> •¹ calculation of tax for 30 % band •² their amount of tax for 30 % band calculated correctly •³ calculation of tax for 41 % band •⁴ their amount of tax for 41 % band calculated correctly from a subtraction followed by multiplication •⁵ their amount of total tax paid calculated correctly 	<table border="1"> <thead> <tr> <th>Annual income bands in EUR</th> <th>Tax rate</th> <th>Calculation of tax</th> <th>Amount of tax EUR</th> </tr> </thead> <tbody> <tr> <td>0 < income ≤ 6000</td> <td>0 %</td> <td>0</td> <td>0</td> </tr> <tr> <td>6000 < income ≤ 12 000</td> <td>5.5 %</td> <td>(12 000 – 6000) x 5.5 %</td> <td>330</td> </tr> <tr> <td>12 000 < income ≤ 25 000</td> <td>14 %</td> <td>(25 000 – 12 000) x 14 %</td> <td>1820</td> </tr> <tr> <td>25 000 < income ≤ 70 000</td> <td>30 %</td> <td>(70000-25000)x30%</td> <td>13500</td> </tr> <tr> <td>Above 70 000</td> <td>41 %</td> <td>(80000-70000)x41%</td> <td>4100</td> </tr> <tr> <td></td> <td></td> <td>Total tax paid on 80 000 EUR</td> <td>19750</td> </tr> </tbody> </table>	Annual income bands in EUR	Tax rate	Calculation of tax	Amount of tax EUR	0 < income ≤ 6000	0 %	0	0	6000 < income ≤ 12 000	5.5 %	(12 000 – 6000) x 5.5 %	330	12 000 < income ≤ 25 000	14 %	(25 000 – 12 000) x 14 %	1820	25 000 < income ≤ 70 000	30 %	(70000-25000)x30%	13500	Above 70 000	41 %	(80000-70000)x41%	4100			Total tax paid on 80 000 EUR	19750				5
Annual income bands in EUR	Tax rate	Calculation of tax	Amount of tax EUR																															
0 < income ≤ 6000	0 %	0	0																															
6000 < income ≤ 12 000	5.5 %	(12 000 – 6000) x 5.5 %	330																															
12 000 < income ≤ 25 000	14 %	(25 000 – 12 000) x 14 %	1820																															
25 000 < income ≤ 70 000	30 %	(70000-25000)x30%	13500																															
Above 70 000	41 %	(80000-70000)x41%	4100																															
		Total tax paid on 80 000 EUR	19750																															

Question	Answers		Notes	Total
6 b		(1 mark)	(2 marks)	
	Identify Factors (F) For scenario 1	Identify two elements from: Income, taxes, expenses, the relocation place OR family	Identify more than two elements from: Income, taxes, expenses, the relocation place OR family	
	Calculation Home (H) OR For scenario 2	Attempt to calculate monthly OR yearly net saved value Example: Calculate Total Tax correctly: Tax: $330 + 1820 + 15000 \times 0.3 = 6650$ OR Calculate Total expenses correctly $(400 + 900 + 500) \times 12 = 21600$ OR 40000-their calculated taxes-their calculated yearly expenses	Correctly calculating scenario 1 monthly net saved value OR yearly net saved value (Saved value=40000 – 21600 – 6650 =)11750 OR 979.166... monthly Accept the result with rounding eg. 12000 yearly OR 1000 monthly	
	Calculation Relocate (R) OR For scenario 2	Attempt to calculate monthly OR yearly net saved value Example: Expenses: $(500+900+80+600)*12+their2x150=24960+300=25260$ OR Calculate correctly total expenses excluding home travel $(500+900+80+600)*12=24960$ OR Assuming a certain number of times to visit home but making an error in calculation eg. $(500+900+80+600) +their2x150=2080+300=2380$ Accept $2080+150=2230$ OR 50000-9650-their yearly incorrect expenses	Correctly calculating scenario 2 monthly net saved value OR yearly net saved value (Saved value=50000 – their25260 – 9650 =)15090 yearly OR $15090/12=1257.5$ monthly Accept the result with rounding eg. 15000 yearly OR 1250 monthly Accept any number of trips home for example $15090 + 150 = 15240$ (Allow for candidates that confuse 'return' for 'one way' only)	10
	Justify accuracy of calculations (J)	Weak unsupported justification OR Sensible rounding used OR Recognizing that these are approximate calculations and not accurate Do not accept: My calculations are accurate with any justification	Recognizing the calculation is not accurate with good reasoning: because many of the monthly expenses are estimates because medical expenses can vary because the number of journeys home vary	

	Decision (D)	<p>Relocate OR do not relocate with weak supporting justification</p> <p>Examples:</p> <p>I will relocate because I will make more money</p> <p>I will not relocate because I don't want to move</p> <p>Relocate or do not relocate without justification OR with irrelevant justification award 0 marks</p>	<p>Relocate or do not relocate with good supporting justification (balanced reflection)</p> <p>Examples:</p> <p>I will relocate because I will make more money even if I come to visit home once a month</p> <p>I will not relocate because even though I will be making xxx more money, it is not much compared to staying with family.</p> <p>I will relocate because I will make more money and I will gain new experiences by moving</p>	
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Question	Answers		Notes	Total
7 a	<ul style="list-style-type: none"> •¹ any correct area •² the corresponding other correct area •³ show appropriate operation either adding OR subtracting 800 AG 		SC seeing only: $1800 - 1000 = 800$ award 2 marks OR $600 + 200 = 800$ award 2 marks $60 \times 10 + 30 \times 8 - 40 = 800$ award 1 mark for 60×10	
	Example method 1	Example method 2	Example method 3	Example method 4
	<ul style="list-style-type: none"> • $30 \times 60 (= 1800)$ • $4 \times 10 \times 25 = (1000)$ • $(30 \times 60) - 4 \times 10 \times 25$ <p>Total 800 AG</p>	<ul style="list-style-type: none"> • $60 \times 10 (= 600)$ • $10 \times 10 \times 2 (= 200)$ • $60 \times 10 + 10 \times 10 \times 2$ <p>Total 800 AG</p>	<ul style="list-style-type: none"> • $10 \times 25 (= 250)$ and $10 \times 25 (= 250)$ • $10 \times 30 (= 300)$ • $250 + 250 + 300$ <p>Total 800 AG</p>	<ul style="list-style-type: none"> • $10 \times 10 \times 3 (= 300)$ • $10 \times 25 \times 2 (= 500)$ • $300 + 500$ <p>Total 800 AG</p>
b	$\tan \theta = \frac{30}{60}$		Accept ($\tan \theta = \frac{15}{30}$)	1
c	<ul style="list-style-type: none"> •¹ using tan ratio to determine correct value of θ •² using correct ratio to set equation in x •³ rearranging x on one side correctly •⁴ the correct value of x •⁵ rounding their result correctly to 1 dp 		<ul style="list-style-type: none"> •¹ $(\arctan \frac{1}{2}) = 26.565\dots \text{deg}$ •² $\sin(\text{their } \theta) = \frac{3}{x}$ OR $\frac{3}{\sin(\text{their } \theta)} = \frac{x}{\sin 90^\circ}$ OR $\frac{3}{x} = \text{their } 0.447\dots$ •³ $x = \frac{3}{\sin(\text{their } \theta)}$ OR $x = \frac{3}{\text{their } 0.447\dots}$ •⁴ $(x =) 3\sqrt{5}$ OR $6.708\dots \text{ (cm)}$ •⁵ $(x =) 6.7 \text{ (cm) 1 dp}$ <p>$(x =) 3\sqrt{5}$ OR $6.708\dots \text{ (cm) without working award 3 marks}$</p>	5

	<p>Alternative method</p> <ul style="list-style-type: none"> •¹ using Pythagoras to determine correct value of $\sin\theta$ •² using correct ratio to set equation in x •³ rearranging x on one side correctly •⁴ the correct value of x •⁵ rounding their result correctly to 1 dp 	<p>Alternative method</p> <ul style="list-style-type: none"> •¹ $\sin\theta = \frac{1}{\sqrt{5}}$ OR 0.447.... •² $\frac{3}{x} = \text{their } \frac{1}{\sqrt{5}}$ OR $\frac{3}{\text{their sin}\theta} = \frac{x}{\sin 90}$ OR $\frac{3}{x} = \text{their } 0.447...$ •³ $x = \frac{3}{\text{their sin}\theta}$ OR $x = \frac{3}{\text{their } 0.447...}$ •⁴ ($x = 3\sqrt{5}$ OR 6.708... (cm) •⁵ ($x = 6.7$ (cm) 1 dp <p>Seeing only $\frac{3}{\sin 26.565..} = 6.708..$ award 4 marks</p> <p>Seeing only $\frac{3}{\sin \text{their}\theta} = \text{their value not rounded}$ OR exact value that doesn't need rounding award 3 marks</p>	
d	<ul style="list-style-type: none"> •¹ calculating their base of the triangle correctly •² using trigonometric ratio correctly to set equation involving H •³ rearranging their equation correctly to have H on one side •⁴ calculating correctly the area of triangle using their height of triangle and their base of triangle 	<ul style="list-style-type: none"> •¹ (Base of triangle = 25-their 6.7 =) 18.3 •² $\frac{1}{2} = \frac{H}{25 - 3\sqrt{5}}$ or $\frac{H}{25 - 3\sqrt{5}} = \text{their } 18.3$ •³ $\frac{H}{25 - 3\sqrt{5}} = \frac{\text{their } 18.3}{\sin(\text{their } 26.565...)} = \frac{\text{their } 18.3}{\sin(90 - \text{their } 26.565...)}$ •³ ($H = \frac{1}{2} \times \text{their } 18.3$ OR $\frac{25 - 3\sqrt{5}}{2} = \text{their } 18.3$ OR 9.146...) •² has to be seen in order to award •³. <p>To award •⁴ their H without working has to be in the range of [9.1 , 9.2]</p>	4

	84 AG	<ul style="list-style-type: none"> •⁴ ($T_1 = \frac{1}{2} \times$ their 18.3 \times their 9.146... = 83.6... Accept 83.7...) <p>Do not award •⁴ unless their result can be correctly rounded to 84</p> <p>Do not award •⁴ if their answer is exactly 84</p>	
e	<ul style="list-style-type: none"> •¹ seeing 4 \times 44 and 4 \times 84 •² Adding correctly their multiplied values 	<ul style="list-style-type: none"> •² 512 (cm²) <p>512 without working award 2 marks</p>	2
f	<ul style="list-style-type: none"> •¹ dividing by total area of flag •² calculating their percentage correctly 	<ul style="list-style-type: none"> •¹ Seeing 60 \times 30 OR 1800 in denominator •² (% represented = $\frac{\text{their } 512}{\text{their } 1800} \times 100 = 28.444\ldots(\%)$) <p>28.444... OR 28 % without working award 2 marks</p>	2

Question	Answers	Notes	Total
8 a	<ul style="list-style-type: none"> •¹ one suitable pattern •² another suitable pattern 	<p>Examples of suitable patterns: Differences are 2,4,6 All even numbers Difference increasing Difference is even Second difference constant Number of female times the previous number of female f multiplied by f-1</p> <p>SC 2 marks: Second difference is 2 The differences are two step different OE Double of triangular numbers</p> <p>Do not accept Number of kisses increases as the number of females increases OE</p>	2
b	<ul style="list-style-type: none"> •¹ correct general rule with poor notation •² correct general rule with correct notation 	<p>•¹ $(k =)f^*(f-1)$ OR f^2-f OR $ff-f$ OR f^*f-f</p> <p>•² $(k =)f(f-1)$ OR $(k=)f^2-f$ OR $fxf-f$ OR $fx(f-1)$ OR $(f)(f-1)$</p> <p>Do not accept description in words Do not accept notation that reads incorrect general rule eg. $f \times f-1$</p>	2
c	<ul style="list-style-type: none"> •¹ substitute $f \geq 6$ into their rule •² correctly calculate their value of k after substitution $f \geq 6$ •³ recognise that their result is the same as their predicted value 	<p>•³ ACCEPT seeing the 30 in the table and seeing $k = 30$ from their calculation</p> <p>SC if “tested” correctly award 1 mark Tested correctly is when they apply the steps of verification mentioned in the left column on a value of $f \leq 6$</p>	3

8	d	M ar k	Predictions (P)	Description (D)	Testing (T)	Verifying (V)	Justify/proof (J)	Notation and terminology (N)	Communic ation (C)	
24	1	1	Correctly predict one term for any two sets of data s or b or k or G (when $m \geq 6$)	Attempt to describe a pattern Ex: they are all increasing or Recognize that pattern for s and b are the same	Attempted to test their described pattern or general rule of b or s or G for $m \geq 6$ ex: substitutes in their rule value of $m \leq 5$	Attempt to verify their general rule of b or s or G for $m \geq 6$ ex: substitute in their rule value of $m \geq 6$	Attempt to justify any of their described patterns or general rules Ex: refer to difference between terms or test at least two values for s and say it works or after stating the rule they say every time it is male times male	The notation or terminology is correct OR The notation and terminology have significant errors	Lines of reasoning are incomplete OR incoherent. Ex: Only two lines of calculations or algebraic steps	
			Correctly predict one row for the four sets of data (when $m \geq 6$) OR Correctly predict four values in the columns of s or b or k or G (when $m \geq 6$)	Recognize that pattern for s and b are the same and Attempt to describe a pattern for s Ex: the number is multiplied by itself or the number increases in 3,5,7,..	Correctly calculating their value of b or s or G using their value of $m \leq 5$ and recognizing that their result is the same as the table value (ACCEPT seeing their calculated value and their predicted value in the table being equal)	Correctly calculate their value of b or s or G using their value of $m \geq 6$	Justify any of the general rules correctly Ex: The second difference is constant Ex: The s (or b) are the square numbers OR Attempt to justify the general rule for Greeting (G) Ex: Attempt to add any of their rules for b, s or k together or test at least two values for G and say it works	The notation of a general rule and terminology describing pattern is correct OR Correct general rule in correct notation but not simplified Ex: $G=m(2m+m-1)$	Lines of reasoning are coherent OR answer is organised using a logical structure.	

		M ar k	Predictions (P)	Description (D)	Testing (T)	Verifying (V)	Justify/proof (J)	Notation and terminology (N)	Communication (C)	
		3	Correctly predict two rows for the four sets of data (when $m \geq 6$) OR Correctly predict eight values in the columns of s or b or k or G (when $m \geq 6$)	Correctly describe pattern in words for smiles (s) Ex: They are the square numbers or the second difference is constant or it is quadratic or second degree or $s = m \times f$		Recognise that their result for G is the same as their predicted value (ACCEPT seeing their calculated value and their predicted value in the table being equal) Allow V3 only if they verify their rule for G correctly	Justify any of the general rules correctly Ex: The second difference is constant Ex: The s (or b) are the square numbers AND Attempt to justify the general rule for Greeting (G) Ex: Attempt to add any of the rules for b , s or k together or test at least two values for s and say it works OR Justify correctly the general rule for Greeting (G) Ex: Add correctly their rules for b , s and k together	The notation of their general rule for G and terminology used are correct and their general rule is simplified as $G = 3m^2 - m$ or $G = m(3m-1)$ Award only if D5 is achieved	Lines of reasoning are coherent AND answer is organised using a logical structure Award only if J2 is achieved	
		4		Correctly describe pattern as general rule for smiles (s) AND recognise it is the same as for bows (b) $s = m^2$ and b the same writing only $s = m^2$ award D3			Justify any of the general rules correctly Ex: The second difference is constant Ex: The s (or b) are the square numbers AND Justify correctly the general rule for Greeting (G) Ex: Add correctly the rules for b , s and k together			

M ar k	Predictions (P)	Description (D)	Testing (T)	Verifying (V)	Justify/proof (J)	Notation and terminology (N)	Communication (C)	
5		Attempt to describe pattern as general rule for G Ex: the rule is $3m^2-m$ or $m(3m-1)$ OR adding correct rules incorrectly $G=2m^2-m+m^2=2m^2$						
6		Correctly describe the pattern for G as a general rule $G = m(m-1) + m^2 + m^2$ OR $G = 3m^2 - m$						

Predictions

Table Object

Number of males (m)	Number of females (f)	Number of kisses (k)	Number of bows (b)	Number of smiles (s)	Total number of greetings (G)
1	1	0	1	1	2
2	2	2	4	4	10
3	3	6	9	9	24
4	4	12	16	16	44
5	5	20	25	25	70
6	6	30	36	36	102
7	7	42	49	49	140
8	8	56	64	64	184
9	9	70	81	81	232
10	10	86	100	100	286
11	11	110	121	121	352
12	12	132	144	144	420
13	13	156	169	169	494
14	14	182	196	196	574
15	15	210	225	225	660

Rules:

$$k = m(m-1)$$

$$s = m^2$$

$$b = m^2$$

$$G = m(m - 1) + m^2 + m^2 = 3m^2 - m$$

Markscheme

November 2016

Mathematics

On-screen examination

20 pages

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The markscheme may make use of the following abbreviations:

RM Assessor has the following annotations that should be used to award marks:

A0 only use to award a zero mark for an answer that has no merit e.g. awarded for the candidate that has a wrong answer with no working

NR only use when the candidate has not made any response also stamp the response with 

 Marks awarded by stamping the tick

 Seen; must be stamped on all blank response areas and on concatenated responses

 unclear

- Bullet notation means award 1 mark – see example 1 below

ECF Marks that can be awarded as **error carried forward** from previous results in the question

BOD Benefit of the doubt

MR misread

NWS no working shown

SC special case

OE or equivalent

WTTE or words to that effect or accept incomplete calculator display

AG Answer given

Example 1

- 1 mark awarded and corresponding notes are aligned

b	<ul style="list-style-type: none">• Show clear line of reasoning in the method• 4	45 & 49 seen OE eg, $49 = 45 + x$	ACCEPT $45 + X/10 = 4.9$ <u>and</u> Ans 4	2
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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) 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.
- c) Where candidates have written two solutions to a question, mark the response that deserves more marks.
- d) 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 $\frac{x}{2}$ or $x \div 2$
- e) 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.
- g) Special case marks **SC** can be allocated instead of but not in addition to the marks prescribed in the markscheme. **Accept seeing equation not in-line**,
- h) **Accept notation errors in intermediate steps**,
- i) When a calculator screenshot is taken, accept not seeing the whole operation

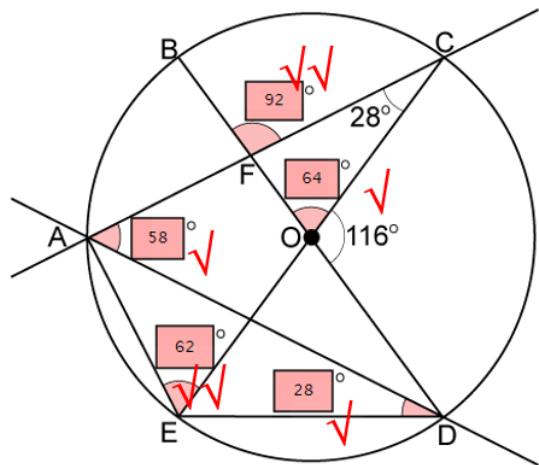
Task 1

		Answers	Notes	Total
1	a	<ul style="list-style-type: none"> •¹ Evidence of substituting one metal weight for 100g correctly •² Evidence of correct operation leading to the weight of one battery •³ Their correct answer 	<ul style="list-style-type: none"> •¹ seeing 200 or $200 + 3b = 305$. Accept not seeing this step •² subtracting 200 from 305 or seeing 105 or $3b = \text{their } 105$ or dividing their 105 by 3 •³ $b = 35$ (gm) <p>35 with no working: award 2 marks</p> <p>35 with one correct operation step: award 3 marks</p> <p>Footnote: Accept seeing only numbers in equations or seeing expressions in words</p>	3
	b	<ul style="list-style-type: none"> •¹ Evidence of one correct operation step to find the total •² their 370 correctly divided by 10 	<ul style="list-style-type: none"> •¹ $(10 \text{ tomatoes}) = 3 \times 100 + 2 \times \text{their } 35$ or seeing their 370 or their $370/10$ •² 37 (g) <p>•² If a further algebraic step divides the final answer by 10 or 100 or 1000: do not award the •²</p> <p>37 (gm) without working: award 1 mark</p> <p>Footnote: Award ECF after their wrong weight in part a) of one battery only if there is working for •¹</p>	2

2	a	• 12 (m ²)		1
	b	• 6 (m)		1
	c	• ¹ (b + 4) • ² (their 9)(4 + b) OR 9b + 36	• ¹ Accept not seeing expression in-line • ² Do not award • ² if incorrect notation. (example: 9*(b+4) or non-simplified expression (example: (6+3)(b+4))	2
	d	• ¹ Evidence of working leading to the value of b • ² b = 3 (m) • ³ E = 9 (m ²) Or their bx3 • ⁴ F = 18 (m ²) or their a x their b	• ¹ an equation for area (6 + 3)(b + 4) = 63 OR 9(b + 4) = 63 or 63-9x4=27 or 27/9 or 63/9 Accept not seeing this step Footnote: seeing b=3 allows • ¹ and • ² So for b=3 award 2 marks Correct values for b, F and E without working award 4 marks Allow ECF after their expression in part (c) even without working	4
	e	• ¹ correct expression for the total area • ² equating their expression with 210 • ³ their expression - 210 = 0 • ⁴ correct factorisation of their equation, or correct substitution into the quadratic formula for their equation • ⁵ their correctly calculated positive value of x selected	• ¹ $x^2 + 3x + 2x + 6$ OR $x^2 + 5x + 6$ OR (x+3)*(x+2) • ² $x^2 + 3x + 2x + 6 = 210$ OR $x^2 + 5x + 6 = 210$ • ³ $x^2 + 5x - 204 = 0$ • ⁴ $(x + 17)(x - 12) = 0$ • ⁵ $x = 12$ Footnote: The positive x value has to be selected in order to award • ⁵ $x = 12$ without working award 4 marks $x = 12$ with trial and error working award 4 marks $x = 12$ with incorrect working award 0 marks $x = 12$ with one correct algebraic step award 5 marks SC: Candidate who does not put their expression=210 and then solve $x^2 + 5x + 6=0$ award 2 marks	5

3	a	• 5		1
	b	$\frac{2 \times 1 + 3 \times 4 + 4 \times 4 + 5 \times 6 + 6 \times 4 + 7 \times 2}{20} = \frac{94}{20}$ <ul style="list-style-type: none"> •¹ multiplying at least three grades by their frequency OR evidence of adding repeated grades •² adding correctly the values of grade multiplied by the frequency or adding correctly the repeated grades •³ dividing by 20 •⁴ 94/20 4.7 AG 	<ul style="list-style-type: none"> •¹ seeing 2×1 and 3×4 and 4×4 for example •² adding $2 \times 1 + 3 \times 4 + 4 \times 4$ for example •⁴ do not accept any other value but 94/20 (OE) <p>Footnote: When a calculator screenshot is taken, accept not seeing the whole fraction (WTTE)</p> <p>94/20 (OE) with any evidence of correct working from the above award 4 marks</p> <p>94/20 (OE) with no working award 3 marks</p>	4
	c	<ul style="list-style-type: none"> •¹ Evidence of working to find the middle value. •² 5 	<ul style="list-style-type: none"> •¹ attempt to add $1 + 4 + 3$ or $2 + 4 + 6$ or writing the repeated grades in order •² 5 with no working award 2 marks 	2
	d	$\frac{6}{20}$ <ul style="list-style-type: none"> •¹ 6 seen in the numerator •² dividing by 20 	$\frac{3}{10} \text{ OR } 0.3$ <p>Footnote: 6/20 or 0.3 with no working award 2 marks</p> <p>Incorrect notation: "6 out of 20" award 1 mark only</p>	2
	e	$\frac{6}{20} \times \frac{8}{20} = 0.12$ <ul style="list-style-type: none"> •¹ multiplying their value in (d) by their probability of 6 or 7 in physics •² $\frac{8}{20}$ •³ their value after multiplying fractions 	<ul style="list-style-type: none"> •³ $\frac{3}{25} \text{ OR } \frac{48}{400} \text{ OR } 0.12$ $\frac{48}{400}$ or 0.12 with no working award 2 marks <p>Footnote: All fractions must be less than 1. Adding $6/20+8/20=14/20$ award 1 mark only (for the $8/20$ seen)</p>	3

4	a	• (BOC =) 64 (degrees)		1
	b	• (DAC =) 58 (degrees)		1
	c	• ¹ (DFC =) 88 seen OR seeing $180 - (28 + \text{their BOC})$ • ² (BFC =) their 92	Award ECF marks only if there is working 92 with no working award 2 marks	2
	d	• (ADE =) 28		1
	e	• ¹ $180 - (90 + 28)$ OR $90 - 28$ • ² (AEC =) their 62	62 with no working award 2 marks	2



General notes for Question 4:

Accept seeing values in the text beside the diagram provided angles are clearly identified

Mark only angles inside the boxes or when they are clearly labelled.

<p>5</p> <ul style="list-style-type: none"> •¹ tan22 •² substitutes correctly into tan ratio •³ calculates the height above the theodolite •⁴ (their) height + 1.2 •⁵ rounds their height correctly to the nearest cm <p>Alternatively</p> <ul style="list-style-type: none"> •¹ Substitutes correctly into cosine ratio •² Calculates the length of the hypotenuse •³ calculates the height above the theodolite (using Pythagoras) •⁴ (their) height + 1.2 •⁵ rounds their height correctly to the nearest cm 	<ul style="list-style-type: none"> •¹ accept not seeing this step can be implied by •² •² $\tan 22 = \frac{\text{height}}{57.25}$ •³ height = $57.25 \times \tan 22 = 23.1305\dots$ •⁴ $23.1305\dots + 1.2 = 24.3305\dots$ •⁵ 24.33 (m). Accept 2433 (cm) Accept seeing rounding to nearest cm in earlier step Footnote: WTTE accept incomplete calculator display <p>Alternatively</p> <ul style="list-style-type: none"> •¹ $\cos(22) = \frac{57.25}{H}$ •² hypotenuse = 61.746... •³ $\sqrt{(\text{their } 61.746\dots)^2 - 57.25^2} = 23.1305\dots$ •⁴ (their 23.1305) + 1.2 •⁵ 24.33 (m). Accept 2433 (cm) Accept seeing rounding to nearest cm in earlier step <p>23.1305 with no working award 2 marks 23.13 with no working award 3 marks 24.33 with no working award 4 marks 24.33 with one correct step award 5 marks Footnote: WTTE accept incomplete calculator display</p>	<p>5</p>
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Task 2

Answers			Notes	Total
6	a	<ul style="list-style-type: none"> •¹ substitutes $y = 65000$ into the equation •² solving their equation correctly for x •³ their value approximated correctly to the nearest million 	<ul style="list-style-type: none"> •¹ $65000 = 2110 x - 52818$ •² $x = 55.8379\dots$ •³ 56 million 55 with no working award 0 marks 55.8379... with no working award 1 mark 56 million with no working award 2 marks 	3
	b	<ul style="list-style-type: none"> •¹ substituting correctly their value in 6(a) into the percentage error formula •² their percentage correctly calculated •³ their negative percentage written as +ve 	<ul style="list-style-type: none"> •¹ $(\text{percentage error} = \frac{\text{their } 56000000 - 68488000}{68488000} \times 100)$ •² -18 % Accept not seeing this step. And award it if they make the correct calculation for their formula •³ 18 % <p>Final answer must be positive and does not need to be rounded Footnote: Award •³ only if their calculation gives a negative value Accept evidence of substitution seen in calculator screenshot (even if incomplete due to screenshot limitations) (WTTE)</p> <p>-18% with no working award 1 mark 18% with no working award 2 marks</p>	3
	c	<ul style="list-style-type: none"> •¹ referring to gradient or slope or constant increase or steady increase •² referring to gradient (or slope) being 2110 which is nearly 2000 	<ul style="list-style-type: none"> •¹ Accept: constant line steepness or proportional or rise over run DO NOT ACCEPT just referring to increase or positive relationship <p>SC: comparing with a numerical example (other than the given 1000000 allows 2000 jobs) and showing that it is approximately true: Award 1 mark. Suggesting an increase in passengers must be accompanied by a corresponding increase in jobs to allow the SC 1 mark</p>	2
	d	<ul style="list-style-type: none"> •¹ 3.6(...) seen •² their 3.6(...)...approximated correctly to the nearest million. 	<ul style="list-style-type: none"> •² ($x =$) 4 million <p>4 with no working award 2 marks</p> <p>Seeing $0.7x3^{1.5}$ only, award 0 marks</p>	2

6	e	Aspect	1 mark	2 marks	3 marks	4 marks	10
IR: Identification of relevant information	One numerical factor mentioned from: Length of runway Number of jobs Economic activity Size of aircraft Number of passengers Safety considering the measured distance from houses	More than one numerical factor mentioned Length of runway Number of jobs Economic activity Size of aircraft Number of passengers Safety considering the measured distance from houses					
CM: Calculations	Showing approximately correct numbers without showing calculations	Attempts to use the runway length (approximately 3.5) to find number of passengers OR Attempts to use the number of jobs assumed (18000) to find the number of passengers SC: writing approximate values with reference to tab1 and tab2	Uses correctly the runway length (approximately 3.5) to find number of passengers OR Uses correctly the number of jobs assumed (18000) to find the number of passengers	Uses correctly the runway length (approximately 3.5) to find number of passengers AND Uses correctly the number of jobs assumed (18000) to find the number of passengers			
JD: Justification of degree of accuracy	Rounding used in any element (rounding to nearest million or 1 dp is accepted but not to 2dp) OR Referring to percentage error	Justifies their choice of rounding OR the implications of working with rounded values OR refers to the limitations of the data by attempting to calculate possible percentage error					

		<p>PD: sustainability of proposed airport</p> <p>It is sustainable or it is not sustainable or a balanced discussion around sustainability supported by a relevant comment from:</p> <ul style="list-style-type: none"> • Safety: It is in a safe area and referring to distance from houses or distance from river or both (even if they measure the distance). Environmental impact (pollution) • Length of runway: around 3.5 and possible increase in the future based on the map • Room for expansion: there is land to add more runways in the future and increase the number of jobs and/or economic activity. • Economical expansion outside the airport • Facilities and services: availability of transport networks 	<p>It is sustainable or it is not sustainable or a balanced discussion around sustainability supported by at least two relevant comments from:</p> <ul style="list-style-type: none"> • Safety: It is in a safe area and referring to distance from houses or distance from river or both (even if they measure the distance). Environmental impact (pollution) • Length of runway: around 3.5 and possible increase in the future based on the map • Room for expansion: there is land to add more runways in the future and increase the number of jobs and/or economic activity. • Economical expansion outside the airport • Facilities and services: availability of transport networks 		
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Further guidance:

For 18000 job, the number of passengers is $(18000+52818)/2110=33.563$ millions

From the length of runway 3.5, the number of passengers is 32.7357... and hence number of jobs 16254

7	a <ul style="list-style-type: none"> •¹ substituting 65 correctly into the area formula •² 4225π 	<ul style="list-style-type: none"> •¹ (Area =) $\pi \times 65^2$ · Accept not seeing this step. Accept notation errors(example: $\pi*65^2$) for •¹only 4225π award 1 mark 4225π with no working award 2 marks 	2
	b <ul style="list-style-type: none"> •¹ substituting their Area and 30 correctly into the P_A formula •² calculating correctly their value of P_A •³ substituting correctly their value of P_A into the P_E formula •⁴ their value of P_E calculated correctly in watt •⁵ writing their value of P_E to nearest kw 	<ul style="list-style-type: none"> Allow in (b) here their area using π or 3.14 or $22/7$ •¹ $P_A = 0.6$ (their area)(30^3) •² (=) 215026309.2 or 214917300 or 215112857.1 •³ $P_E = 0.45$(their 215026309.2 or 214917300 or 215112857) •⁴ (=) 96761839.13 or 96712785 or 96800785.71 (w) •⁵ (=) 96762 or 96713 or 96801 (kw) 96762000 or 96713000 or 96801000 do not allow the •⁵ mark 96761839.13 or 96712785 or 96800785.71 with no working award 3 marks 96762 or 96713 or 96801 with no working award 4 marks 96762 or 96713 or 96801 with one correct step seen award 5 marks Footnote: Substituting their area into incorrect formula does not allow •¹ mark. •² can be awarded as ECF only if their formula is not becoming easier (example: If they do not cube the velocity then the formula is easier and hence they are not awarded •²) The rest of the bullets (•³, •⁴, •⁵) can be awarded as ECF if appropriate 	5

	c	<ul style="list-style-type: none">•¹ 5/2 or 2.5 or 650 seen or 5x130 or 130/2 or 65•² For multiplying 2.5 by 130 or dividing the 650 by 2 or multiplying the radius of one (130/2 or 65) by 5 <p>325 AG</p>	Accept showing that half way is $130+130+65=325$ for 2 marks	2
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			d	
				10
	Aspect	1 mark	2 marks	
	IR: Identification of strategy	<p>One mentioned from:</p> <ul style="list-style-type: none"> • consider the length or width and the diameter of turning zone • SC not numerical: bases need to be staggered OR accept “diagonally placed” • fitting three rows in the 1800 instead of only two • making turning zones closest possible • consider total area and area of one turbine • refer to Turning zones. 	<p>More than one mentioned from:</p> <ul style="list-style-type: none"> • consider the length or width and the diameter of turning zone • SC not numerical: bases need to be staggered. Or accept “diagonally placed” • fitting three rows in the 1800 instead of only two • making turning zones closest possible • consider total area and area of one turbine • refer to Turning zones. 	
	CM a: Calculates number of wind turbines	<p>Number of wind turbines : 10–13 Or can be seen on the canvas 10–13 turbines fitting inside the area OR more than 13 turbines but overlapping inside the area</p>	<p>Number of wind turbines 14 or more Or can be seen on the canvas 14 or more turbines fitting inside the area Accept seeing zones of turbines partially outside the area (strictly speaking the centre should be inside the area)</p>	
	CM b: Estimate Power Output	Attempts to substitute their area into formula of P_A and P_E	Calculates correctly their P_E = their number of turbines from their diagram x their P_E of one turbine	
	PD: sustainability of wind farm	<p>A relevant comment from:</p> <ul style="list-style-type: none"> • The diameter of the router: For better use of this land maybe we need turbines with different diameter • The average wind speed: This area experiences an average wind speed 30 ms^{-1} and since the turbines do not operate beyond this wind speed of 30 then this means that the turbines will not be operating about half the time (at least). 	At least two relevant comments from:	

		<p>beyond this wind speed of 30 then this means that the turbines will not be operating about half the time (at least).</p> <ul style="list-style-type: none"> • Possibility of expanding the area: When providing an area there has to be consideration of possible extension and extra area added. OR as there is no more land to add more wind turbines so output cannot be increased above the maximum • Turining/turbulence zones of wind turbines: There should be no problem if the circular zone of turbines on the extremities go beyond the land because this will not affect their effectiveness but the problem is if they overlap inside the land because this will affect their effectiveness • Maintenance or environmental impacts or general relevant points 	
	JD: Justification of degree of accuracy	<p>Rounding used in any element</p> <p>OR</p> <p>Simple comment like:</p> <ul style="list-style-type: none"> • I used the actual answer not the rounded one from 7a) so the accuracy is exact • My answer is not accurate as I think I can fit more turbines in the area. 	<p>Justifies their choice of rounding OR the implications of working with rounded values</p> <p>Justified comment like:</p> <ul style="list-style-type: none"> • Wind speed cannot be guaranteed so the P_E is not reliable • I used rounded answer form 7a) and the power output may differ by ... (and they calculate the value) if the answer was not rounded

Task 3 (total 39 marks)

		Answers	Notes	Total
8	a	<ul style="list-style-type: none"> •¹ relation between x-coordinates: states the x values of A is the same as C but negative (or opposite) •² relation between y-coordinates: states the y values of A and C are the same OR both 0 	<p>SC: Any correct comment(s) about the location award 1 mark</p> <p>Example: The x coordinates of both are equally apart from the y-axis OR They are both on the x-axis and equally distant from y-axis OR A and C are reflection of each other on the y-axis</p> <p>SC: Comment on both coordinates saying they (or both) are opposite signs or they are multiplied by -1 award (2 marks)</p>	2
	b	<ul style="list-style-type: none"> • the x coordinate of Q is half the x coordinate of C (or x-coordinate of C double x-coordinate of Q) 		1
	c	<ul style="list-style-type: none"> •¹ ($Q_4 =$) (5,3) •² ($Q_5 =$) (6,3) •³ ($Q_6 =$) (7,3) 		3
	d	<ul style="list-style-type: none"> •¹ one correct term •² fully correct <p>$X_c = 2n + 2$</p>	Accept equivalent expressions with any correct rearrangement or not simplified for 2 marks example: $4+2(n-1)$ OE award 2 marks Award 1 mark for each correct term	2
	e	<ul style="list-style-type: none"> • $X_Q = (2n + 2)/2$ or $n + 1$ OE 	Allow ECF from (d)	1
	f	<ul style="list-style-type: none"> •¹ substitutes a number $n \geq 4$ into their equation from (e) •² compares with the corresponding value in the table for $4 \leq n \leq 6$ or compares with predictions for $n \geq 7$ •³ acknowledges that the two values above are equal 	SC if “tested” correctly with a value of $n \leq 3$ award 1 mark	3
	g	<ul style="list-style-type: none"> • (Midpoint =) $(y_1 + y_2)/2$ OR $(0 + 6)/2$ OR average of 0 and 6 OR in the middle between 0 and 6 OR in the middle of the height 6 or $6/2$ 		1

	<p>h</p> <p>$\frac{3-0}{2-4}$</p> <p>•¹ for numerator 3 – 0 or 0-3 or vertical distance correctly described in words •² for denominator 2– 4 or -4-2 or horizontal difference correctly described in words</p>	<p>Accept inappropriate notation (example: 3-0/2—4)</p>	<p>2</p>
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Further guidance:

Question 8i (24 marks) Question Item Group 08

Universal Canvas Object

n	1	2	3	4	5	6
C_n	(4,0)	(6,0)	(8,0)	(10,0)	12, 0	14,0
A_n	(-4,0)	(-6,0)	(-8,0)	(-10,0)	-12,0	-14,0
Q_n	(2,3)	(3,3)	(4,3)	(5,3)	6,3	7,3
P	(0,2)	0,2	0,2	0,2	0,2	0,2
$m = \text{gradient}$	$\frac{3}{6}$	$\frac{3}{9}$	$\frac{3}{12}$	$\frac{3}{15}$	$\frac{3}{18}$	$\frac{3}{21}$

$$y = \frac{3}{3n+3}x + 2$$

OR

$$y = \frac{1}{n+1}x + 2$$

Markscheme

May 2021

Mathematics

On-screen examination

26 pages

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The markscheme may make use of the following abbreviations:

OE or equivalent

WTTE or words to that effect or accept incomplete calculator display

AG Answer given

- Bullet notation means award 1 mark – see example below

Example 1

.1 mark awarded and corresponding notes are aligned

b	<p>.1 Show clear line of reasoning in the method</p> <p>.2 4</p>	<p>.1 45 and 49 seen OE</p> <p><i>Ex: $49 = 45 + x$</i></p> <p>.2</p>	2
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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 as 1.9 ; 12,000 or 12 000 as 12000
- b) Accept notation errors in intermediate steps.
- c) Ignore further working after a correct answer **unless** noted otherwise.
- 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. $\frac{1}{2}$ OE means we accept 1/2 or 0.5 or $2 \div 4$ or 2^{-1} ; $\frac{x}{2}$ OE means we accept $x / 2$ or $x \div 2$ or $0.5x$; 0.23 OE means we accept 23%
- 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	Answers	Notes	Total
1 a	correctly place all four values	<p>U</p>	1
b	.1 correctly describe A AND the intersection in context .2 correctly describe B' in context	<p>.1 multiples of 2 and ACCEPT multiples of 2 but (WTTE) .2 not multiples of 3 ACCEPT multipliers</p> <p>DO NOT ACCEPT correct descriptions not in context or just listing the numbers of the set</p> <p>SC for 2 marks Multiples of 2 only (WTTE)</p>	2
c	.1 correctly write their probability of $A \cap B'$.2 correctly multiply their probabilities without replacement	<p>.1 their $\frac{4}{10}$ OE, consider their $\frac{4}{10}$ from 1a only if they did not list elements in 1b. DO NOT ACCEPT their 4 based only on a description in 1b .1 DO NOT ACCEPT the notation 4 over 10 .2 (their $\frac{4}{10} \times$ their $\frac{3}{9} =$) their $\frac{12}{90}$ OE or 0.133(33...) or 13.3(33)%</p>	2
d	.1 multiply their probabilities for first selected numbers without replacement .2 multiply their probabilities for second selected numbers without replacement .3 correctly add their multiplied probabilities	<p>.1 their $\frac{4}{10} \times$ their $\frac{6}{9}$ OE , ACCEPT 0.266(66..) or 0.267 seen .1 consider their4 from their probability used in 1c .2 their $\frac{6}{10} \times$ their $\frac{4}{9}$ OE , ACCEPT 0.266(66...) or 0.267 seen .2 consider their4 from their probability used in 1c .3 their $\frac{8}{15}$ OE , ACCEPT 0.533(33...)</p>	3

Question	Answers	Notes				Total																	
2 a	.1 correctly write one value .2 correctly write second value .3 correctly write third value	Addition grid <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 10px;">+</td> <td style="padding: 10px;">$\sqrt{5}$</td> <td style="padding: 10px;">$-\sqrt{5}$</td> </tr> <tr> <td style="padding: 10px;">$\sqrt{20}$</td> <td style="padding: 10px;">$3\sqrt{5}$</td> <td style="padding: 10px;">$\sqrt{5}$</td> </tr> <tr> <td style="padding: 10px;">$\sqrt{45}$</td> <td style="padding: 10px;">$4\sqrt{5}$</td> <td style="padding: 10px;">$2\sqrt{5}$</td> </tr> </table>	+	$\sqrt{5}$	$-\sqrt{5}$	$\sqrt{20}$	$3\sqrt{5}$	$\sqrt{5}$	$\sqrt{45}$	$4\sqrt{5}$	$2\sqrt{5}$	OR <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 10px;">+</td> <td style="padding: 10px;">$\sqrt{5}$</td> <td style="padding: 10px;">$-\sqrt{5}$</td> </tr> <tr> <td style="padding: 10px;">$\sqrt{20}$</td> <td style="padding: 10px;">$\sqrt{45}$</td> <td style="padding: 10px;">$\sqrt{5}$</td> </tr> <tr> <td style="padding: 10px;">$\sqrt{45}$</td> <td style="padding: 10px;">$\sqrt{80}$</td> <td style="padding: 10px;">$2\sqrt{5}$</td> </tr> </table>	+	$\sqrt{5}$	$-\sqrt{5}$	$\sqrt{20}$	$\sqrt{45}$	$\sqrt{5}$	$\sqrt{45}$	$\sqrt{80}$	$2\sqrt{5}$	ACCEPT only the forms and notations above	3
+	$\sqrt{5}$	$-\sqrt{5}$																					
$\sqrt{20}$	$3\sqrt{5}$	$\sqrt{5}$																					
$\sqrt{45}$	$4\sqrt{5}$	$2\sqrt{5}$																					
+	$\sqrt{5}$	$-\sqrt{5}$																					
$\sqrt{20}$	$\sqrt{45}$	$\sqrt{5}$																					
$\sqrt{45}$	$\sqrt{80}$	$2\sqrt{5}$																					
b	.1 correctly write two values .2 correctly write third value .3 correctly write fourth value	Multiplication grid <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 10px;">\times</td> <td style="padding: 10px;">$2b$</td> <td style="padding: 10px;">$4ab^{-2}$</td> </tr> <tr> <td style="padding: 10px;">$\frac{7}{2}a$</td> <td style="padding: 10px;">$7ab$</td> <td style="padding: 10px;">$14a^2b^{-2}$</td> </tr> <tr> <td style="padding: 10px;">$3a^4b$</td> <td style="padding: 10px;">$6a^4b^2$</td> <td style="padding: 10px;">$12a^5b^{-1}$</td> </tr> </table>	\times	$2b$	$4ab^{-2}$	$\frac{7}{2}a$	$7ab$	$14a^2b^{-2}$	$3a^4b$	$6a^4b^2$	$12a^5b^{-1}$	If any of the values are correct but not in exactly the form and notation above, award marks as appropriate then subtract one mark	3										
\times	$2b$	$4ab^{-2}$																					
$\frac{7}{2}a$	$7ab$	$14a^2b^{-2}$																					
$3a^4b$	$6a^4b^2$	$12a^5b^{-1}$																					

Question	Answers	Notes	Total
3 a	.1 correctly set $f(x) = g(x)$ OR correctly expand $g(x)$.2 correctly set $f(x) = g(x)$ AND correctly expand $g(x)$ AG $x^2 - 4x - 5 = 0$.1 $2x + 4 = (x - 1)^2 - 2$ OR $x^2 - 2x + 1 - 2$.1 ACCEPT $2x + 6 = (x - 1)^2$.2 $2x + 4 = x^2 - 2x + 1 - 2$.2 ACCEPT $2x + 4 = x^2 - 2x - 1$ or $2x + 6 = x^2 - 2x + 1$ Ignore further working	2
b	.1 correctly factorize the quadratic equation OR correctly substitute into quadratic formula .2 correct values of x .3 correct coordinate for A .4 correct coordinate for B	.1 $(x - 5)(x + 1) = 0$ OR $\frac{4 \pm \sqrt{(-4)^2 - 4(1)(-5)}}{2(1)}$ OE .1 ACCEPT $\frac{4 \pm \sqrt{-4^2 - 4(1)(-5)}}{2(1)}$.2 ($x =$) 5 and ($x =$) -1 ACCEPT ($x =$) -1, 5 .3 ($A =$) (-1, 2) ACCEPT $x = -1, y = 2$ or $f(-1) = 2$.4 ($B =$) (5, 14) ACCEPT $x = 5, y = 14$ or $f(5) = 14$ ACCEPT seeing .1 and .2 in 3a	4
c	.1 correctly substitute their coordinates from 3b of A and B into the correct distance formula .2 correctly calculate their value after substitution into the correct distance formula	.1 ($AB =$) $\sqrt{(\text{their}(-1) - \text{their}5)^2 + (\text{their}2 - \text{their}14)^2}$ OE .2 ($AB =$) $\text{their}\sqrt{180}$ or $6\sqrt{5}$ or $13.4(164\dots)$	2

Question		Answers	Notes	Total
4	a	124 755	ACCEPT 124,755	1
	b	.1 correctly divide 4a by 1000 and correctly round down .2 multiply their 124 by 4 .3 correctly subtract 150	.1 their124 seen .2 $4 \times$ their124 or their 496 Ex: 4×124.755 .2 DO NOT ACCEPT $4 \times$ their124000 .3 (their496 – 150 =)their346 .3 ACCEPT (their124000 – 150 =)their correct value .3 DO NOT ACCEPT if negative	3

4	c	<p>AM1 (when they start by doing operations to the 500 operations:</p> <ul style="list-style-type: none"> - add 150 to 500 or 650 seen - divide by 4 - multiply by 1000 - divide by 0.2 OE <p>.1 any two operations from the operations above .2 another two operations from the operations above .3 correctly write the minimum number of viewers after realising the rounding up</p> <p>AM2 (when they start by doing operations to number of viewers)</p> <p>.1 correctly write the number of viewers .2 any two operations from the operations below .3 another two operations from the operations below</p> <p>operations:</p> <ul style="list-style-type: none"> - multiply their number of viewers by 0.2 OE - divide by 1000 - multiply by 4 - subtract 150 <p>AM3 (when they set an equation)</p> <p>.1 correctly write the equation .2 correctly solve their equation</p> <p>.3 correctly write the minimum number of viewers (after realising the rounding up)</p>	<p>AM1 (when they start by doing operations to the 500)</p> <p>.1 Ex: $\frac{650}{4}$ OE or 162.5 or 163 seen</p> <p>.2 Ex: $\frac{\text{their}163 \times 1000}{0.2}$ OE</p> <p>.3 $(\frac{163000}{0.2}) = 815000$</p> <p>AM2 (when they start by doing operations to number of viewers)</p> <p>.1 815000</p> <p>.2 Ex: $\text{their}815000 \times \frac{0.2}{1000}$</p> <p>.3 Ex: $\text{their}163 \times 4 - 150$</p> <p>AM3 (when they set an equation)</p> <p>.1 $\frac{0.2x}{1000} \times 4 - 150 = 500$</p> <p>.2 their 812 500</p> <p>.2 ACCEPT only if their equation is of similar complexity i.e. including at least two of: $x \times 4$, $\frac{x}{1000}$, $x \times 0.2$, $x - 150$</p> <p>.3 $812500 \times 0.2 = 162500$, $163000 \div 0.2 = 815000$</p>	3
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Question	Answers	Notes	Total
5 a	<p>AM1 (using sin or cos ratios) .1 correctly divide by two the 150 AND 5.4</p> <p>.2 correctly substitute into trig ratio</p> <p>.3 correct value of r before rounding AG 2.80</p> <p>AM2 (using sine rule) .1 correctly substitute into sine rule</p> <p>.2 correctly rearrange for r on one side</p> <p>.3 correct value of r before rounding AG 2.80</p> <p>AM3 (using cos rule) .1 correctly substitute into cosine rule</p> <p>.2 correctly rearrange for r^2 on one side</p> <p>.3 correct value of r before rounding AG 2.80</p> <p>AM4 (using tan ratio) .1 correctly calculate the angle and correctly divide 5.4 by two</p> <p>.2 correctly substitute tan15 or tan75 ratio into Pythagoras</p> <p>.3 correct value of r before rounding AG 2.80</p>	<p>AM1 (using sin or cos ratios) .1 75 AND 2.7 seen. ACCEPT 15 AND 2.7 seen</p> <p>.2 $\sin 75 = \frac{2.7}{r}$ OR $\cos 15 = \frac{2.7}{r}$ OE ACCEPT $\frac{2.7}{\sin 75}$ OR $\frac{2.7}{\cos 15}$ seen</p> <p>.3 ($r =$)2.79(52....)</p> <p>.3 ACCEPT their correct r due to earlier rounding provided it rounds to 2.8</p> <p>AM2 (using sine rule) .1 $\frac{5.4}{\sin 150} = \frac{r}{\sin 15}$ OE</p> <p>.2 ($r =$)$\frac{5.4 \times \sin 15}{\sin 150}$ OE</p> <p>.3 ($r =$)2.79(52....)</p> <p>.3 ACCEPT their correct r due to earlier rounding provided it rounds to 2.8</p> <p>AM3 (using cos rule) .1 $5.4^2 = 2r^2 - 2r^2 \cos 150$ OE</p> <p>.2 ($r^2 =$)$\frac{5.4^2}{2 - 2\cos 150}$ OE , or 7.81(33..) seen</p> <p>.3 ($r =$)2.79(52....)</p> <p>.3 ACCEPT their correct r due to earlier rounding provided it rounds to 2.8</p> <p>AM4 (using tan ratio) .1 15 and 2.7 or 15 and 2.7 seen</p> <p>.2 $r^2 = 2.7^2 + 2.7^2 \tan^2 15$ or $(r^2 =)2.7^2 + \frac{2.7^2}{\tan^2 75}$ OE or 7.81(33..) seen</p> <p>.3 ($r =$)2.79(52....)</p> <p>.3 ACCEPT their correct r due to earlier rounding provided it rounds to 2.8</p>	3

5	b	<p>AM1</p> <p>.1 correctly substitute 2.8 into volume of sphere formula</p> <p>.2 correctly substitute 2.86 into volume of cone formula</p> <p>.3 evidence of equating their volumes</p> <p>.4 correctly calculate their h after solving their equation</p> <p>AM2 (when using sin or cos)</p> <p>.1 correctly substitute correct values into trig ratio OR sine rule</p> <p>.2 correctly calculate slant height</p> <p>.3 correctly substitute their slant height into Pythagoras</p> <p>.4 correctly calculate their h using Pythagoras</p> <p>AM3 (only when using the tan ratio)</p> <p>.1 correctly calculate angle and side of the right angled triangle</p> <p>.2 correctly substitute into tan ratio</p> <p>.3 correctly rearrange their tan equation for h on one side</p> <p>.4 correctly calculate their h after multiplying by tan75 OR dividing by tan15</p>	<p>AM1</p> <p>.1 ($V = \frac{4\pi 2.8^3}{3}$) OE or 91.95(23..) ACCEPT using pi or 3.14 instead of π</p> <p>.1 ACCEPT using 2.795(2...) instead of 2.8</p> <p>.2 $\frac{\pi 2.86^2 h}{3}$ OE or $8.56(56..)h$, ACCEPT using pi or 3.14 instead of π</p> <p>.3 their $\frac{\pi 2.86^2 h}{3} =$ their $\frac{10976\pi}{375}$ OE</p> <p>.4 (h=) their10.7(3499...)</p> <p>.4 ACCEPT their10.7(34999...) only if one of .1, .2, or.3 is awarded</p> <p>AM2 (when using sin or cos)</p> <p>.1 $\sin 15 = \frac{2.86}{x}$ or $\cos 75 = \frac{2.86}{x}$ OR $\frac{x}{\sin 75} = \frac{5.72}{\sin 30}$ OE</p> <p>.2 (x =)11.05(019....)</p> <p>.3 ($h^2 =$)their11.05² – 2.86²</p> <p>.4 (h=) their10.67(366...) or their 10.7</p> <p>AM3 (only when using the tan ratio)</p> <p>.1 75 and 2.86 OR 15 and 2.86 seen</p> <p>.2 $\tan 75 = \frac{h}{2.86}$ OR $\tan 15 = \frac{2.86}{h}$</p> <p>.3 (h=)their2.86 × tan 75 or (h=)2.86 × tan their75 OR $\frac{\text{their2.86}}{\tan 15}$ or $\frac{2.86}{\tan \text{their15}}$</p> <p>.4 (h=) their10.67(366...) or their 10.7</p> <p>Note that for the three methods, always .1 and .2 need to be completely correct to award them. only .3 and .4 can be with "their"</p>	4
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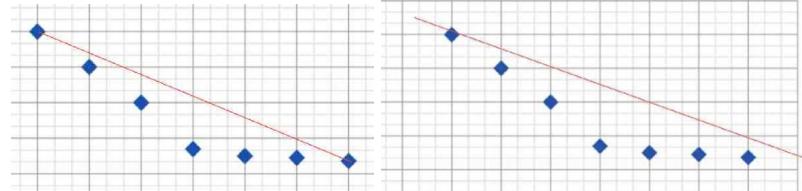
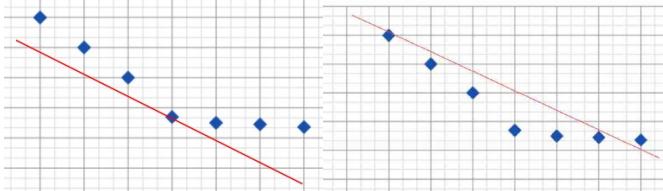
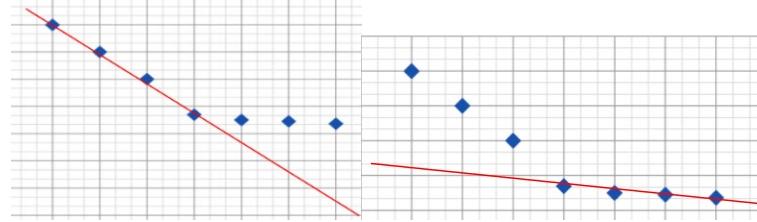
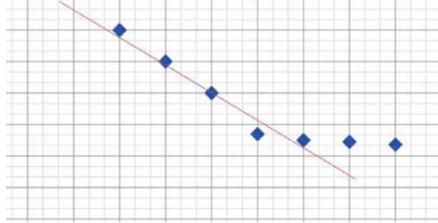
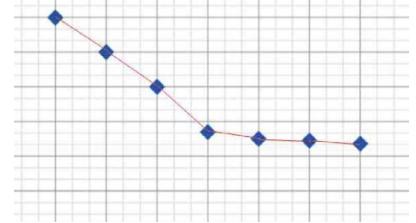
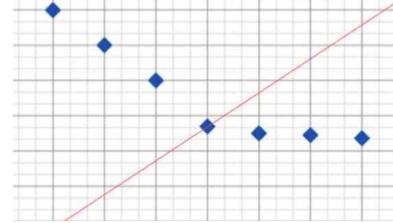
Question		Answers	Notes	Total
6	a	8 to 10 hours within the interval 6 pm to 6 am	Ex: 8pm to 5am ACCEPT correct 24-hour format ignoring am/pm Ex: 20:00am to 5:0pm	1
	b	AM1 (using the 12-hour clock) .1 Maximum at 12:00 pm .2 Minimum at 12:00 am AM2 (using the 24-hour clock) .1 Maximum at 12:00 (am/pm) .2 Minimum at 24:00 (am/pm)	AM1 (using the 12-hour clock) .2 ACCEPT 0:00 am AM2 (using the 24-hour clock) .2 ACCEPT 0:00 SC for 1 mark Maximum at 24:00 (am/pm) and Minimum at 12:00 (am/pm)	2
	c	.1 Amplitude 0.5 OE .2 Period 24	ACCEPT .5	2
	d	.1 Maximum 37 .2 Minimum 36		2
	e	.1 evidence of substituting 7.25 into the correct formula .2 correctly calculate their B using their substituted t .3 correctly round their calculated value to 1 dp	.1 ($B =$) $-0.5\cos(7.25 \times 15) + 36.5$ ACCEPT incorrect use of brackets .2 their 36.66(071973....) , ACCEPT not seeing this step .3 their 36.7 ACCEPT 33 if their .2 is 32.99(8...) or 33.046(8...)	3
	f	.1 correctly write the equation modelling Ray's temperature	.1 $R = -0.5\cos 15t + 36.75$ (using R or any other letter) ACCEPT $B = -0.5\cos 15t + 36.75$ ACCEPT $-0.5\cos 15t + 36.75$	1

6	g	<p>.1 evidence of correctly equating their expression in terms of t with 36.5</p> <p>.2 correctly rearrange their equation for $\cos 15t$ on one side</p> <p>.3 correctly remove their cosine</p> <p>.4 correct value of their first t or their first time of day</p>	<p>.1 their $-0.5 \cos 15t + 36.75 = 36.5$ ACCEPT using x instead of t</p> <p>.2 $\cos 15t = \frac{\text{their}(-0.25)}{-0.5}$ or their 0.5 OE</p> <p>.3 $15t = \text{their}60$ ACCEPT not seeing this step</p> <p>.4 ($t=$) their 4 (am) or 4:00 OE .4 ignore incorrect time of day after seeing their 4 .4 ACCEPT their t or their time of day after solving correctly their linear equation of .1 Ex: $\frac{0.25}{0.5 \cos 15} = 0.51(76....)$ or 0.5 or 12:31 or 12:30 or 0:31 or 0:30</p>	4
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Question	Answers	Notes	Total
7	a .1 mode 0.78 .2 median 0.77		2
	b .1 add the product of grade and frequency .2 divide the sum of products by 20 0.77 AG	<p>.1 $4 \times 0.75 + 3 \times 0.76 + 5 \times 0.77 + 6 \times 0.78 + 1 \times 0.79 + 1 \times 0.8$ OE .1 ACCEPT 15.4 seen .1 ACCEPT not seeing the whole operation from calculator screenshot provided it shows at least 4 correct products. Ex:</p> <p style="text-align: center;">(4 × 0.75 + 3 × 0.76 + 5 × 0.77 + 6 × 0.78 + 1 × 0. Screenshot</p> <p>Or</p> <p style="text-align: center;">3 × 0.76 + 5 × 0.77 + 6 × 0.78 + 1 × 0.79 + 1 × 0.8 Screenshot</p> <p>.2 $\frac{4 \times 0.75 + 3 \times 0.76 + 5 \times 0.77 + 6 \times 0.78 + 1 \times 0.79 + 1 \times 0.8}{4 + 3 + 5 + 6 + 1 + 1}$ ACCEPT $\frac{15.4}{20}$ seen .2 ACCEPT not seeing the whole operation from calculator screenshot Ex:</p> <p style="text-align: center;">(4 × 0.75 + 3 × 0.76 + 5 × 0.77 + 6 × 0.78 + 1 × 0. Screenshot $\frac{\text{ans}}{20} = 0.77$</p>	2

<p>7 c</p> <p>.1 any two from</p> <ul style="list-style-type: none"> i. line within the zone ii. fairly passing through points Ex: at least two points above and two points below the line iii. line domain at least [5.5.10.5] <p>.2 the third from</p> <ul style="list-style-type: none"> i. line within the zone ii. fairly passing through points. Ex: at least two points above and two points below the line iii. line domain at least [5.5.10.5] <p>DO NOT award any marks for horizontal line</p> <p>DO NOT award any marks if they have more than one line drawn</p> <p>DO NOT award any marks if their line has positive gradient</p>	<p>The figure shows three separate scatter plots. The first plot shows a yellow shaded zone between two parallel lines, with several data points falling within this zone. The second plot shows a red line passing through most of the data points, which are scattered both above and below the line. The third plot shows a horizontal blue line with data points scattered around it.</p> <p>Line must be in the zone indicated</p> <p>Fairly passing between points – at least two points above and below the line</p> <p>Ex:</p> <p>A scatter plot with 'Number of hours sleep (h)' on the x-axis (ranging from 0 to 12) and 'Mean reaction time in seconds (r)' on the y-axis (ranging from 0.0 to 1.2). A red line of best fit shows a negative correlation. Data points are approximately at (5, 1.1), (6, 1.0), (7, 0.9), (8, 0.75), (9, 0.75), (10, 0.75), and (11, 0.75).</p>	<p>2</p>
	<p>Examples acceptable for (2 marks)</p> <p>The figure shows four separate scatter plots, each with a different set of data points and a corresponding line of best fit. The scenarios vary in terms of the relationship between the variables and the placement of the line relative to the data points.</p>	

Further examples of different scenarios on the next page

7	Examples acceptable for (1 mark)   <p>line within the zone and line domain at least [5.5,10.5], but the line is not fairly passing through points. Award 1 mark</p>  <p>fairly passing through points and domain at least [5.5,10.5], but the line is not within the zone. Award 1 mark</p> <p>line is within the zone and fairly passing through points but domain not at least [5.5,10.5] Award 1 mark</p>		
	Examples not acceptable (0 marks)  <p>Line is not within the zone and domain is not [5.5,10.5] Award 0 marks</p>	 <p>more than one line drawn. Award 0 marks</p>	 <p>their line has positive gradient. Award 0 marks</p>
d	.1 correct value of their r for $h = 4$.2 correct value of their r for $h = 7.5$.1 ACCEPT error ± 0.02 DO NOT ACCEPT if $h=4$ is not on their line .2 ACCEPT error ± 0.02 DO NOT ACCEPT if $h=7.5$ is not on their line	2

7	e	<p>.1 correctly substitute 0.77 into the formula .2 correct value of w .3 correctly round their w to 2 sf</p>	<p>.1 ($w =$) $24(100)^{-0.77}$.2 0.692(1675608...) ACCEPT not seeing this step .3 their 0.69 OE</p>	3
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Question 7f 8 marks			
Marks	1	2	3
Factors (F)	The Two factors below identified explicitly Reaction time AND Sleeping time WTTE DO NOT ACCEPT factors embedded in working		
Calculate (C)	one correct w value from their r without working OR At least two incorrect w values from their r with working seen ACCEPT $w > 1$ ACCEPT w and its corresponding r value seen in the table or in the response box ACCEPT their rounding of w provided it correctly rounds to 1 d.p Ex: $w=0.6867$ and they write 0.68 DO NOT ACCEPT w for $r=0.77$	Two correct w values from their r without working ACCEPT $w > 1$ ACCEPT w and its corresponding r value seen in the table or in the response box ACCEPT their rounding of w provided it correctly rounds to 1 d.p Ex: $w=0.6867$ and they write 0.68 DO NOT ACCEPT w for $r=0.77$	Three correct w values from their r without working ACCEPT $w > 1$ ACCEPT w and its corresponding r value seen in the table or in the response box ACCEPT their rounding of w provided it correctly rounds to 1 d.p Ex: $w=0.6867$ and they write 0.68 DO NOT ACCEPT w for $r=0.77$
Comment (J)	Correct comment on the positive relationship between probability of winning and sleeping. Ex: WTTE When sleeping duration increases the probability of winning increases ACCEPT: -Good sleep increases probability of winning -Bad sleep decreases probability of winning -reaction time is better when sleeping well so probability of winning increases -sleeping 10h has probability 0.8, sleeping 4h has probability 0.2 and 0.8 is more than 0.2 -sleeping 10h has $w=0.8$ while sleeping 4h has $w=0.1$ only DO NOT ACCEPT : -comment involving only reaction time and sleeping. -sleeping 10h has probability 0.8 compared to sleeping 4h has probability 0.1	Additional correct comment realizing that probability of winning depends on more than sleeping. Ex: WTTE -Chance of winning will not just keep increasing when the number of hours of sleep increases. -Sleeping h hours does not automatically mean that the sprinter will win or will not win -Winning also depends on other factors ACCEPT Wining also depends on any of: talent or endurance or fitness or training or experience OE DO NOT ACCEPT J2 if J1 not awarded	

Marks	1	2	3
Justify degree of Accuracy (A)	<p>Weak justification inaccurate with weak justification Ex: -inaccurate since I used line of best fit that has approximations -inaccurate as values given are not exact -inaccurate as sample size small or only 20 -accurate, however I used rounding -accurate to a certain extent, as data given was not exact -using rounding decreased the accuracy</p> <p>OR Accurate with acceptable justification Ex: -accurate since numbers I used in my calculations are rounded 2 s.f. -the accuracy of my findings comes from rounding I used which is 2 s.f.</p> <p>ACCEPT accurate due to rounding only if they mention the degree of accuracy of their rounding</p> <p>DO NOT ACCEPT -accurate because I used my line of best fit or data given or graph OE -accurate because I used exact values or because I didn't round my results OE</p> <p>DO NOT ACCEPT just seeing their values rounded correctly</p>	<p>Inaccurate with good justification inaccurate AND state that the relation between reaction time and sleeping cannot be linear WTTE</p> <p>OR inaccurate AND state that the line equation may not be valid beyond the data given WTTE</p>	

Question	Answers	Notes	Total
8	a correctly place 12 and 14		1
b	.1 correctly describe one pattern for longer base in words with correct terminology .2 correctly describe a second pattern for longer base in words with correct terminology	<p>ACCEPT complete terminology only, for example (below are four different descriptions)</p> <p>even numbers, divisible by 2, multiples of 2, the even numbers starting from 4</p> <p>Increasing by 2, adds 2, goes up by 2, moving up by 2</p> <p>Arithmetic with difference 2, difference is 2</p> <p>Second difference is zero</p> <p> DO NOT ACCEPT incomplete terminology, for example:</p> <p>Arithmetic, linear, increasing by a constant, constant difference, the even numbers, the multiples of 2</p> <p> DO NOT ACCEPT the rule in words, for example:</p> <p>2 times n plus 2, n multiplied by 2 plus 2, double of n plus 2, twice stage number plus 2, the sum of 2 and product of n by 2 WTTE</p> <p>Note: More than two different patterns, all correct award (2 marks) Ex: adds 2 and Second difference is zero and it is 2 times n plus 2 More than two different patterns, with any incorrect award (1 mark) Ex: adds 2 and Second difference is zero and it is double n</p>	2
c	.1 the correct general rule .2 the correct simplified general rule with correct notation for L in terms of n .	<p>.1 ($L =$) $2n + 2$ or ($L =$) $2(n + 1)$ or $L = 2 \times n + 2$ or $L = 2 * n + 2$ or $l=2n+2$ or $T=2n+2$ or $L=n2+2$ or $L=n+n+2$</p> <p>.2 $L = 2n + 2$ or $L = 2(n + 1)$ ACCEPT $L(n) = 2n + 2$ or $L_n = 2(n + 1)$</p> <p>DO NOT ACCEPT description in words</p> <p>SC if NR in 8c and correct general rule seen in 8b condone incorrect notation award 1 mark</p>	2

8	d	<p>.1 correctly substitute $n \geq 5$ into their general rule (from 8c or 8b)</p> <p>.2 correctly calculate their value of L after substituting $n \geq 5$</p> <p>.3 recognise that their correctly calculated value of L is the same as their predicted value</p>	<p>.1 Ex: $2 \times 5 + 2$</p> <p>.2 Ex: 12 (for $n = 5$)</p> <p>.3 same as when we continue the pattern and explains how the pattern continues Ex: how 12 is obtained from pattern of adding 2 to 10</p> <p>.3 ACCEPT seeing their value in the table in 8a and seeing their matching calculated L using $n \geq 5$ Ex: we see their calculated $L=12$ and we see $L=12$ in their table</p>	3
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Question 8e 22 marks				
Mark	1	2	3	4
Predictions (P)	Correctly predict three terms for S , H or A ACCEPT whether in the table or in the response box	Correctly predict five terms in S , H and A ACCEPT whether in the table or in the response box	Correctly predict six terms in S , H and A ACCEPT whether in the table or in the response box	
Description (D)	<p>Correctly describe a pattern in words for A ACCEPT Square numbers or perfect squares Square of odd numbers The difference is increasing by a constant Increase is increased by 8 Second increase is 8 Difference is multiples of 8 Going up by multiples of 8 The second difference is constant Quadratic DO NOT ACCEPT the square numbers A is the square of H odd numbers</p> <p>OR Attempt to describe a general rule for A in terms of n Examples: rule in words: The square of two n plus 1 $A = (n + 1)^2$ or $A = n^2 + 8$ or $A=4n^2+1$</p> <p>OR Correctly describe a general rule for A in terms of S or H Ex: $A=(S+1)^2$ or $A=H^2$ or $A=SH+H$ ACCEPT $A=LxS+1$ ACCEPT non-simplified and ignore incorrect notation.</p>	<p>Correctly describe a pattern in words for A AND Attempt to describe a general rule for A in terms of n or correctly describe a general rule for A in terms of S or H</p> <p>ACCEPT non-simplified and ignore incorrect notation</p>	<p>Correctly describe a general rule for A in terms of n Rule: $A = (2n + 1)^2$ or $A = 4n^2 + 4n + 1$</p> <p>ACCEPT non-simplified and ignore incorrect notation</p>	<p>Correctly describe a pattern in words for A AND Correctly describe a general rule for A in terms of n</p> <p>ACCEPT non-simplified and ignore incorrect notation</p>

Mark	1	2	3	4
Testing (T)	<p>Attempt to test their general rule for A using $n \leq 4$ Ex: correctly substitute in their general rule value of $n \leq 4$</p> <p>OR Correctly test their described pattern or their rule (e.g. recursive rule)</p> <p>OR Correctly test their general rule for A in terms of S or H or L</p>	<p>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 $n \leq 4$</p> <p>AND Recognise that their correctly calculated value for A is the same as the given value.</p> <p>ACCEPT seeing their correctly calculated value for A and the given value in the table being equal</p>		
Verifying (V)	<p>Attempt to verify their general rule for A using $n \geq 5$ Ex: correctly substitute in their general rule value of $n \geq 5$</p> <p>OR Correctly verify their described pattern or their rule (e.g. recursive rule)</p> <p>OR Correctly verify their general rule for A in terms of S or H or L</p>	<p>Correctly calculate their value for A in their general rule only in terms of n using $n \geq 5$</p>	<p>Correctly calculate their value for A in their general rule only in terms of n using $n \geq 5$</p> <p>AND Recognise that their correctly calculated value for A is the same as their predicted value obtained by continuing the pattern</p> <p>ACCEPT seeing their correctly calculated value for A and their predicted value in the table being equal</p>	

Mark	1	2	3	4
Justify / Proof (J)	<p>Attempt to justify their described pattern or their general rule Ex: Substitute at least two other values of n in A and say they are the same or the rule works OR Quadratic model and valid attempt to find coefficients or correctly find one coefficient using any method OR They substitute into area of trapezium formula at least one from the $L=2n+2$, $S=2n$ and $H=2n+1$ OR A is the square of H and $H=2n+1$ OE</p>	<p>Justify their general rule arithmetically Quadratic model and get correct values of coefficients using any method OR Compare values they obtain using the general rule with values they obtain using the area of trapezium formula.</p>	<p>Attempt to justify the general rule for A geometrically Ex: They substitute into area of trapezium formula $L=2n+2$, $S=2n$ and $H=2n+1$ but simplify incorrectly OR They substitute into area of trapezium formula at least two from $L=2n+2$, $S=2n$ and $H=2n+1$ and simplify correctly Ex: $\frac{(2n+2)+2n}{2}h = (2n+1)h$</p>	<p>Correctly justify the general rule for A geometrically They substitute into area of trapezium formula $L=2n+2$, $S=2n$ and $H=2n+1$ And simplify correctly Ex: $\frac{(L+S)h}{2} =$ $\frac{(2n+2+2n)(2n+1)}{2}$ $= 4n^2 + 4n + 1$</p>

Communication criteria

Mark	1	2	3
Notation and terminology (N)	<p>Correct notation of <u>their</u> general rule Ex: $A=(S+1)^2$ or $A=H^2$ or $A=SH+H$ or $A=(n+1)^2$ OE OR The notation of <u>the general rule</u> includes errors, ex: $A=(2n+1)^2$ or $A=(2*n+1)^2$ Or $A=(2x+1)^2$ or $A=(n+n+1)^2$ The rule for A is $(2n+1)^2$ $A=4xn^2+4xn+1$ or $T=(2n+1)^2$ 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</p>	<p>Correct notation of <u>the general</u> rule for A The general rule: $A = (2n + 1)^2$ or $A = (2n + 1)(2n + 1)$ or $A = 4n^2 + 4n + 1$ ACCEPT $A(n) = (2n + 1)^2$ or $A_n = (2n + 1)^2$ OR The notation of <u>the general rule</u> includes errors AND Correctly describe a pattern in words for A DO NOT ACCEPT if they don't have a general rule</p>	<p>Correct notation of <u>the general</u> rule for A AND Correctly describe a pattern in words for A</p>

Mark	1	2	3
Communication (L)	At least three from the following are seen: <ul style="list-style-type: none">• 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: <ul style="list-style-type: none">• 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 <p>AND For coherence, they identify the processes correctly. At least one from the following:<ul style="list-style-type: none">• test• verify• justifyEx:<ul style="list-style-type: none">• 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: They assume quadratic model (or 2nd diff 8 OE) and get values of coefficient(s) using any method• For justify: They justify <u>the general rule</u> for A geometrically</p>	DO NOT ACCEPT if D3 and J2 not awarded At least four of the following are seen: <ul style="list-style-type: none">• describe a pattern or rule in words• write <u>the general rule</u>• test <u>the general rule</u>• verify <u>the general rule</u>• justify <u>the general rule</u> <p>AND For coherence, they identify the processes correctly. At least two from the following:<ul style="list-style-type: none">• test• verify• justifyEx:<ul style="list-style-type: none">• 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 <u>the general rule</u> for A geometrically</p>
Organisation and coherence			
Can be awarded even there are errors in their descriptions and working.			

n	Longer base of trapezium (L)	Smaller base of trapezium (S)	Height (H)	Area (A)
1	4	2	3	9
2	6	4	5	25
3	8	6	7	49
4	10	8	9	81
5	12	10	11	121
6	14	12	13	169
7	16	14	15	225
n	$2n + 2$	$2n$	$2n + 1$	$(2n + 1)^2$

Markscheme

May 2019

Mathematics

On-screen examination

31 pages

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The following are the annotations available to use when marking responses.

Annotation	Explication	Shortcut	Annotation	Explication	Shortcut
	Unclear			Award 0 marks	Alt+0
	Special case			Award 1 mark	Alt+1
	Misread			Award 2 marks	Alt+2
	No working shown			Award 3 marks	Alt+3
	Error carried forward			Award 4 marks	Alt+4
	Words to that effect			Award 5 marks	Alt+5
	Benefit of the doubt			Award 6 marks	Alt+6
	Answer Given			Award 7 marks	Alt+7
	Highlight tool			Award 8 marks	Alt+8
	Ellipse tool			Award 9 marks	Alt+9
	On page comment tool			Award 10 marks	
	Seen			Award 11 marks	
	Caret - Omission			Award 12 marks	
	Wavy underline tool				

RM Assessor has the following annotations that should be used to award marks:

A0 only use to award a zero mark for an answer that has no merit e.g. awarded for the candidate that has a wrong answer with no working

NR only use when the candidate has not made any response also stamp the response with

 **Marks awarded by stamping the tick**

 **SEEN** Seen; must be stamped on all blank response areas and on concatenated responses

 **unclear**

The markscheme makes use of the following abbreviations:

ECF Marks that can be awarded as **error carried forward** from previous results in the

question **BOD** Benefit of the doubt

MR misread

NWS no working shown

SC special case

OE or equivalent

WTTE or words to that effect or accept incomplete calculator display

AG Answer given

- Bullet notation means award 1 mark – see example below

Example 1

- 1 mark awarded and corresponding notes are aligned

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

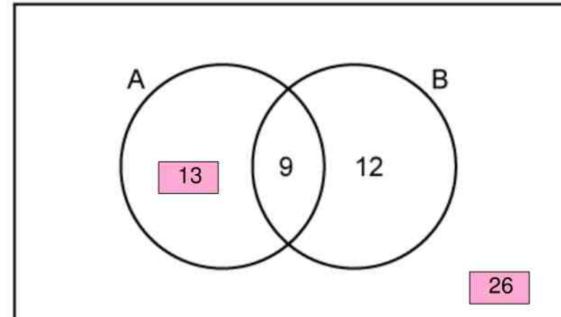
- a) **ECF** applies from one part of a question to a subsequent part of the question and also applies within the same part.
- b) If an answer resulting from **ECF** is inappropriate (eg, negative distances or $\sin x > 1$) then subsequent marks should not be awarded.
- c) If a question is transformed 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 $\frac{x}{2}$ **OR** $x/2$ **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

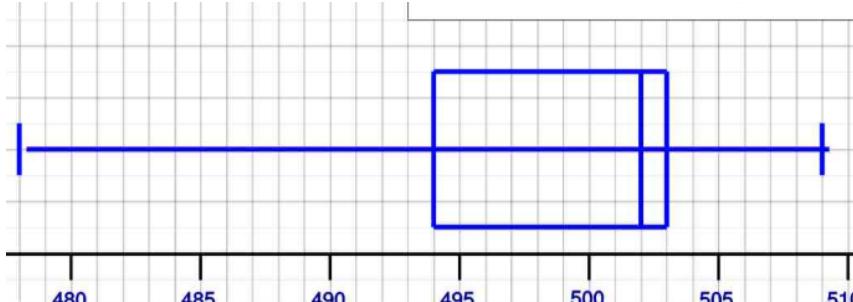
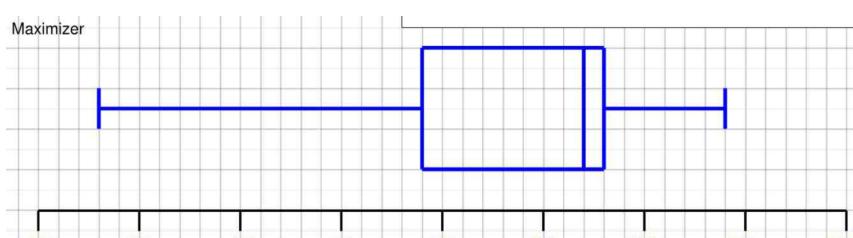
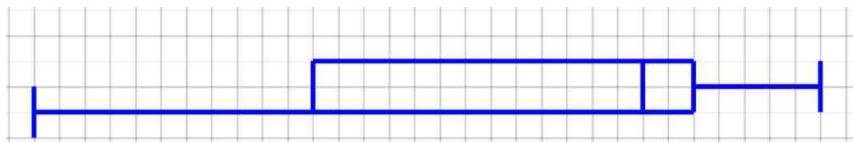
Question	Answers	Notes	Total
1 a	<ul style="list-style-type: none"> •¹ correctly place one expression •² correctly place the other expression <p>SC 3 expressions placed and two correct award 1 mark 3 expressions placed and one correct award 0 marks 4 expressions placed award 0 marks</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;">$3x + 4$</div> <div style="display: flex; justify-content: space-between;"> Expression 1 <div style="border: 1px solid black; padding: 5px; text-align: center;">$2x + 1 + x + 3$</div> </div> <div style="display: flex; justify-content: space-between;"> Expression 2 <div style="border: 1px solid black; padding: 5px; text-align: center;">$(4x + 2) - (x - 2)$</div> </div>	2
b	<ul style="list-style-type: none"> •¹ correctly place one expression •² correctly place another expression •³ correctly place the third expression <p>SC 4 expressions placed and three correct award 2 marks 4 expressions placed and two correct award 1 mark 4 expressions placed and one correct award 0 marks 5 or 6 expressions placed award 0 marks</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;">$6x - 5$</div> <div style="display: flex; justify-content: space-between;"> Expression 1 <div style="border: 1px solid black; padding: 5px; text-align: center;">$\frac{12x^2 - 10x}{2x}$</div> </div> <div style="display: flex; justify-content: space-between;"> Expression 2 <div style="border: 1px solid black; padding: 5px; text-align: center;">$2(3x + 4) - 13$</div> </div> <div style="display: flex; justify-content: space-between;"> Expression 3 <div style="border: 1px solid black; padding: 5px; text-align: center;">$\frac{(3x)^2}{x} - \frac{6x + 10}{2}$</div> </div>	3

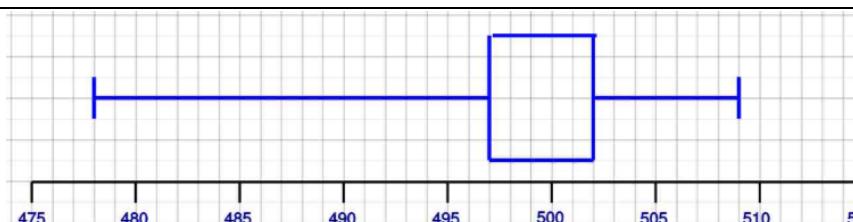
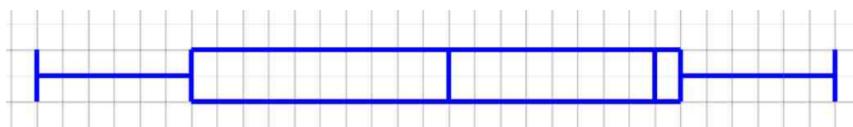
Question	Answers	Notes	Total
2 a	<p>AM 1</p> <ul style="list-style-type: none"> •¹ Correct substitution into Pythagoras' Theorem •² 441 seen •³ Their BC correct after square root <p>AM 2</p> <ul style="list-style-type: none"> •¹ Correctly find value of angle A or angle C •² Correctly substitute into trigonometric ratio or sine rule to find BC •³ Their value for BC correct after using trigonometric ratio <p>AM 3</p> <ul style="list-style-type: none"> •¹ seeing multiple and 3, 4, 5 •² multiply by 7 •³ Their value for BC correct after multiplying 3 by 7 	<p>AM 1</p> <ul style="list-style-type: none"> •¹ $35^2 = 28^2 + BC^2$ or $(BC^2 =) 35^2 - 28^2$ or $1225 - BC^2 = 784$ •² $(BC^2 =) 441$ or $(BC =) \sqrt{441}$ •³ Their 21 •³ ACCEPT their BC in surd form only if it is in its simplest form •³ Award only if $0 < \text{their } 21 < 35$ •³ DO NOT ACCEPT $\sqrt{441}$ for final answer <p>AM 2</p> <ul style="list-style-type: none"> •¹ $(A=)36.869\dots$ or 37 or $(C)=53.13\dots$ or 53 •² $\sin(36.869\dots \text{or } 37) = \frac{BC}{35}$ or $\cos(53.13\dots \text{or } 53) = \frac{BC}{35}$ or $\tan(53.13\dots \text{or } 53) = \frac{28}{BC}$ or $\frac{BC}{\sin(36.869\dots \text{or } 37)} = \frac{35}{\sin 90}$ OE •³ Their 21 <p>21 with any correct •¹ or •² award (3 marks) 21 without working award (2 marks) 441 without working award (1 mark)</p>	3
b	option B		
c	<ul style="list-style-type: none"> •¹ Adding 4×28 to $4 \times \text{their}(2a)$ •² Correctly calculate their result after adding their 8 sides 	<ul style="list-style-type: none"> •¹ $4 \times 28 + 4 \times \text{their}21$ or $112 + \text{their}4$ •² Their 196 (cm) 196 without working award (2 marks) 98 without working award (1 mark) <p>SC for 1 mark Calculating correctly the perimeter of half shape: $2 \times 28 + 2 \times \text{their}21 = \text{their}98$</p>	2

Question	Answers	Notes	Total
3	a • ¹ Correctly place 13 • ² Correctly place 26	 <p>U</p>	2
	b (study extended) mathematics and physics	(9 students) study maths and physics WTTE ACCEPT study both subjects DO NOT ACCEPT elements in both A and B OE DO NOT ACCEPT 9	1
	c • ¹ 9 seen alone in numerator • ² Divide by 60	• ¹ 9/their60 or 9 out of their 60 • ² $\frac{\text{their } 9}{60}$ or 3/20 or 0.15 or 15% • ² DO NOT ACCEPT 1.5/10 OE 9/60 or 3/20 or 0.15 or 15% without working award (2 marks) 9 over 60 or 3 over 20 or 9:60 or 3:20 award (1 mark)	2

<p>3</p> <p>d</p> <ul style="list-style-type: none"> •¹ Considering three probabilities related to their(3c) with or without replacement (probabilities must be less than one) •² Multiply their three probabilities •³ The correct answer 	<p>•¹ their $\frac{9}{60}, \frac{9}{60}, \frac{9}{60}$ or $3 \times$ their $\frac{9}{60}$ or $\left(\text{their } \frac{9}{60}, \frac{8}{59}, \frac{7}{58}\right)$, ACCEPT $\left(\text{their } \frac{3}{20}, \frac{2}{19}, \frac{1}{18}\right)$ or $\left(\text{their } \frac{9}{60}, \frac{8}{60}, \frac{7}{60}\right)$</p> <p>•² $\left(\text{their } \frac{9}{60}\right)^3$ or $\left(\text{their } \frac{9}{60} \times \frac{8}{59} \times \frac{7}{58}\right)$</p> <p>•² ACCEPT $\left(\text{their } \frac{3}{20} \times \frac{2}{19} \times \frac{1}{18}\right)$ or a mistake in one fraction ex: $\left(\text{their } \frac{9}{60} \times \frac{8}{59} \times \frac{7}{55}\right)$</p> <p>•³ $\frac{504}{205320}$ or $\frac{21}{8555}$ or 0.00245(47...) or 0.245(47...)% OE</p> <p>•³ ACCEPT 0.0025 or 0.25% OE</p> <p>$\frac{504}{205320}$ or $\frac{21}{8555}$ or 0.00245(47...) or 0.0025 or 0.25% without working award (2 marks)</p> <p>0.002 or 0.2% or 0.0024 or 0.24% without working award (1 mark)</p>	<p>3</p>
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3	e	<ul style="list-style-type: none">•¹ Realise it is not practical•² State a valid reason for the impracticality related to their result, stated here or in their(3c) or their(3d), being small	<ul style="list-style-type: none">•¹ Not very practical or doesn't work or not reliable or not effective WTTE•¹ DO NOT ACCEPT unclear judgement ex: if a student is selected randomly it will have a probability 9/60 or the practicality is 9/60•² The probability is very low or small or unlikely to select applicable students or most likely wrong ones will be chosen WTTE•² ACCEPT the odds are very low or very low chance or low percentage WTTE•² ACCEPT probability of selecting student who study both is lower WTTE•² DO NOT ACCEPT if they do not have a result stated here in part (e) or in part (c) or (d)•² DO NOT ACCEPT because probability is 0.00245 or only 9/60 OE•² DO NOT ACCEPT if they refer to probability 0.5 or more being small•² and •¹ can be awarded independently	2
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Question		Answers	Notes	Total
4	a	50 %	50(%) OE, ACCEPT the expression “at least 50%”	1
	b	<p>The five values required of the blue box and whisker plot: Min 478, LQ 494, Median 502, UQ 503, Max 509</p> <ul style="list-style-type: none"> •¹ Correctly indicate by a vertical line three values of the above •² Correctly indicate by a vertical line the fourth value of the above •³ Correct and complete box and whisker plot with the fifth value correctly indicated by a vertical line <p>For incomplete box and whisker plot, mark with BOD the •¹ and •² and do not award •³</p>	<p>ACCEPT their blue box plot drawn on the red box plot ACCEPT</p>  <p>Maximizer</p>  <p>ACCEPT lines not being aligned or box not accurately closed. Example:</p>  <p>Note: Seeing their median aligned with their UQ mark with BOD for the highest mark. Ex:</p>	3

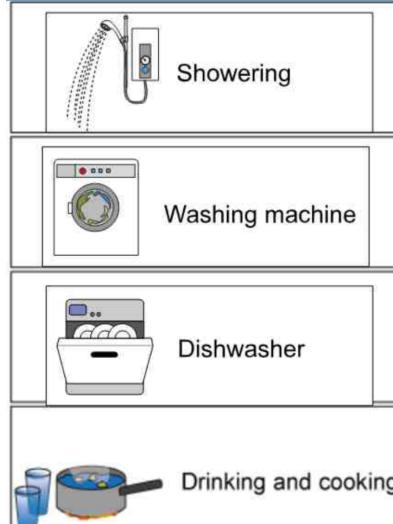
4	b	<p>Note: Seeing their median aligned with their UQ mark with BOD for the highest mark. Ex:</p>  <p>Consider: Min(478), LQ(497), Med(502), UQ(502), and Max(509) Hence, 1 mark awarded for three values correct</p> <p>DO NOT ACCEPT the median when indicated by multiple vertical lines. Example:</p> 
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4	c	<p>•¹ Correct comment, related to evidence from the box and whisker plot in their(4b) implying GeneriCell is better than their Maximizer</p> <p>•² Correct comment, related to evidence from the box and whisker plot in their(4b) implying their Maximizer is better than GeneriCell</p>	<ul style="list-style-type: none"> •¹ Higher upper quartile or 25 % are above 506 for GeneriCell while 25% above their503 for Maximizer WTTE •¹ ACCEPT better upper quartile or higher Q3 •¹ ACCEPT most Genericell batteries last 506 or less while most Maximizer last their503 or less •¹ ACCEPT more Generic last over their503 •¹ DO NOT ACCEPT most Genericell batteries last 506 while most Maximizer last their503 or most GeneriCell last longer •¹ DO NOT ACCEPT bigger Inter Quartile Range •¹ DO NOT ACCEPT even if GeneriCell lasts less they could be better value for money since they are cheaper •² Higher median or higher lower quartile or smaller Inter Quartile Range OR 75% above their494 for maximizer while less than 75% are above 488 for GeneriCell WTTE •² ACCEPT better lower quartile or longer median •² ACCEPT The IQR is their9 while for generic it is 18 •¹ DO NOT ACCEPT total lifetime for 9 Maximizer batteries is more than total time of 9 GeneriCells batteries •² DO NOT ACCEPT Higher average unless they mention median explicitly <p>For •¹ and •² ACCEPT the use of abbreviations example: LQ or Q1 for Lower Quartile, Med for median, Q3 or UQ for Upper Quartile. ACCEPT for Interquartile range: IQR or Q3-Q1 or range between Q1 and Q3, but DO NOT ACCEPT inner quartile</p>	2
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Question	Answers	Notes	Total
5 a	<p>AM 1</p> <ul style="list-style-type: none"> •¹ Correctly multiply both sides by 2 OR correctly add coefficients of x •² Divide the right hand side of the equation by the coefficient of x •³ their24 correct after their first algebraic step <p>AM 2</p> <ul style="list-style-type: none"> •¹ Add the 24 and its half •² Correctly equate 24+12 with the total being 6^2 or 36 •³ Identify the 24 as the number 	<p>AM 1</p> <ul style="list-style-type: none"> •¹ $2x + x = 72$ or $3x = 72$ OR $1.5x = 6^2$ •² $\frac{72}{3}$ or $\frac{6^2}{1.5}$ or $\frac{36}{1.5}$ •³ Their 24 <p>AM 2</p> <ul style="list-style-type: none"> •¹ $24 + 12$ •² $(24 + 12) = 6^2$ or $(24 + 12) = 36$ •³ The number is 24 OR $x = 24$ <p>24 OR $\frac{72}{3}$ without working award (2 marks)</p> <p>Seeing only $24 + 12 = 36$ award (2 marks)</p> <p>24 as the answer with any correct •¹ or •² award (3 marks)</p> <p>24 without working award (2 marks)</p>	3

<p>5 b</p> <p>AM 1 (to be used when the equation is written)</p> <ul style="list-style-type: none"> •¹ Correctly set the equation •² Correctly factorize the equation OR correctly substitute into quadratic formula •³ $(x =) 7$ •⁴ $(x =) -8$ <p>AM 2 (to be used when the equation is not written)</p> <ul style="list-style-type: none"> •¹ Correctly show that the sum of 7 and its square is 56 •² Identify the 7 as the number •³ Correctly show that the sum of -8 and its square is 56 •⁴ Identify the -8 as the number 	<p>AM 1 (to be used when the equation is written)</p> <ul style="list-style-type: none"> •¹ $x^2 + x = 56$ or $x(x+1) = 56$ OE •² $(x-7)(x+8) = 0$ or $x = \frac{-1 \pm \sqrt{1^2 - 4(1)(-56)}}{2(1)}$ OE •³ 7 seen, ACCEPT $7^2 + 7 = 56$ or $49 + 7 = 56$ •⁴ -8 seen, ACCEPT $-8^2 - 8 = 56$ or $64 - 8 = 56$ <p>Note for AM1: seeing •¹ or •² implies the use of AM1 not AM2 seeing •² correct implies •¹ seeing •¹ or •² correct then 7 or -8 award (3 marks) seeing •¹ or •² correct then 7 and -8 award (4 marks)</p> <p>AM 2 (to be used when the equation is not written)</p> <ul style="list-style-type: none"> •¹ $7 + 49 = 56$ or $7 + (7)^2 = 56$ •² The number is 7 or $x = 7$ •³ $-8 + 64 = 56$ or $-8 + (-8)^2 = 56$ •⁴ The number is -8 or $x = -8$ <p>7 or -8 without working award (1 mark) 7 and -8 without working award (2 marks)</p>	<p>4</p>
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Question	Answers	Notes	Total
6	a 39 (%)	 ACCEPT	1
	b • ¹ Multiply 40 % by 120 • ² The correct answer	• ¹ 0.4×120 OE • ² 48 (L) 48 without working: Award (2 marks) SC for 1 mark Correctly calculating the value of their(6a)% $\times 120$	2
	c • ¹ Divide their(6b) by 8 • ² Correctly calculate their result after a division by 8	• ¹ $\frac{\text{their } 48}{8}$ OE • ² their 6 6 without working: Award (2 marks) SC for 1 mark Their 6 correct without working	2
	d • ¹ Multiply their(6c) by 5 • ² Correct result after a multiplication by 5	• ¹ $5 \times \text{their } 6$ • ² Their 30 30 without working: Award (2 marks) SC for 1 mark Their 30 correct without working SC for 1 mark Candidates MR “reduces by 5L” and getting the result of 18(L)	2
	e AM1 • ¹ Recognize 95(%) • ² Multiply 95% by 14.4 • ³ Correct result after multiplying their percentage by 14.4	AM1 • ¹ $100 - 5 (= 95)$ or 95 or 0.95 • ² $95\% \times 14.4$ or 0.95×14.4 OE • ³ Their 13.68 (L), ACCEPT 13.7	3

<p>6</p> <p>e</p> <p>AM1</p> <ul style="list-style-type: none"> •¹ Recognize 95(%) •² Multiply 95% by 14.4 •³ Correct result after multiplying their percentage by 14.4 <p>AM2</p> <ul style="list-style-type: none"> •¹ Multiply 5 % by 14.4 •² Subtract 0.72 from 14.4 •³ Correct result after subtracting from 14.4 	<p>AM1</p> <ul style="list-style-type: none"> •¹ $100 - 5 (= 95)$ or 95 or 0.95 •² $95\% \times 14.4$ or 0.95×14.4 OE •³ Their 13.68 (L), ACCEPT 13.7 •³ ACCEPT Their 13.68 (L) only if their percentage is less than 100% <p>AM2</p> <ul style="list-style-type: none"> •¹ 0.05×14.4 or evidence of cross multiplication using 5% or 0.72 seen •² $14.4 - 0.72$ or $14.4 - (0.05 \times 14.4)$ •³ Their 13.68 (L), ACCEPT 13.7 •³ ACCEPT Their 13.68 (L) only if positive <p>13.68 without working: Award (2 marks) 13.68 with any correct •¹ or •² award (3 marks)</p>	<p>3</p>
<p>f</p> <p>Correctly order the three activities</p>		<p>1</p>

<p>6</p> <p>g</p> <ul style="list-style-type: none"> •¹ Recognise that showering saves (not uses) more water than washing machine •² Values of saving for showering AND washing machine seen •³ Recognise that washing machine uses more water than dishwasher AND they have same eco (5%) saving 	<ul style="list-style-type: none"> •¹ showering saves more than machine or reduces the most WTTE; •¹ ACCEPT Showering saves their18 or 37.5% •¹ DO NOT ACCEPT referring to the use or consumption of water instead of water saving or 40% being the biggest •¹ DO NOT ACCEPT “eco-friendly” to express saving water •² their18 and $(14.4 - \text{their}13.68 =)\text{their}0.72$ seen •² ACCEPT Showering saves their18 while machine saves less than 1 •² DO NOT ACCEPT Showering saves their18 which is more than their13.68 or Showering saves their18 which is more than washing machine •³ 12% is more than 9% and in eco-setting they both save 5% •³ ACCEPT washing machine uses more and they save the same or 5% of 12% is more than 5% of 9% •³ ACCEPT $(14.4 - \text{their}13.68 =)\text{their}0.72$ and $(0.09 \times 120 \times 0.05 =)0.54$ <p>Note: seeing •² implies •¹</p> <p>SC for 3 marks</p> <p>All three values of saving calculated</p> <p>Example: showering their18, washing machine their 0.72, and dishwasher 0.54</p>	<p>3</p>
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Question	Answers		Notes	Total
7	a	(AB) = 5.30 (m)		1
	b	<p>AM1</p> <ul style="list-style-type: none"> •¹ Correct proportion of circle seen •² Correctly substitute their(7a) into circumference formula •³ Correctly multiply their proportion of circle by their circumference <p>AM2</p> <ul style="list-style-type: none"> •¹ Correct proportion of quarter circle seen •² Multiply their proportion by 8.33 •³ Correctly multiply their proportion of quarter of circle by 8.33 	<p>AM1</p> <ul style="list-style-type: none"> •¹ $\frac{75}{360}$ or $\frac{5}{24}$ or 0.2083..OE , ACCEPT $\frac{360}{75}$ or 4.8 OE •² $2\pi(\text{their } 5.3)$ or 33.(3...) or 33.(284) seen, ACCEPT $2\pi(3.5 + 1.8)$ •³ (their $\frac{75}{360} \times 2\pi(\text{their AB})$)=their 6.9(3768...)or 7 •³ ACCEPT $(\frac{2\pi(\text{their AB})}{\text{their } 4.8})$=their 6.9(3768...)or 7 <p>AM2</p> <ul style="list-style-type: none"> •¹ $\frac{75}{90}$ or $\frac{5}{6}$ or 75 : 90 or 0.8333 OE , ACCEPT $\frac{90}{75}$ or 1.2 •² their $\frac{75}{90} \times 8.33$, ACCEPT $\frac{8.33}{\text{their } 1.2}$ •³ their 6.9(4166...) or 7 <p>ACCEPT their calculations using 3.14 or 22/7 instead of π 6.9(3768) or 6.9(4166...) or 7 with any correct •¹ or •² : Award (3 marks) 6.9(3768) or 6.9(4166...) without working: Award (2 marks) 7 without working: Award (1 mark)</p>	3

7	c	<p>AM1</p> <ul style="list-style-type: none"> •¹ Correctly substitute their(7a) in correct trig ratio •² Correct operation for their trig ratio to calculate DG •³ Correctly calculate their DG after using their trig ratio •⁴ Correctly round their DG to 1 dp <p>AM2</p> <ul style="list-style-type: none"> •¹ Correctly write down value of FG •² Correct operation for their trig ratio to calculate DG OR Correctly substitute into Pythagoras •³ Correctly calculate their DG after using their trig ratio OR Pythagoras •⁴ Correctly round their DG to 1 dp 	<p>AM1</p> <ul style="list-style-type: none"> •¹ $\cos 75 = \frac{DG}{\text{their}(5.3)}$ or $\sin 15 = \frac{DG}{\text{their}(5.3)}$ or $\frac{DG}{\sin 15} = \frac{\text{their}5.3}{\sin 90}$ •² $(DG =) \text{their}(DF) \times \cos 75$ or $\text{their}(DF) \times \sin 15$ •³ their1.37(17...) Award only if •¹ or •² are awarded •³ Award only if $0 < \text{theirDG} < 5.3$ •⁴ their1.4 (m) •⁴ DO NOT ACCEPT unless their result needs rounding •⁴ ACCEPT not seeing their •³ <p>AM2</p> <ul style="list-style-type: none"> •¹ $(FG = \text{their}5.3 \times \sin 75 \text{ or } \text{their}5.3 \times \cos 15 =) 5.1(194...)$ •² $(DG =) \frac{\text{theirFG}}{\tan 75}$ or $(DG =) \text{their FG} \times \tan 15 \text{ OR}$ $(DG^2 =) (\text{their}5.3)^2 - (\text{theirFG})^2$ •³ their1.37(17...) , Award only if •¹ or •² are awarded •³ ACCEPT1.36(65..) •³ Award only if $0 < \text{theirDG} < 5.3$ •⁴ their1.4 (m) •⁴ DO NOT ACCEPT unless their result needs rounding •⁴ ACCEPT not seeing their •³ <p>1.4 with any correct •¹ or •² or •³: Award (4 marks) 1.4 without working: Award (3 marks) 1.37(17) without working: Award (2 marks)</p>	4
	d	Correctly subtract their(7c) from their(7a)	(EG = Their 5.3 – their 1.4 =) their3.9 (m) Award only if their EG is positive ACCEPT correct result of subtraction of their 1.4 from their 5.3 without working shown	1

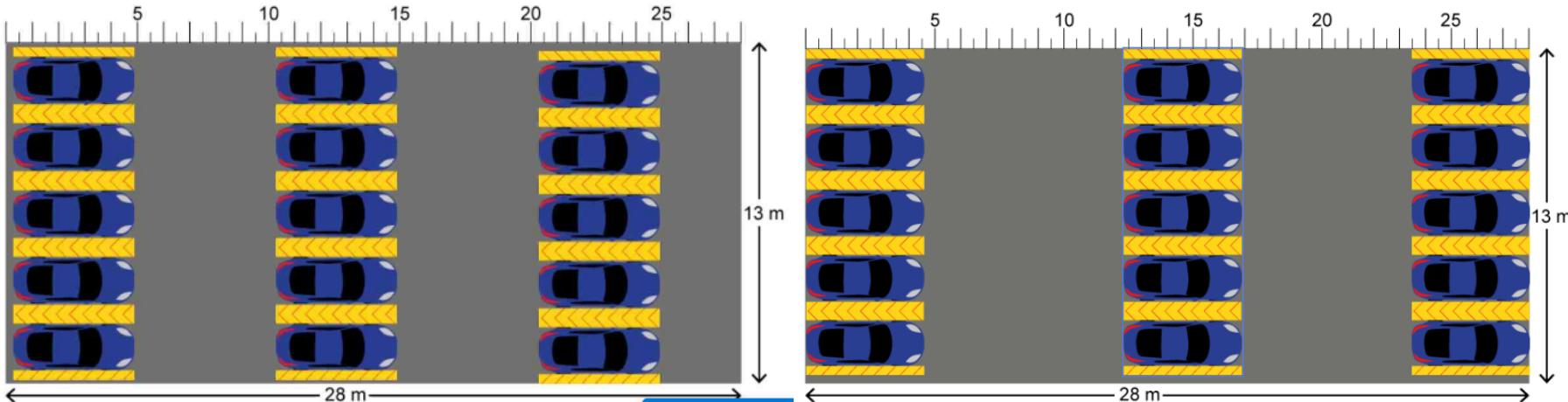
e	Mark	1	2	3	
	Identify factors (F)	<p>State one factor from:</p> <ul style="list-style-type: none"> - Car size (length or width) - Distance between cars or space for doors to open or yellow part - lane width - Angle (perpendicular or angled) - Length of arc - parking space dimension or area available <p>OR</p> <p>Two factors seen in calculations without words. Ex: $28 - 2 \times 4.5 + 5.5$</p> <p>Ignore additional irrelevant factors</p>	<p>State two factors from:</p> <ul style="list-style-type: none"> - Car size (length or width) - Distance between cars or space for doors to open or yellow part - lane width - Angle (perpendicular or angled) - Length of arc - parking space dimension or area available <p>Ignore additional irrelevant factors</p>		
	Design (D)	<p>For Perpendicular parking: 10 to 25 cars respecting one condition</p> <p>For Angled parking: 8 to 20 cars respecting one condition</p> <p>The conditions for their selected parking are:</p> <ol style="list-style-type: none"> 1) Car sets used inside the canvas and are not overlapping 2) Car sets used in either perpendicular or angled parking canvas but not both. ACCEPT cars in both canvas if in their text they chose one 3) Lane width 5.5 m for perpendicular or 4 m for angled <p>ACCEPT error up to 0.5 m ACCEPT any orientation of cars In the case when they have car sets in both canvases, mark the best one.</p>	<p>For Perpendicular parking: 15 or 20 cars respecting two conditions</p> <p>For Angled parking: 12 or 16 cars respecting two conditions</p> <p>The conditions for their selected parking are:</p> <ol style="list-style-type: none"> 1) Car sets used inside the canvas and are not overlapping 2) Car sets used in either perpendicular or angled parking canvas but not both. ACCEPT cars in both canvas if in their text they chose one 3) Lane width 5.5 m for perpendicular or 4 m for angled <p>ACCEPT error up to 0.5 m ACCEPT any orientation of cars In the case when they have car sets in both canvases, mark the best one.</p>	<p>For Perpendicular parking: 15 cars respecting all three conditions</p> <p>For Angled parking: 16 cars respecting all three conditions</p> <p>The conditions for their selected parking are:</p> <ol style="list-style-type: none"> 1) Car sets used inside the canvas and are not overlapping 2) Car sets used in either perpendicular or angled parking canvas but not both. ACCEPT cars in both canvas if in their text they chose one 3) Lane width 5.5 m for perpendicular or 4 m for angled <p>ACCEPT error up to 0.5 m ACCEPT any orientation of cars</p>	10

	Justify with calculations (C)	<p>Correct calculations for their cars in Perpendicular parking OR their cars in Angled parking</p> <p>Example: For perpendicular parking with 10 cars $2 \times 4.5 + 2 \times 5.5 (= 20)$ For angled parking with 12 cars $3 \times \text{their}5 + 2 \times 4 (= \text{their}23)$</p> <p>ACCEPT Calculations involving area of parking divided by area of car and lanes Example for perpendicular parking with 20 cars: $\frac{28 \times 13 - 2 \times 5.5 \times 13}{4.5 \times 2.5} (= 19.6)$</p>	<p>Correct calculations for 15 cars in Perpendicular parking OR 16 cars in Angled parking</p> <p>Example: For perpendicular parking $3 \times 4.5 + 2 \times 5.5 (= 24.5)$ OR For angled parking $4 \times \text{their}5 + 2 \times 4 (= \text{their}28 \text{ less than } 28)$</p> <p>ACCEPT for perpendicular $4 \times 4.5 + 2 \times 5.5 = 29$ and hence 15 cars can fit</p> <p>ACCEPT using lane width 5.3 for perpendicular parking</p>	<p>Correct calculations for 15 cars in Perpendicular parking AND 16 cars in Angled parking</p> <p>Example: For perpendicular parking $3 \times 4.5 + 2 \times 5.5 (= 24.5)$ AND For angled parking $4 \times \text{their}5 + 2 \times 4 (= \text{their}28 \text{ less than } 28)$</p> <p>ACCEPT for perpendicular $4 \times 4.5 + 2 \times 5.5 (= 29)$ and hence 15 cars can fit</p> <p>DO NOT ACCEPT unless they select one parking as their choice</p>	
	Justify accuracy (A)	<p>Recognizing it is not accurate with weak justification Examples: these are approximate calculations and not accurate Inaccurate because of rounding Inaccurate because People tend to make mistakes in parking OR Sensible rounding used in calculations without a comment (example $\frac{28 \times 13}{4.5 \times 2.5} = 32$ cars) DO NOT ACCEPT: my results are accurate WTTE</p>	<p>Recognizing it is not accurate with acceptable justification Examples: The lane width used from the conditions (5.5 or 4) is more than the minimum lane width required (5.3 or 3.9) or Width used is 2.5 m which is more than 1.8 m (the width of the car). or All cars have specific given dimensions</p>		

7e Pictures from Canvas:

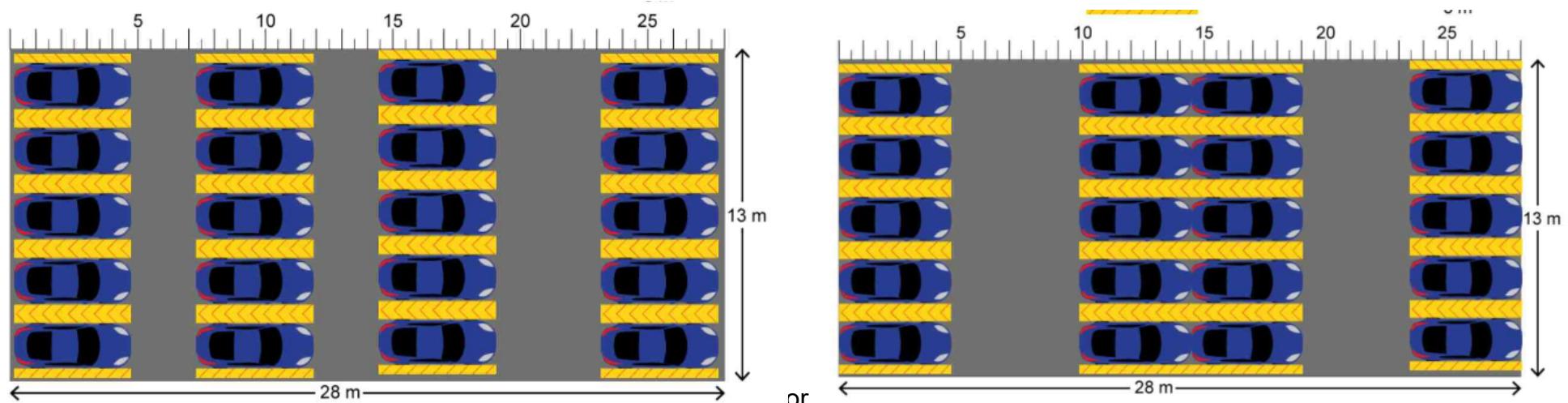
For Perpendicular parking:

ACCEPTED 15 cars layout For D3 (provided they have layout only in Perpendicular parking Canvas or they choose in their text the perpendicular)



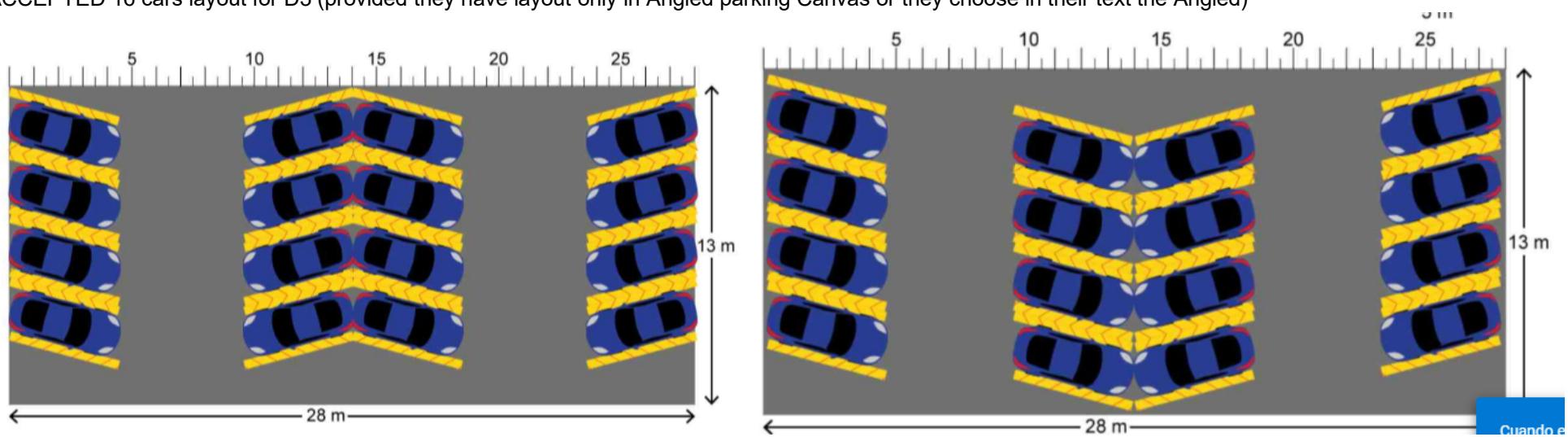
For Perpendicular parking:

ACCEPTED 20 cars layout For D2 (provided they have layout only in Perpendicular parking Canvas since only lane width condition is not met)



For Angled parking:

ACCEPTED 16 cars layout for D3 (provided they have layout only in Angled parking Canvas or they choose in their text the Angled)



Question	Answers	Notes	Total
8 a	<p>AM1</p> <ul style="list-style-type: none"> •¹ Correctly substitute 5 and 7 into area of trapezium formula •² Multiply by 1 AND equate with 6 <p>6 AG</p> <p>AM2</p> <ul style="list-style-type: none"> •¹ Recognize the rectangle of area 5 squares •² Demonstrate that the area of triangle above is 1 square AND that together they will be 6 <p>AM3</p> <ul style="list-style-type: none"> •¹ Substitute correctly 2.5 in $2x + 1$ •² Multiply by 1 AND equate with 6 	<p>AM1</p> <ul style="list-style-type: none"> •¹ $\frac{5+7}{2}$, ACCEPT The average of 5 and 7 is 6 •² $\frac{5+7}{2} \times 1 = \frac{12}{2} = 6$, DO NOT ACCEPT if $\times 1$ is not seen •² ACCEPT not seeing $\frac{12}{2}$, ACCEPT $\frac{(5+7)1}{2} = 6$ <p>AM2</p> <ul style="list-style-type: none"> •¹ The area of rectangle is 5 or 5 blocks or 5×1, ACCEPT 1+1+1+1+1 •² Half of two squares above OE or $\frac{1}{2} \times 1 \times 2$ or $\frac{2}{2}$ or 0.75 + 0.25 AND The total makes 6 or Thus another square WTTE or $5 + 1 = 6$ •² DO NOT ACCEPT two halves of squares or $0.5 + 0.5$ or $\frac{2}{3} + \frac{1}{3}$ or two tiny little parts OE <p>AM3</p> <ul style="list-style-type: none"> •¹ $2(2.5) + 1$ •² $(2(2.5) + 1) \times 1 = 6$, DO NOT ACCEPT if $\times 1$ is not seen <p>For all •² ACCEPT equating with 6 by a calculator screenshot $5 + \frac{7}{2} = 6$ or $5+7/2 = 6$ or $2 \times 3 = 6$ or $3 + 3 = 6$, Award (0 marks) Seeing only $12/2=6$, Award (0 marks) Seeing only $5 + 1 = 6$ or $2 \times 2.5 + 1 = 6$ or $\frac{5+7}{2} = 6$, Award (1 mark)</p>	2
b	Correctly place 10 AND 12		1

	c	<ul style="list-style-type: none"> •¹ Correctly describe one pattern for A only in words with correct terminology •² Correctly describe a second pattern for A in words with correct terminology 	<p>Examples of accepted terminology: Even numbers, multiples of 2 Increasing by 2, adds 2 every time, goes up by 2, moving up by 2 Difference is 2 Second difference is zero Arithmetic progression, Arithmetic sequence</p> <p>DO NOT ACCEPT the rule in words e.g. 2 times n, n multiplied by 2, double of n, twice stage number, the product of n and 2 dividing area by 2 gets n the area is half the stage number $2n$ or $2 \times n$ follows the 2 times table Increasing Arithmetic series</p> <p>Note: More than two different patterns, all correct award (2 marks) More than two different patterns, at least one correct award (1 mark)</p>	2
	d	<ul style="list-style-type: none"> •¹ The correct general rule •² The correct simplified general rule with correct notation 	<ul style="list-style-type: none"> •¹ $2n$ or $A = 2 \times n$ or $A = 2 * n$ or $A = n + n$ or $A = n + \frac{2n}{2}$ or $n = \frac{A}{2}$ or $A = 2d$ or $A = 2(n)$ •² $A = 2n$ or $2n = A$, ACCEPT $a = 2n$ or $2n = a$ <p>DO NOT ACCEPT description in words SC if NR in d) and (A =)$2n$ is seen in (8c) Award: (1 mark)</p>	2

	e	<ul style="list-style-type: none"> •¹ Correctly substitute $n \geq 5$ into their general rule •² Correctly calculate their value of A after substituting $n \geq 5$ •³ Recognise that their correctly calculated value of A is the same as their predicted value 	<ul style="list-style-type: none"> •¹ Ex: 2×6 •² Ex: 12 (for $n = 6$) •³ Same as value I predicted in table (and we find the candidate has 12 in the table for $n = 6$) OR same as when we continue the pattern and explains how 12 is obtained from pattern of adding 2 to 10 •³ ACCEPT seeing the 12 in the table in (8b) and seeing their calculation for T when $n = 6$ as 12 <p>SC for 1 mark Correctly test by applying the steps of verification mentioned in the left column with a value of $n \leq 4$</p> <p>SC for 1 mark Correctly verify their described pattern or rule (e.g. recursive rule)</p>	3
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8	f	Mark	1	2	3	4	5		
		Predictions (P)	Correctly predict one term for T ACCEPT whether in the table or in the response box	Correctly predict two terms for T ACCEPT whether in the table or in the response box	Correctly predict three terms or more for T ACCEPT whether in the table or in the response box IGNORE further incorrectly predicted values				
		Description (D)	Attempt to describe a pattern in words for T OR a rule in words Ex : They are all even numbers Increases by even numbers Increases by two more each time Increases by 4,6,8,.. Adds up by 4,6,8,.. The minus between them adds 2 OR n times $n + 1$ Product of n and $n + 1$ Product of Stage number and next stage number Sum of n and its square	Attempt to describe pattern for T as general rule Ex for rule attempt: $\frac{T}{n} = n + 1$ $T = n \times n + 1$ $T_n = T_{n-1} + 2n$ OR One correct pattern described in words for T Ex: The increase increases by 2 The second difference is constant Double the triangular numbers It is quadratic Increases by 4,6,8,10,.. Adds up by 4,6,8,10,..	Correctly describe the pattern for T as a general rule OR Two correct patterns described in words for T OR Attempt to describe pattern for T as general rule AND One correct pattern described in words for T	Correctly describe the pattern for T as a general rule AND One correct pattern described in words for T OR Attempt to describe pattern for T as general rule AND Two correct patterns described in words for T	Correctly describe the pattern for T as a general rule AND Two correct patterns described in words for T Rule: $T = n(n + 1)$ or $T = n^2 + n$	23	

		Testing (T) Attempt to test their general rule for T 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 T using $n \leq 4$ Ex: Correctly calculate their value for T in their general rule using $n \leq 4$ AND Recognise that their correctly calculated value for T is the same as the given value. ACCEPT seeing their correctly calculated value for T and the given value in the table being equal			
		Verifying (V) Attempt to verify their general rule for T using $n \geq 5$ Ex: substitute in their general rule value of $n \geq 5$ OR Correctly verify their described pattern or their rule (e.g. recursive rule)	Correctly calculate their value for T in their general rule using $n \geq 5$	Correctly calculate their value for T in their general rule using $n \geq 5$ AND Recognise that their correctly calculated value for T is the same as their predicted value obtained by continuing the pattern ACCEPT seeing their correctly calculated value for T 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 A.S Ex: $u_1 = 2, d = 2, u_n = 2n$ or	Justify their general rule correctly Ex: Use the A.S to show the rule. Example:	Attempt to prove their general rule Ex: Adding the bases of trapezium we get $1 + 2n + 1$. Dividing by 2 we get $n + 1$ then the	Correctly prove their general rule using n in bases and simplifying correctly. Ex: $\frac{1+2n+1}{2} \times n = \frac{2n+2}{2} \times n$	

		<p>Quadratic model and valid attempt to find coefficients or Test at least two other values for T using any values of n and say it works comparing to the table or Refer to bases and height of trapezium but not correctly</p>	$u_1 = 2, u_n = 2n$ $S_n = \frac{n}{2}(2 + 2n)$ OE or Quadratic model and get correct values of coefficients using any method or Compare values they obtain using the general rule with values they obtain using area of trapezium formula	height we multiply by is n or Attempt to use n when calculating area of trapezium $\frac{1+2n+1}{2} \times 1$ or Substitute $\frac{n}{2}$ into equation of line $(2(\frac{n}{2}) + 1)$	or Substitute $\frac{n}{2}$ into equation of line to find average width and multiply by the height n Ex: $(2(\frac{n}{2}) + 1) \times n$		
	Notation and terminology (N)	<p>Correct notation of <u>their</u> rule OR Correct terminology describing at least one pattern</p> <p>DO NOT ACCEPT if they don't have any rules and they don't describe any patterns</p>	<p>Correct notation of <u>the general</u> rule for T OR The notation of <u>the general</u> rule includes errors AND Correct terminology describing at least one pattern</p> <p>DO NOT ACCEPT if they don't have a general rule</p>	<p>Correct notation of <u>the general</u> rule for T AND Correct terminology describing at least one pattern</p> <p>The general rule: $T = n(n + 1)$ Or $T = n^2 + n$</p> <p>For notation of general rule, DO NOT ACCEPT $T = n \times (n + 1)$ or $T = n * (n + 1)$ $n * (n + 1) = T$ $T = nn + n$ $T = n \times n + n$ The rule for T is $n^2 + n$ $T = n^2 + n$</p>			

				Can be awarded only if D2 is achieved	Can be awarded only if D3 is achieved	Can be awarded only if D4 is achieved				
	Communication (L)	Very weak communication Two or three lines of communication OR Only calculations or algebraic steps	Weak communication More than three lines of communication but lack coherence	Good communication More than three lines of coherent communication Can be awarded only if J2 is achieved						

The general rule: $T = n(n + 1)$ or $T = n^2 + n$

Predictions

Stage (n)	Area of trapezium (T)	
1	2	
2	6	
3	12	
4	20	
5	30	
6	42	
7	56	
8	72	

Markscheme

May 2018

Mathematics

On-screen examination

27 pages

This markscheme is **confidential** and for the exclusive use of examiners in this examination session.

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The following are the annotations available to use when marking responses.

Annotation	Explication	Annotation	Explication	Shortcut
	Unclear		Award 0 marks	Alt+0
	Special case		Award 1 mark	Alt+1
	Misread		Award 2 marks	Alt+2
NWS	No working shown		Award 3 marks	Alt+3
	Error carried forward		Award 4 marks	Alt+4
	Words to that effect		Award 5 marks	Alt+5
	Benefit of the doubt		Award 6 marks	Alt+6
	Answer Given		Award 7 marks	Alt+7
	Highlight tool		Award 8 marks	Alt+8
	Ellipse tool		Award 9 marks	Alt+9
	On page comment tool		Award 10 marks	
	Seen		Award 11 marks	
	Caret - Omission		Award 12 marks	
	Wavy underline tool			

The markscheme may make use of the following abbreviations:

RM Assessor has the following annotations that should be used to award marks:

A0 only use to award a zero mark for an answer that has no merit eg, awarded for the candidate that has a wrong answer with no working



NR only use when the candidate has not made any response also stamp the response with

Marks awarded by stamping the tick

Seen; must be stamped on all blank response areas and on concatenated responses

unclear

- Bullet notation means award 1 mark – see example 1 below

ECF Marks that can be awarded as **error carried forward** from previous results in the question

BOD Benefit of the doubt

MR misread

NWS no working shown

SC special case

OE or equivalent

WTTE or words to that effect

AG Answer given

Example 1

- 1 mark awarded and corresponding notes are aligned

b	<ul style="list-style-type: none">• Show clear line of reasoning in the method• 4	45 & 49 seen OE eg, $49 = 45 + x$ Accept $45 + X/10 = 4.9$ <u>and</u> Ans 4	2
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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.

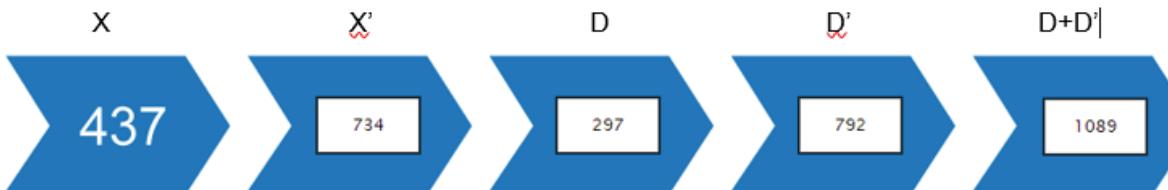
- a) **ECF** applies from one part of a question to a subsequent part of the question and also applies within the same part.
- b) If an answer resulting from **ECF** is inappropriate (eg, negative distances or $\sin x > 1$) then subsequent marks should not be awarded.
- c) If a question is transformed 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 in final answers unless noted otherwise in the MS.
- b) 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.
- c) Where candidates have written two solutions to a question, mark the response that deserves more marks.
- d) 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 $\frac{x}{2}$ or $x/2$ or $x \div 2$
- e) 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.
- f) Special case marks **SC** can be allocated instead of but not in addition to the marks prescribed in the markscheme..
- g) Accept notation errors in intermediate steps.
- h) When a calculator screenshot is taken, accept not seeing the whole operation.
- i) Accept seeing an equation not in-line

General note for marking open-ended response questions:

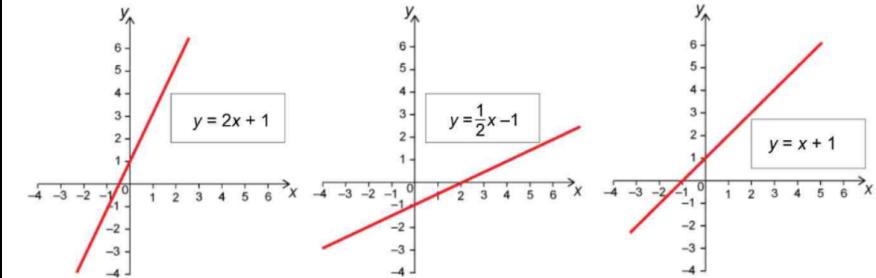
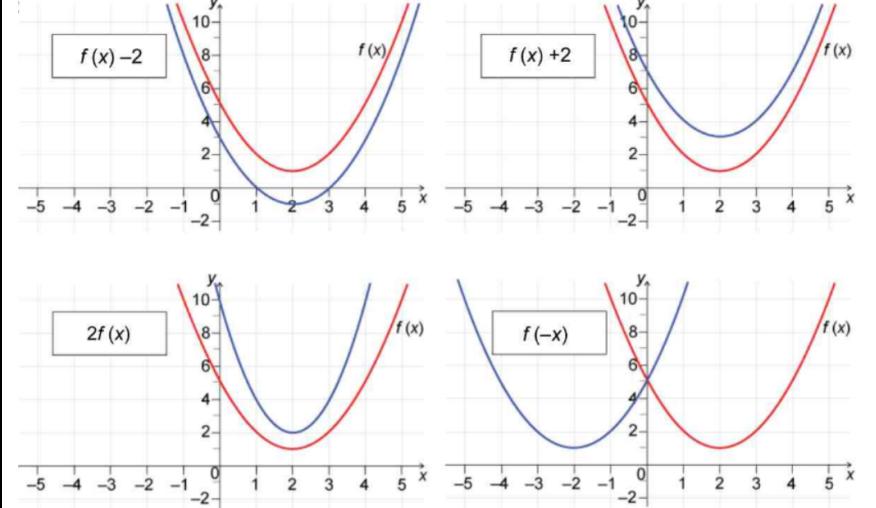
In cases in Task 2 and 3 where the markscheme is set out in a table then awarding the highest box includes all the lower boxes. So if for example you see at J4 in Task 3 that they have correctly proved their general rule, then J4 is awarded. That is the 4 (full) marks. You don't need to look at the other J criteria. It is probably best to look for the top box answer and if you don't find it look at the next box down. So if they don't get D4 then look at their attempt at a general rule and they might gain D3. If you don't see that look to see if they described a pattern and so on.

Question	Answers	Notes	Total
1 a	 <ul style="list-style-type: none"> •¹ 437 and their D correctly reversed •² their D correct •³ their D and their D' correctly added 	<ul style="list-style-type: none"> •¹ 734 and 792 •² (their 734 - 437=) 297 •³ (their 297 + their 792 =)1089 •³ 1089 with no entries in their D and their D' :award 1 mark 	3
b	<ul style="list-style-type: none"> •¹ expressing X correctly in terms of multiples of a, b and c •² expressing X' correctly in terms of multiples of a, b and c 	<ul style="list-style-type: none"> •¹ $100a + 10b + (1)c$ •¹ ACCEPT inappropriate notation provided it reads correctly. e.g.: $100*a+10*b+1*c$ •¹ DO NOT ACCEPT incorrectly read expressions. e.g.: $100(a+(10b)+c)$ •² $100c + 10b + (1)a$ •² ACCEPT inappropriate notation provided it reads correctly. e.g.: $100*c+(10b)+1*(a)$ •² DO NOT ACCEPT incorrectly read expressions. e.g.: $100c+10(b)+a)$ <p>SC for 1 mark $100a, 10b, c$ and $100c, 10b, a$</p>	2

1	c	<ul style="list-style-type: none">•¹ their X' - their X OR their X - their X' •² their answer correct in terms of a and c <i>only</i>	<p>ACCEPT not seeing absolute value</p> <p>•¹ $(100c+10b+1a) - (100a+10b+1c)$ or $(100a+10b+1c) - (100c+10b+1a)$</p> <p>•¹ If their X and X' are numbers, ACCEPT only if their result is positive</p> <p>•² $99c - 99a$ or $99a - 99c$ OE</p> <p>•² ACCEPT non-simplified answers $100c + a - 100a - c$ or $(100a + c) - (100c + a)$ OE</p> <p>$(100c+a)-(100a+c)$ or $99a - 99c$ or $99(c - a)$ OE without working: award 2 marks</p> <p>Seeing only X'-X : award 0 marks</p> <p>SC for 1 mark if their X and X' from part (b) are identical and 0 is their result in part (c) OR Comparing correctly their coefficients of a and c in their X and X'</p>	2
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Question	Answers	Notes	Total
2	<p>Candidates may use any appropriate algebraic notation to represent the frog and dragonfly here we have used x and y</p> <ul style="list-style-type: none"> •¹ setting both equations correctly •² a correct step towards eliminating one variable •³ their x correct •⁴ their y correct according to their x in any of their equations •⁵ seeing their $2x$ and their $4y$ correct •⁶ their values above added correctly <p>Alternative method for trial and error responses</p> <ul style="list-style-type: none"> •¹ seeing two numbers with sum 22 •² seeing two numbers with difference 12 •³ x or y correct •⁴ x and y correct •⁵ seeing their $2x$ and their $4y$ correct •⁶ their values above added correctly 	<ul style="list-style-type: none"> •¹ $x + y = 22$ and $x - y = 12$ •² for example: 34 seen or 10 seen or $22 - y = 12 + y$ or $22 - x = x - 12$ or $2x$ seen or $2y$ seen •³ ($x =$) 17 •⁴ ($y =$) 5 •⁵ 2 x their 17 and 4 x their 5 OE •⁶ their 54 <p>54 without working: award 4 marks 54 with one of •¹ to •⁵ : award 5 marks 54 with two of •¹ to •⁵ : award 6 marks</p> <p>seeing only $2 \times 17 + 4 \times 5$ OE e.g. $17 + 17 + 5 + 5 + 5 + 5$: award 5 marks seeing only $34 + 20 = 54$: award 5 marks seeing only $2 \times 17 + 4 \times 5 = 54$ OE : award 6 marks Seeing only 17 and 5 then $X = 54$: award 6 marks</p> <p>Alternative method for trial and error responses</p> <ul style="list-style-type: none"> •¹ trial e.g. $13 + 9$ •² trial e.g. $15 - 3$ •³ 17 or 5 •⁴ 17 and 5 •⁵ 2 x their 17 and 4 x their 5 OE •⁶ their 54 	6

Question	Answers		Notes	Total							
3 a	<ul style="list-style-type: none"> •¹ two inequalities correct •² the third inequality correct •³ one correct constraint OR three correct constraints not including the boundary •⁴ the second and third constraint correct <table border="1" style="margin-top: 10px;"> <thead> <tr> <th>Inequalities</th><th>Constraints</th></tr> </thead> <tbody> <tr> <td>$x \geq 100$</td><td>(number of) cookies more than or equal 100 WTTE exceeds or equal 100, at least 100, a minimum of 100, not less than 100 ACCEPT between 100 and 450 OR bigger than 99 OR can exceed or equal 100</td></tr> <tr> <td>$y \geq 50$</td><td>(number of) muffins more than or equal 50 WTTE exceeds or equal 50, at least 50, a minimum of 50, not less than 50 ACCEPT between 50 and 250 OR bigger than 49 OR can exceed or equal 50</td></tr> <tr> <td>$y \leq x$</td><td>(number of) cookies more than or equal (the number) of muffins WTTE exceeds or equal, at least, minimum as, not less than ACCEPT x can exceed or equal y OR y cannot exceed x</td></tr> </tbody> </table>	Inequalities	Constraints	$x \geq 100$	(number of) cookies more than or equal 100 WTTE exceeds or equal 100, at least 100, a minimum of 100, not less than 100 ACCEPT between 100 and 450 OR bigger than 99 OR can exceed or equal 100	$y \geq 50$	(number of) muffins more than or equal 50 WTTE exceeds or equal 50, at least 50, a minimum of 50, not less than 50 ACCEPT between 50 and 250 OR bigger than 49 OR can exceed or equal 50	$y \leq x$	(number of) cookies more than or equal (the number) of muffins WTTE exceeds or equal, at least, minimum as, not less than ACCEPT x can exceed or equal y OR y cannot exceed x	ACCEPT if they use x and y instead of cookies and muffins DO NOT ACCEPT cost or price or value of cookie/muffin • ³ An example for “ OR ”: cookies exceeds 100 and muffins exceeds 50 and cookies bigger than muffins • ³ DO NOT ACCEPT ECF from the inequality	4
Inequalities	Constraints										
$x \geq 100$	(number of) cookies more than or equal 100 WTTE exceeds or equal 100, at least 100, a minimum of 100, not less than 100 ACCEPT between 100 and 450 OR bigger than 99 OR can exceed or equal 100										
$y \geq 50$	(number of) muffins more than or equal 50 WTTE exceeds or equal 50, at least 50, a minimum of 50, not less than 50 ACCEPT between 50 and 250 OR bigger than 49 OR can exceed or equal 50										
$y \leq x$	(number of) cookies more than or equal (the number) of muffins WTTE exceeds or equal, at least, minimum as, not less than ACCEPT x can exceed or equal y OR y cannot exceed x										
b	profit (on/of) one (cookie and/or muffin) OR profit per cookie and per muffin	Profit and one or per must be seen or implied ACCEPT amount of money gained to express profit DO NOT ACCEPT cost or price DO NOT ACCEPT the profit of a muffin is 1.5 times the profit of cookie OE	1								
c	<ul style="list-style-type: none"> •¹ correct values substituted, seeing 450 and 50 substituted correctly •² their correct answer after adding their multiplied numbers 	• ¹ ($P =$) $(1x)450 + 1.50 \times 50$ or $450 + 75$ • ² 525 (CAD) 525 without working: award 2 marks	2								
d	250 (cookies) and 250 (muffins)		1								

Question	Answers	Notes	Total
4 a	<ul style="list-style-type: none"> •¹ one equation placed correctly •² the other two equations placed correctly 		2
b	<ul style="list-style-type: none"> •¹ 1st equation placed correctly •² 2nd equation placed correctly •³ 3rd equation placed correctly •⁴ 4th equation placed correctly 	 <p>Do not award the mark if two functions are dragged on the same graph</p>	4

Question	Answers	Notes	Total
5 a	<ul style="list-style-type: none"> •¹ recognizing that FCD = ECB (vertically opposite) can be seen on the diagram •² mentioning reason for congruency 	<ul style="list-style-type: none"> •¹ ACCEPT FCD and ECB are equivalent OR FCD = number and ECB = same number OR angles FCD and ECB are congruent •¹ ACCEPT BEC=DFC=140 provided the 140 is mentioned •² ASA or Angle Side Angle or Two angles and one side in-between OE •² ACCEPT , if ASA not mentioned, recognizing that (angle) EBC=FDC and BCE=DCF and ONLY BC=DC. <p>Do not award •² for AAS or AAA or SAS OE</p>	2
b	<ul style="list-style-type: none"> •¹ identifying values of side and angle of right angled triangle •² substituting correctly into appropriate sin or cos ratio •³ their answer correct after rearranging correctly their trig ratio <p>Alternative method</p> <ul style="list-style-type: none"> •¹ substituting correctly into sine rule for triangle ABD with one unknown •² rearranging their sine rule correctly •³ their answer correct after rearranging their sine rule <p><i>Another alternative method below</i></p>	<ul style="list-style-type: none"> •¹ 30° and 480 (cm) OR 60° and 480 (cm) seen •² $\sin(\text{their } 60) = \text{their } 480/AB$ OR $\cos(\text{their } 30) = \text{their } 480/AB$ •³ their 554(.256... cm) <p>Seeing only $\sin(30 \text{ or } 60) \times 480 (= \dots)$ OE with other trig ratios: award 1 mark</p> <p>Seeing only $\sin(30 \text{ or } 60) \times \text{not } 480 = \dots$ or $\sin(\text{not } 30 \text{ or } 60) \times 480 = \dots$ OE with other trig ratios: award 0 marks</p> <p>Alternative method</p> <ul style="list-style-type: none"> •¹ $\frac{960}{\sin 120} = \frac{AB}{\sin 30}$ or $\frac{192.(489\dots)}{\sin 20} = \frac{AB}{\sin 100}$ •² $(AB =) 960 \times \frac{\sin 30}{\sin 120}$ or $(AB =) 192.(489\dots) \times \frac{\sin 100}{\sin 20}$ •³ their 554(.256... cm) <p><i>Another alternative method below</i></p>	3

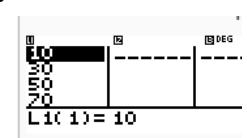
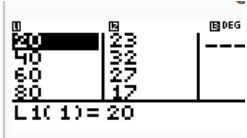
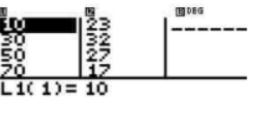
5	b	<p>Alternative method</p> <ul style="list-style-type: none"> •¹ identifying values of side and angle of right angled triangle •² substituting correctly into tan ratio then calculate their h correctly •³ their answer correct after using Pythagoras correctly 	<p>Alternative method</p> <ul style="list-style-type: none"> •¹ 30° and 480 (cm) OR 60° and 480 (cm) seen •² $(\tan(\text{their } 30)) = h/\text{their } 480$ then $(h=)\text{their } 277.13\dots$ •³ $(480^2 + (\text{their } 277.13)^2 =) \text{ their } 554(.256\dots \text{ cm})$ •³ ACCEPT 554 or $(480/0.87) = 551.72$ or 552 •³ DO NOT ACCEPT $(480/0.86) = 558$ <p>554(.256..) or 551.72 or 552 without working: award 2 marks 554(.256..) or 551.72 or 552 with one working step: award 3 marks</p> <p>SC for 1 mark Using the area as 92395 and reach AB=517</p>	
c		(scale factor=) 8	ACCEPT 1/8 or 1:8 OE	1
d		<ul style="list-style-type: none"> •¹ squaring their scale factor •² their area correct <p>Alternative method</p> <ul style="list-style-type: none"> •¹ using their ratio correctly to find length AC of kite •² their area of kite calculated correctly 	<ul style="list-style-type: none"> •¹ $(1/8)^2$ or 8^2 •² $92395 \div \text{their } 8^2$ or $92395 \times (\text{their } 1/8)^2$ or $92395 \times (120/960)^2$ or $1443.67\dots$ or $1444 \text{ (cm}^2)$ <p>Dividing by 8 or multiplying by $1/8$: award 0 marks</p> <p>Alternative method</p> <ul style="list-style-type: none"> •¹ $\frac{92395 \times 2}{960 \times 8} = 24.061\dots$ •² $1/2 \times \text{their } 24.061\dots \times 120$ or $1443.67\dots$ or $1444 \text{ (cm}^2)$ <p>$1443.67\dots$ or $1444 \text{ (cm}^2)$ without working: award 2 marks</p>	2

Question	Answers	Notes	Total
6 a	<ul style="list-style-type: none"> •¹ (Min) 1 and (Max) 17 seen •² correct subtraction to get their 16 	<ul style="list-style-type: none"> •¹ 1 and 17 •² 16 •² DO NOT ACCEPT a negative number 16 without working: award 2 marks <p>SC for 1 mark Seeing only (6,16) or -16</p>	2
b	<ul style="list-style-type: none"> •¹ identifying any two times 12 hours apart •² 12 (hours) 	<ul style="list-style-type: none"> •¹ 3 and 15. •¹ ACCEPT seeing two times which are 12 hours apart •¹ ACCEPT seeing two points with x-coordinates 12 hours apart •¹ ACCEPT recognizing that there are two cycles in 24 hours OE •² DO NOT ACCEPT any other value but 12 12 without working award: 2 marks 	2
c	<ul style="list-style-type: none"> •¹ 8 (am) or 10 (am) seen •² Both and only 8 (am) and 10 (am) seen 	<ul style="list-style-type: none"> •¹ ACCEPT [7:50, 8:10] or [9:50, 10:10] •² ACCEPT poor notation Ex: (8,10) or 8-10 OE 	2

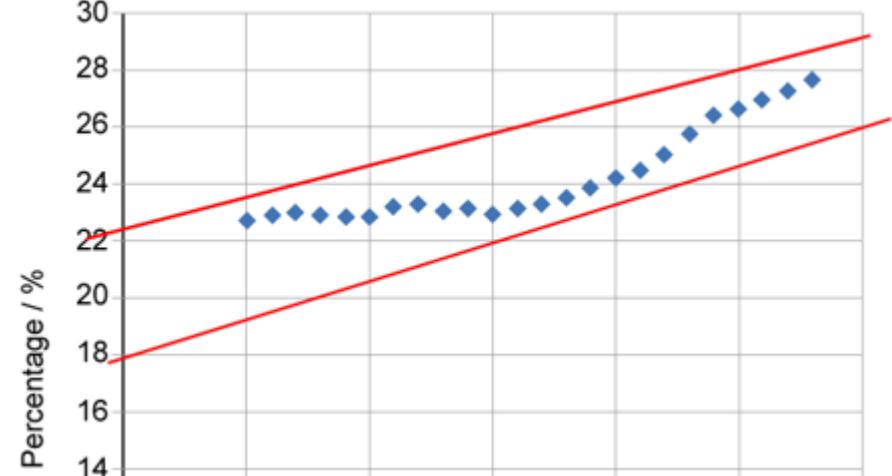
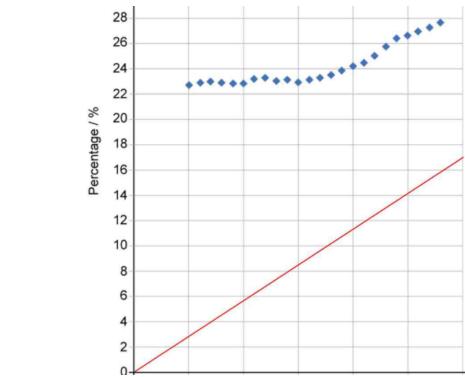
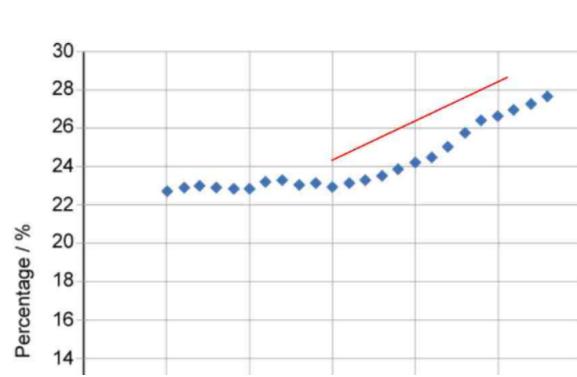
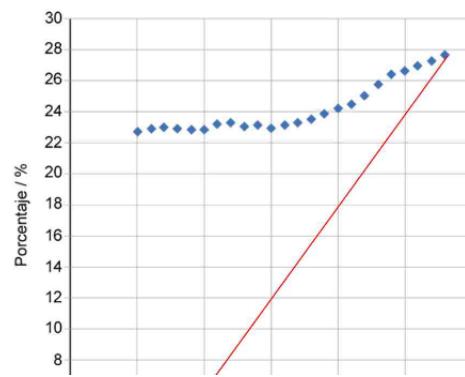
6	d	<ul style="list-style-type: none"> •¹ correct justification for a •² correct justification for c 	<ul style="list-style-type: none"> •¹ vertical stretch, amplitude •¹ ACCEPT difference between middle and maximum or $(\max - \min)/2$ or half of the range •¹ ACCEPT a is half of 16 or $16/2$ or 17-9 •¹ DO NOT ACCEPT a is difference between high and low tide •² vertical translation or shift up •² ACCEPT average of min and max or the principal axis or $(\max + \min)/2$ or mean of max and min or min+amplitude •² ACCEPT $(17+1)/2$ or $1+8$ •² DO NOT ACCEPT c is the mean or median or midpoint of the graph •² DO NOT ACCEPT c is the y-intercept or first point OE •² DO NOT ACCEPT substituting with a point <p>SC for 1 mark The sum of a and c is 17 (high tide) OR Substituting correctly with two points and solving correctly to get $a = 8$ and $c = 9$</p>	2
e		<ul style="list-style-type: none"> •¹ correct substitution of 17 •² their height correct after their calculation 	<ul style="list-style-type: none"> •¹ $8\sin(30 \times 17) + 9$ •¹ ACCEPT substituting with $t=1$ or 5 or 13 or 25. e.g.: $8\sin(30)+9$ •² 13(m) <p>13 without working: award 1 mark</p>	2

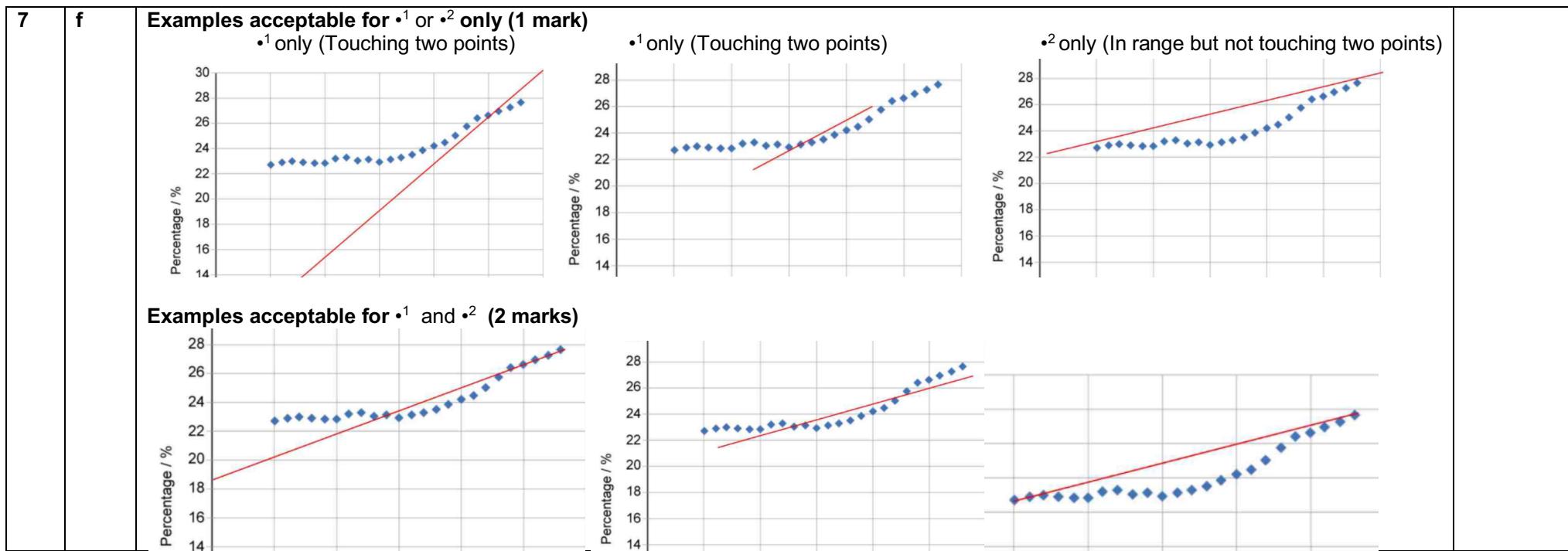
Question	Answers	Notes	Total
7 a	$20 < A \leq 40$	ACCEPT 20 to 40 or 20-40 or [20,40] or $20 < A < 40$ ACCEPT 21 to 40 DO NOT ACCEPT 20 to 39 OE	1
b	$\frac{10 \times 23 + 30 \times 32 + 50 \times 27 + 70 \times 17 + 90 \times 1}{100}$ <p>OR</p> $\frac{23}{100} \times 10 + \frac{32}{100} \times 30 + \frac{27}{100} \times 50 + \frac{17}{100} \times 70 + \frac{1}{100} \times 90$ <ul style="list-style-type: none"> •¹ evidence of using the middle age values •² multiplying at least two of their middle ages by the percentage •³ dividing by 100 •⁴ adding correctly their values of middle ages multiplied by the percentage <p>38.2 AG</p>	<p>Footnote: When a calculator screenshot is taken, ACCEPT not seeing the whole calculation.</p> <p>Example: award 4 marks</p> <p>$\begin{array}{r} 90+1190+1350+96 \\ \text{ans}\div100 \end{array} \quad \begin{array}{r} \text{DEG} \\ 3820 \\ 38.2 \end{array}$ $(10*.23)+(30*.3)$ $\quad \begin{array}{r} \text{DEG} \\ 38.2 \end{array}$</p> <p>or</p> <ul style="list-style-type: none"> •¹ 10,30,50 seen •² any two of their 10×23 or 230, their 30×32 or 960 •³ any dividing by 100 seen •⁴ evidence of adding all correctly •⁴ DO NOT ACCEPT if total is not 38.2 <p>$191/5=38.2$: award 0 marks</p> <p>$\frac{3820}{100}$ without working: award 1 mark</p> <p>It is the sum divided by 100: award 1 mark</p>	4

*Alternative method below**Alternative method below*

7	b	<p>Alternative method using calculator STAT input</p> <ul style="list-style-type: none"> •¹ evidence of using the middle age values •² data entered correctly in to columns or n =100 •³ evidence of selecting L₁ and L₂ •⁴ seeing 38.2 on the screen 	<p>Alternative method using calculator STAT input</p> <ul style="list-style-type: none"> •¹  or  •²   ACCEPT for •¹ and •² seeing  •³ ACCEPT for •² and •³ seeing  Seeing only award 4 marks
c		$\frac{1+17}{100} = \frac{18}{100}$ <ul style="list-style-type: none"> •¹ seeing 1 + 17 OR 18 •² dividing their sum by 100 	<ul style="list-style-type: none"> •¹ ACCEPT 0.01 + 0.17 •² 0.18 OE <p>0.18 OE without working: award 2 marks</p>

7	d	<ul style="list-style-type: none"> •¹ dividing 1207000 by 23858000 •² 0.05059... or 0.0506 or 5.059... (%) or 5.06(%) <p>5 (%) AG</p>	<ul style="list-style-type: none"> •¹ ACCEPT 1207/23858 •² ACCEPT 0.0505 or 5.05(%) <p>ACCEPT seeing cross multiplication process for 2 marks e.g. $23858 - 100\%$ $1207 - 5.059\%$</p> <p>0.005059 or 5.059 (%) or 5.06 without working: award 1 mark</p> <p>SC for 1 mark</p> <p>$0.05 \times 23,858,000 = 1,192,900$ or ≈ 1207000</p> <p>OR</p> <p>$1,207,000 / 0.05 = 24,140,000$ or ≈ 23858000</p>	2
e		<ul style="list-style-type: none"> •¹ multiplying their result in (c) by 0.05 •² their correct result after multiplication 	<ul style="list-style-type: none"> •¹ 0.18×0.05 •¹ ACCEPT their result in (c) x their result in (d) provided they are both less than 1 •² 0.009 OE <p>0.009 OE without working: award 2 marks</p>	2

7	f	<ul style="list-style-type: none"> •¹ the line is crossing twice or touching at least two points •² domain covering at least year 1994 to 2010 and the line is within the range shown below 	<ul style="list-style-type: none"> •¹ see examples below •² see examples below 	2
		<p>Examples not acceptable (0 marks): Not crossing twice, Not touching two points and not in range (0 marks)</p>   		



7	g	Mark	1	2	3	4
		F: Identification of Factors	<p>One factor mentioned from:</p> <ul style="list-style-type: none"> - Nature of the increase - Life expectancy - Birth rate or mortality - Rules of immigration - Gradient or rate of line or Percentage increase of immigrants seen - Percentage of immigrants - Change in population distribution (human landscape) - Economy status - Imagined factor like disaster happening in Australia - <p>DO NOT ACCEPT only saying many factors</p>	<p>Two factors mentioned from:</p> <ul style="list-style-type: none"> - Nature of the increase - Life expectancy - Birth rate or mortality - Rules of immigration - Gradient or rate of line or Percentage increase of immigrants seen - Percentage of immigrants - Change in population distribution (human landscape) - Economy status - Imagined factor like disaster happening in Australia - <p>DO NOT ACCEPT only saying many factors</p>		
		E: Estimation	<p>Estimation of year in range (2055 to 2300) or (in 42 to 287 years) without showing calculations</p> <p>OR</p> <p>Estimation not in range using their incorrect line equation or incorrect proportions or percentages</p>	<p>Estimation of year in range (2055 to 2300) using:</p> <p>equation of line not matching their line of best fit</p> <p>OR</p> <p>Incorrect proportion or percentage increase of immigration</p> <p>Ex: Estimate 2080 using 6% in 23 years, or estimate 2150 using 0.3% every year, or 2070 using 1% every 5 years</p>	<p>Estimation of year in range (2055 to 2300) using:</p> <p>equation of line matching their line of best fit but incorrect result</p> <p>Ex: reaching estimation 2100 from $y=0.2x+20$</p> <p>OR</p> <p>Using appropriate proportions</p> <p>Ex:</p> <p>Estimate 2180 using 6% in 23 years, or estimate 2090 using 0.3% every year, or 2070 using 2% every 5 years</p>	<p>Estimation of year in range (2055 to 2300) using:</p> <p>correctly equation of line matching their line of best fit</p> <p>Ex: reaching estimation 2120 from $y=0.2x+23$</p>

7	g	Mark	1	2	3	4
		D: Degree of Accuracy	<p>Suitable rounding used for their estimated year</p> <p>DO NOT ACCEPT if they just write down a year without any reference or calculations</p> <p>SC: if they use their line equation or proportions correctly and their estimated year does not need rounding: award D1</p>			
		J: Justification of whether it makes sense	<p>Inaccurate with weak reason Examples: 1. Inaccurate because I used line of best fit. 2. Inaccurate because I used % which are not accurate inaccurate because the difference between what I estimated and news headline is very big</p> <p>OR Accurate with valid reason Examples: 1. Accurate because I used my line of best fit to estimate 2. Accurate because I used average % of increase 3. Accurate because I considered all data given DO NOT ACCEPT My prediction is accurate because I made the calculations DO NOT ACCEPT accurate or inaccurate without reason</p> <p>Can be awarded only if E1 is achieved</p>	<p>Inaccurate with a valid reason related to variables affecting the future Examples: 1. The prediction I made not very accurate because many factors may vary 2. Predictions using line of best fit for the future not guaranteed 3. The prediction using the line equation not very accurate because it is taking only a window or isolated time 4. The prediction using the line equation not very accurate because it assumes the future follows same pattern 5. My predictions not very accurate because the population (human landscape) can change in Australia</p> <p>ACCEPT Calculating using their line equation the % immigration in 2050 and showing it is not 50%</p>		

7	g	Mark	1	2	3	4
		N: Comment on News headline	<p>Comment on the news headline, with a supporting reason, seen anywhere</p> <p>Example:</p> <ol style="list-style-type: none"> 1. Not accurate because I estimated my calculation 2300 2. It can be correct as my value estimated is close 3. Many factors affect it they cant say for sure <p>DO NOT ACCEPT right or wrong headline without reason</p>			

Question	Answers	Notes	Total
8 a	<ul style="list-style-type: none"> •¹ attempt to add at least 3 values of sides •² all correct values added 70 AG 	Values 20, 5, 15, 10, 5, 15 or 20, 20, 5, 10, 15 in any order • ¹ e.g.: $20+5+10+30$ or $20+2\times 5$ • ² $20+5+15+10+5+15$ OR $20+2\times 5+2\times 15+10$ OR $2+10+30+10$ ACCEPT $15+15+20+20$ OR $2\times 15+2\times 20$ $20+20+20+10$ OE: award 1 mark • ² DO NOT ACCEPT if sum is not 70 Calculating area: award 0 marks	2
b	6 and 68 correctly placed		1
c	a suitable pattern described for the perimeter P in acceptable terminology	ACCEPT perimeter goes up by 2 they get 2 cm more OE They are even numbers As the value of AB increases by x the perimeter increases by $2x$ the perimeter difference is 2 add 40 to double L sum of double L and 40 DO NOT ACCEPT $2L+40$ Two L plus forty they are increasing linear relation they are increasing or decreasing by 2	1
d	<ul style="list-style-type: none"> •¹ attempt to express the general rule in terms of their L •² correct general rule for P in terms of L 	• ¹ Examples: $40 + 2L$ or $P=2AB+40$ or $(10\times 6)+2\times(L-10)$ or $P=2x+40$ • ¹ ACCEPT $2\times L+$ any number or $40+$ any number $\times L$ • ¹ ACCEPT add 40 to double L WTTE • ² $P = 40 + 2L$ or $P=2(20 + L)$ • ² ACCEPT $P = 40 + 2\times L$ or $P=2\times(20 + L)$ or $P=2L+40$ • ² ACCEPT non-simplified answers like: $P=(10\times 6)+2\times(L-10)$ or $P=3L+30-(L-10)$ or $P=L+L+40$ OE	2

8	e	<ul style="list-style-type: none"> •¹ substitute $L \geq 16$ into their rule •² correctly calculate their value of P after substitution $L \geq 16$ •³ recognizing that their result is the same as their predicted value 	<ul style="list-style-type: none"> •¹ Ex: $2 \times 16 + 40$ •² Ex: 72 (for the $L = 16$) •³ Same as value I predicted in table (and we find the candidate has 72 in the table for $L = 16$) or same as when we continue the pattern and explains how 72 is obtained from pattern of adding 2 to 70 <p>•³ ACCEPT seeing the 72 in the table and seeing their calculated $P=72$ when $L=16$</p> <p>SC for 1 mark If “tested” correctly with a value from the table. For example: testing with $L = 10$ to get $P = 60$</p>	3
	f	<ul style="list-style-type: none"> •¹ correctly substituting in a perimeter formula •² dividing by 2 •³ adding the three perimeters <p>100 π AG</p>	<ul style="list-style-type: none"> •¹ 60π or 40π or 100π or $2\pi 30$ or $2\pi 20$ or $2\pi 50$ •² 30π and 20π and 50π •³ ($P =$) $50\pi + 30\pi + 20\pi$ •³ DO NOT ACCEPT if sum is not 100π <p>ACCEPT 157.079..+94.247..+ 62.831.. provided they compare the sum with 314.159....</p> <p>ACCEPT •¹, •² and •³ in any order</p> <p>Seeing only $50\pi + 30\pi + 20\pi$: award 3 marks</p>	3

8	g	Mark	1	2	3	4	
		Predictions (P)	<p>Predict correctly one value for P, either in the response box or in the table</p> <p>Example: $r = 25, P = 110\pi$</p> <p>OR</p> <p>Predict correctly three values of P without corresponding r</p>	<p>Predict correctly three values of P; either in the response box or in the table</p> <p>Example: $r = 25, P = 110\pi$ $r = 30, P = 120\pi$ $r = 35, P = 130\pi$</p> <p>DO NOT ACCEPT if corresponding r not mentioned</p>			
		Description (D)	<p>Attempt to describe a pattern in words</p> <p>Examples:</p> <ol style="list-style-type: none"> 1. As the r increases by 5 the P increases by 10 2. Multiples of 10 3. Adding 10 4. Divisible by 10 5. Double r and add 6. It is a line equation 	<p>Describe correctly a pattern in words</p> <p>Examples:</p> <ol style="list-style-type: none"> 1. The number multiplied by π is add 60 to the double of r 2. As the r increases by 5 the P increases by 10π 3. $2r+40$ or $3r+60$ or $60+2n$ where n is the row number 4. $(AB=)2R+2r$ on the diagram 	<p>Attempt to describe P as a general rule.</p> <p>Examples:</p> <ol style="list-style-type: none"> 1. $(P =) 2r + 60$ 2. $\pi D/2 + 30\pi + \pi r$ 3. $(P=)2 \pi (R+r)$ 4. $(P=) 2r + 60 \times \pi$ 5. $(P=) AC \times \pi + BC \times \pi$ 	<p>Correctly describe pattern as general rule</p> <p>Examples:</p> <ol style="list-style-type: none"> 1. $P = \pi(2r + 60)$ 2. $P = 2\pi(r + 30)$ OE <p>SC ACCEPT $(P=) 2\pi (x + 30)$ or the rule is $\pi (2r + 60)$ for D4 but award N1</p>	
		Testing (T)	attempt to use r from {5,10,15, 20} in their described pattern or general rule	<p>Recognizing that their result is the same as value in table</p> <p>ACCEPT seeing their calculated P value from their general rule and the value in the table being equal even without π</p>			

8	g	Mark	1	2	3	4	
		Verifying (V)	attempt to use $r > 20$ in their described pattern or general rule	Calculate correctly their value of P using their $r > 20$ in their general rule	Recognizing that their result is the same as their predicted value ACCEPT seeing their calculated P value from their general rule and their predicted value in the table being equal provided their calculated value includes π		
		Justify/proof (J)	Weak attempt to justify their described pattern or their general rule Examples: 1. trying at least two values and arguing as justification that they are the same or rule works 2. We always add 60 to the double of r (even if seen before their rule) 3. As r increases by 1 the P increases by 2 4. When $r=0$ P is 60	Good attempt to Justify their general rule Examples: 1. As r increases by 1 the P increases by 2 AND when $r=0$ P=60 2. As r increases by 1 the P increases by 2 AND perimeter of AC is 60 3. The equation is a line with gradient 2 and y-intercept 60	Correctly justify the general rule Examples: 1. As r increases by 1 the P increases by 2π AND when $r=0$ P=60 π 2. As r increases by 1 the P increases by 2π AND AC(diameter)=60 3. The equation is a line with gradient 2π and y-intercept 60 π OR Attempt to prove the general rule for the perimeter P Attempt to add perimeters in terms of r Examples: 1. $\pi 30+r+30 \pi+\pi r$ 2. $\pi R+\pi r+\pi r$	Correctly prove the general rule for the perimeter P by adding the perimeters in terms of r correctly $\pi (30+r)+30 \pi+\pi r$ ACCEPT $2\pi(R+r)$ OE J4 automatically gains T2 and V3	

8	g	Mark	1	2	3	4	
		Notation and terminology (N)	<p>Notation or terminology is correct</p> <p>OR The notation and terminology have significant errors for example 3.14 for pi</p> <p>OR The general rule is correct but not in correct notation Examples: 1. $P=\pi (2r+60)$ 2. The rule is $\pi(2r + 60)$</p>	<p>The notation and terminology are correct</p> <p>Note: One minor error, not in general rule, can be overlooked</p> <p>Can be awarded only if they have a general rule</p> <p>ACCEPT the use of x or * for multiplication</p>			
		Communication (L)	<p>Very weak communication</p> <p>Two or three lines of communication</p> <p>OR Only calculations or algebraic steps</p>	<p>Weak communication</p> <p>More than three lines of communication but lack coherence</p>	<p>Good communication</p> <p>More than three lines of coherent communication</p> <p>Can be awarded only if J2 is achieved</p>		

20 marks**Predictions**

R	r	P
30	5	70π
30	10	80π
30	15	90π
30	20	100π
30	25	110π
30	30	120π
30	35	130π
30	40	140π
30	45	150π
30	50	160π

Markscheme

May 2017

Mathematics

On-screen examination

22 pages

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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.

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

General points

- 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.
- 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.
- Where candidates have written two solutions to a question, mark the response that deserves more marks.
- 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 $\frac{x}{2}$ **OR** $x/2$ **OR** $x \div 2$
- 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.
- Special case marks **SC** can be allocated instead of but not in addition to the marks prescribed in the markscheme.
- Accept seeing equations not in-line.
- Accept notation errors in intermediate steps.
- When a calculator screenshot is taken, accept not seeing the whole operation

Example 1

- 1 mark awarded and corresponding notes are aligned

b	<ul style="list-style-type: none"> • Show clear line of reasoning in the method • 4 	45 & 49 seen OE e.g. $49 = 45 + x$ ACCEPT $45+x/10=4.9$ <u>and</u> Ans 4	2
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Task 1

Answers			Notes	Total
1	a	<ul style="list-style-type: none"> •¹ 2^3 OR 5 indicated as factor •² ($40 =$) $2^3 \times 5$ 	<ul style="list-style-type: none"> •¹ seen as multiplied factor OR seen in division ACCEPT $2^2 \times 2$ OR 2^3 OR 2.2.2 DO NOT ACCEPT $2+2+2$ DO NOT ACCEPT 5 in a list •² ACCEPT $2^2 \times 2^2 \times 5$ OR $2^3 \times 5$ OR 2.2.2.5 	2
	b	<ul style="list-style-type: none"> •¹ 4, 5, 8, 10 •² 8, 12 	For • ¹ and • ² ACCEPT any order	2
	c	<p>1 mark for each fully correct set</p>	<ul style="list-style-type: none"> •¹ 5, 10 •² 4, 8 •³ 12 <p>Mark part (c) independently from part (b). ECF from part (b) not allowed</p>	3
	d	4, 8, 20	<p>ECF allowed from (c)</p> <p>ECF allowed from (b) only if (c) is NR</p> <p>Do not award the mark if extra numbers are listed</p>	1

		Answers	Notes	Total
1	e	<ul style="list-style-type: none">•¹ either multiples of 4 OR factors of 40•² completely correct answer	<ul style="list-style-type: none">•¹ ACCEPT divisible by 4•² They are the multiples of 4 (less than 21) and factors of 40. “and” or WTTE must be seen for ex: “both” “as well as” OR “meanwhile” OR “also” Extra descriptions not contradicting the correct description can be ignored <p>Description not in context ex: “They are elements of both sets A and B”. Award 0 marks</p>	2

Answers			Notes	Total
2	a	(Modal interval is) 45-49	Accept 45 to 49 OR 45,49 OR $45 \leq x \leq 49$ OR [45,49] Do not accept $45 < x < 49$ OR [45,49[1
	b	52	If more than one number is written then 0 marks	1
	c	• ¹ Calculating IQR for medicine • ² Calculating IQR for physics • ³ Comment comparing the interquartile ranges Alternatively • ¹ Recognizing LQ is the same • ² Recognizing UQ in medicine is bigger • ³ Comment comparing the interquartile ranges	• ¹ (IQR for medicine=) 20 • ² (IQR for physics=) 15 • ³ IQR for physics is smaller than that of medicine OE : ex: difference of 5. IQR must be seen. Do not accept "range" • ³ ACCEPT "The winners in physics are closer in age". • ³ IQR of medicine must be bigger than physics regardless of their values SC: if both IQR are seen as 47 to 67 and 47 to 62 only, award only 1 mark for • ¹ and • ² then award • ³ as appropriate	3
	d	• ¹ identifying the frequency (55) • ² dividing their frequency by 210	• ¹ 55 identified OR seen as the numerator • ¹ Do not accept 55 seen in a list for ex: 3+12+22+55+.. • ² $\frac{(\text{their } 55)}{210}$ OE for example 0.262 OR 0.26 OR $\frac{11}{42}$ OR 26.2% OR 26% 55/210=0.3 Award 2 marks	2
	e	• ¹ Applying the 20% to 210 • ² Read off the graph the corresponding age	• ¹ $\frac{20}{100} \times 210$ OR 42 OR $\frac{80}{100} \times 210$ OR 168	2

Answers			Notes	Total
3	a	Step a: 14,3 . Step c: 5,7, 3 • ¹ All step a correct • ² All step c correct	• ¹ 14, 3 • ² <i>their</i> 5, 7, <i>their</i> 3 Allow ECF from <i>their</i> step a only if <i>their</i> step c is single digits	2
	b	• ¹ Correct sum of <i>their</i> numbers • ² Not divisible by 10 OR Not a multiple of 10	• ¹ <i>their</i> 83 • ² ACCEPT “must be a multiple of 10” NOTE: Sum their values correctly to a number divisible by 10 and saying it is valid because sum is divisible by 10 award • ¹ only	2
	c	• ¹ (61+ X =) 70 seen • ² (X=) 9	9 without working: award 2 marks	2

		Answers	Notes	Total
3	d	<ul style="list-style-type: none"> •¹ Instruction F correct •² Instruction G correct •³ Instruction H correct 	<p>•¹ (If the doubled digit is a two-digit number) add the two digits together Accept “add the two numbers together” OR WTTE</p> <p>•² Add the numbers Accept “plus” the numbers OR “sum” the numbers OR WTTE</p> <p>•³ If the sum is divisible by 10 then it is valid OR if the sum is not divisible by 10 then not valid OR check if (make sure) the number is divisible by 10 OR WTTE</p> <p>The instruction has to be in the correct place to award the mark</p> <p>SC: Step G adding and if sum divisible by 10 valid. Step H adding and if sum not divisible by 10 invalid Award only 1 mark for •² and •³. Award •¹ as appropriate</p> <p>SC: Step G adding and if sum divisible by 10 valid Step H if the sum not divisible by 10 invalid Award 2 marks for •² and •³. Award •¹ as appropriate</p>	3

Answers			Notes	Total
4	a	(f(4) =) 2		1
	b	<ul style="list-style-type: none"> •¹ substituting <i>their</i> 2 into $3f(x)-1$ •² <i>their</i> value of $f(x)$ correct 	<ul style="list-style-type: none"> •¹ $3x(\text{their } 2) - 1$ OR $6 - 1$ •² <i>their</i> 5 <p>5 without working award 2 marks</p> <p>ATTENTION If <i>their</i> value in (a) is not 2 allow ECF in (b) only if there is working</p>	2
	c	<ul style="list-style-type: none"> •¹ One correct algebraic step leading to a solution •² Dividing <i>their</i> equation by 2 •³ <i>Their</i> $f(x)$ calculated correctly •⁴ <i>Their</i> corresponding value of x correct 	<ul style="list-style-type: none"> •¹ $-2f(x) = 11 - 3$ OR $-2f(x) = 8$ •¹ Do not accept $3-2f(x)-11=0$ •² $-f(x) = 4$ •³ $f(x) = -4$ •⁴ $x=0$ 	4

Task 2

Answers			Notes	Total
5	a	3 (degrees)		1
	b	<ul style="list-style-type: none"> •¹ Setting Pythagoras OR finding angle BAE correctly •² <i>Their</i> value of AB calculated correctly •³ Substituting <i>their</i> AB correctly into trigonometric ratio •⁴ Correct operation to calculate BC 6.25 AG 	<ul style="list-style-type: none"> •¹ $AB^2 = 65^2 + 100^2$ or $\text{angleBAE} = 33.023\dots$ accept not seeing this step •² $AB = \sqrt{14225}$ or 119.26286... •³ $\tan(\text{their } 3) = \frac{BC}{\text{theirAB}}$ OR $\frac{BC}{\sin(\text{their } 3)} = \frac{\text{theirAB}}{\sin(\text{their } 90 - 3)}$ •⁴ $BC = \sqrt{14225}$ or 119.26286... $\times \tan 3$ OR 6.2503... 	4
	c	<ul style="list-style-type: none"> •¹ Substituting 6.25 correctly into volume formula •² Volume calculated correctly using <i>their</i> substituted radius •³ <i>Their</i> value correctly rounded to nearest m³ 	<ul style="list-style-type: none"> •¹ $\frac{4}{3}\pi(6.25)^3$. Accept: 4/3*pi6.25^3 •² $\frac{15625}{48}\pi$ OR <i>their</i> 1022.65 (using π) OR <i>their</i> 1022.135 (using 3.14) •² Accept not seeing this step •³ 1023 (m³) OR 1022 (m³) 	3

		Answers	Notes	Total
5	d	<ul style="list-style-type: none"> •¹ A valid mathematical reason •² Another valid reason (mathematical OR real-life) 	<p>Mathematical reasons:</p> <ul style="list-style-type: none"> (i) Referring to rounding of measurements <i>or</i> calculations (ii) Referring to inner and outer diameter OR thickness of sphere <p>Examples of real-life reasons:</p> <ul style="list-style-type: none"> (i) Referring to shape not a perfect sphere (ii) Referring to the sphere is not totally filled with water (regardless the reason) (iii) Expansion of water <p>DO NOT ACCEPT the vertical post may include water as well DO NOT ACCEPT referring to errors in measurements given DO NOT ACCEPT “because maybe I made mistakes”</p>	2

5	e	Marks	1	2	10
		(H) Calculate total water consumption for the households in the community	<p>Two attempts from any of the calculations below:</p> <p>Dividing 300000 by 4 to find the number of households $300\ 000/4 (= 75\ 000)$ households</p> <p>OR Multiplying <i>their</i> 366 by <i>their</i> 75000 to find the amount of water consumed per day by households <i>their</i> 366 * <i>their</i> 75000 (= 27 450 000) litres per day</p> <p>OR Dividing <i>their</i> 366 by 24 to find the amount of water in litres per hour for each household <i>their</i> 366/24(=15.25) l/h</p> <p>OR Calculating how many litres for every household during the 4 hours outage time</p> <p>OR Acceptable estimation for the amount of water used by household per hour (between 1100 000 and 1200000) without calculations</p>	<p>Calculate correctly the amount of water used by households per hour $(27\ 450\ 000/24 =) 1\ 143\ 750$ litres per hour</p> <p>OR $(15.25 \times 75000 =) 1143750$ litres per hour</p>	
		(L) Calculate total water consumption for individuals in the community	<p>One attempt from any of the calculations below:</p> <p>Multiplying 300000 by <i>their</i> 51 to find the amount of water consumed per day by the individuals Ex: $300\ 000 \times \text{their} 51 (=15\ 300\ 000)$ litres per day</p> <p>OR Dividing by 24 to find amount of water consumed per individual per hour <i>their</i> 51/24(=2.125) l/h</p> <p>OR Calculating how many litres for every individual during the 4 hours outage time</p> <p>OR Acceptable estimation for the amount of water used by individuals per hour (between 630000 and 650000 l/h) without calculations</p>	<p>Calculate correctly the amount of water used by individuals per hour Ex: $(15300000/24 =) 637500$ litres per hour</p> <p>OR $(2.125 \times 300000 =) 637500$ litres per hour</p>	

5	e	Marks	1	2	
		(T) Estimate amount of time before the water runs out	<p>Attempt to calculate estimate for time: Household $\frac{950\ 000}{their1\ 143\ 750}$ ($\approx 0.830.....$ hrs ≈ 50 mins)</p> <p>Or Individual $\frac{950\ 000}{their637\ 500}$ ($\approx 1.49.....$ hrs ≈ 89 mins)</p> <p>OR attempt for household and individuals but wrong result $\frac{950\ 000}{their1\ 143\ 750 + their637\ 500}$ ($\approx not 0.5$)</p>	<p>Calculating <i>their</i> estimate combining both household and individual information correctly</p> <p>$\frac{950\ 000}{their1\ 143\ 750 + their637\ 500}$ $\approx 0.5(33.....)$ hrs ≈ 30 to 35 mins</p>	
		(A) Advice for the community	<p>Advice related to minimizing the use in general</p> <p>OR Advise related to minimize/stop one specific activity</p>	<p>Advice requesting clearly to stop/reduce at least two of the following activities that consume too much water: Showers, wash dishes, washing clothes, or garden watering</p>	
		(J) Justification degree accuracy	<p>Weak justification not supported</p> <p>Examples: This is just an estimate</p> <p>OR We never know for sure the actual amount</p> <p>OR This is just an average</p> <p>OR Correct and sensible rounding for their value(s) of time Example 30 min or 0.5 hours</p> <p>Do not accept: "my time is very accurate because I made the correct calculations"</p>	<p>Good justification supported</p> <p>Examples Comment that the time calculated is if all population do not respond to advice and that the estimate of time can be more if they respond to advice</p> <p>OR Calculate time if they respond to advice</p> <p>OR the number of persons per household is an average so not accurate</p> <p>OR Referring to fact that during the specific 4 hours of outage not all activities considered in calculations are actually performed</p>	
NOTE: Seeing the total consumption for households and individuals ($1\ 143\ 750 + 637500 =$) 1781250 l/h allows H2 and L2					

Answers		Notes	Total	
6	a	<ul style="list-style-type: none"> •¹ Substituting correctly into formula of area of circle •² Calculating correctly <i>their</i> area of one sector •³ Multiplying <i>their</i> area of sector by 3 •⁴ Subtracting <i>their</i> area of sectors from 173 correctly 	<ul style="list-style-type: none"> •¹ $\pi \times 10^2$ OR 100π OR 314 •² $\frac{1}{6}$ <i>their</i> area of circle seen OR 52.359.. (accept not seeing this step) •³ Area of sectors OR 3x <i>their</i> area of one sector OR $3 \times \frac{1}{6}$ area of circle OR $\frac{1}{2}$ area of circle OR 50π OR 157(.0796327) •⁴ $173 - \text{their } 50\pi$ OR 15.9(2036732 OR 16 (km²)) Award •⁴ only if <i>their</i> result is positive 	4
	b	<ul style="list-style-type: none"> •¹ Calculating area of one sector OR area of circle •² Subtracting <i>their</i> area of four sectors from their area of square correctly 	<ul style="list-style-type: none"> •¹ $\frac{1}{4} \pi \times 10^2$ OR $\pi \times 10^2$ OR 100π OR 314 •² <i>their</i> 400 – <i>their</i> 100π OR $400 - 314$ OR 85.8(4073464) OR 86 (km²) 	2

6	c	Marks	1	2	4
		(V) Comparing Values of part (a) and part (b)	Recognizing which of their values from part (a) and part (b) is bigger		
		(J) Justification	Weak justification Examples: -The area uncovered in the triangular formation is smaller -The smaller area uncovered means better signal -The area covered in triangular is only half a circle while the area covered in rectangular is a circle	Good justification Referring to the proportion of uncovered area to the total area	
		(P) Proposing formation	Proposing the formation in part A OR triangular formation as the most suitable formation.		

Task 3

Answers			Notes	Total
7	a	<ul style="list-style-type: none"> •¹ Denominator •² Increased by 2 	<ul style="list-style-type: none"> •¹ Do not accept “the lower term” OR “the bottom” OR “the down” •² ACCEPT adds 2 OR multiples of 2 OR even numbers <p>SC award 1 mark for the following: Denominator multiple of $2k$ Denominator increases</p>	2
	b	$\frac{1}{12}$ (when $k=6$)	Answer may be seen in the table attached to 7a only if no response in the box of 7b NOTE if their value in the table in 7a not same as response in 7b, mark response in 7b.	1
	c	$(x_A =) \frac{1}{2k}$	Accept $1/2k$ OR $(2k)^{-1}$ Do not accept $1/2xk$ OR $1/2^*k$	1
	d	<ul style="list-style-type: none"> •¹ substituting a number $k \geq 7$ into their rule from (c) •² Refer to predictionn for $k \geq 7$ from table in part (a) •³ acknowledging that the two values above are equal 	<ul style="list-style-type: none"> •¹ $\frac{1}{2 \times 7}$. Accept $2 \times 7 = 14$ •² when $k=7$ in the table $X_A=1/14$ •³ They are equal <p>SC if “tested” correctly award 1 mark Tested correctly is when they apply the steps of verification mentioned in the left column on a value of $k \leq 6$</p>	3

		Answers				Notes	Total
7	e	x coordinate of point B (x_B)	$\frac{-1}{2}$	$\frac{-1}{4}$	$\frac{-1}{6}$	$\frac{-1}{8}$	
		y coordinate of point B (y_B)	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{12}$	$\frac{1}{16}$	
		y coordinate of point C (y_C)	$\frac{-1}{4}$	$\frac{-1}{8}$	$\frac{-1}{12}$	$\frac{-1}{16}$	
<ul style="list-style-type: none"> •¹ One correct column OR two correct rows •² Fully correct 							2

Answers			Notes	Total
7	f	<ul style="list-style-type: none"> •¹ one correct pattern described for Y_A •² another correct pattern described for Y_A •³ one correct pattern described for X_B •⁴ another correct pattern described for X_B 	<p>•¹ and •² Examples of accepted described patterns for Y_A:</p> <p>Denominators are multiples of 4 OR divisible by 4 Denominator is 4 times k Y_A is the same as Y_B Y_A is opposite to Y_C OR same as Y_C but different sign Numerator is constant OR numerator=1</p> $Y_A = \frac{1}{4k}$ <p>Do not accept denominator Y_A multiples of 2 OR even numbers Do not accept Y_A is always positive Do not accept Y_A multiples of 4 OR even numbers Do not accept the <u>bottom</u> is multiples of 4</p> <p>•³ and •⁴ Examples of accepted described patterns for X_B :</p> <p>Denominators are multiples of 2 OR even numbers X_B is same as X_A but opposite sign Numerator is always -1 Denominator is double k $X_B = -X_A$ $X_B = -\frac{1}{2k}$</p> <p>Do not accept X_B multiples of 2 OR even numbers Do not accept X_B is always negative</p>	4

7	g	Mark	Predictions (P)	Description (D)	Testing (T)	Verifying (V)	Justify/proof (J)	Notation and terminology (N)	Communication (C)	
7	g	1	Correctly predicted one term when $k \geq 5$	Attempted to describe a pattern Ex: k increases by 1 OR Numerator is equal 1 OR Bottom is times 4	Attempted to test their described pattern Ex: Substitute into their formula using $k \leq 4$	Attempted to verify their described pattern OR general rule using one value for $k \geq 5$ (ex: substitutes in their formula $k \geq 5$)	Attempted to justify their described pattern OR general rule Ex: Referring to denominator being in arithmetic sequence OR It is the opposite of YA OR opposite of YB OR Testing <u>at least 2</u> values correctly and saying it is the same OR the denominator is always multiplied by 4 OR times 4	The notation and terminology have significant errors	No communication Only calculations OR algebraic steps	22
		2	Correctly predicted two terms when $k \geq 5$	Correctly described pattern for their Y_c in words Ex: Denominator is always k times 4 OR denominator increases by 4	Tested correctly their described pattern OR general rule using $k \leq 4$ By Comparing with their predicted value	Calculates correctly their value for $k \geq 5$ and mentions the corresponding value in the table	Correctly justify their general rule Ex: Seeing Denominator is divisible by 4 (or multiple of 4) is justification OR Attempt to substitute X_A OR Y_A in terms of k into the gradient formula OE OR referring to denominator being arithmetic sequence and attempt to write U_1 and d	The notation and terminology are mostly correct Award only if D3 is achieved	Weak communication	

7	g	3	Correctly predicted Y_c up to $k=5$	Attempted to describe pattern for their Y_c as general rule Examples: $Y_c = 4k$ OR The pattern is $-\frac{1}{4k}$	Comment comparing the values above to verify	Attempt to prove the general rule for Y_c Substitute X_A and Y_A in terms of k into the gradient formula OE correctly OR referring to denominator being arithmetic sequence and mentioning U_1 and d correctly		Good communication Award only if J2 is achieved	
		4	Correctly predicted all terms of Y_c up to $k=6$	Correctly described pattern for their Y_c as general rule $y_c = -\frac{1}{4k}$		Correctly prove the general rule for Y_c Simplify correctly to reach the rule for Y_c OR Finding U_n of the arithmetic sequence			

Exemplification for (7g):

Predictions (P): can be seen in the table at 7e even if response box in 7g is empty

k	1	2	3	4	5	6
x coordinate of point A (x_A)	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{6}$	$\frac{1}{8}$	$\frac{1}{10}$	$\frac{1}{12}$
y coordinate of point A (y_A)	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{20}$	$\frac{1}{24}$
x coordinate of point B (x_B)	$-\frac{1}{2}$	$-\frac{1}{4}$	$-\frac{1}{6}$	$-\frac{1}{8}$	$-\frac{1}{10}$	$-\frac{1}{12}$
y coordinate of point B (y_B)	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{20}$	$\frac{1}{24}$
y coordinate of point C (y_C)	$-\frac{1}{4}$	$-\frac{1}{8}$	$-\frac{1}{12}$	$-\frac{1}{16}$	$-\frac{1}{20}$	$-\frac{1}{24}$

Describing the pattern: Denominator arithmetic sequence with first term -4 and common difference -4 OR Denominator multiples of 4 with negative sign OR equivalent.

$$\text{General rule } y_C = -\frac{1}{4k}$$

Testing the rule using any value of k between 1 and 5, e.g.: $k = 3$, $y_C = -\frac{1}{12}$ and $4 \times 3 = 12$

Verifying the rule by one value of k beyond $k=5$, e.g.:

When $k=6$ $y_C = -\frac{1}{24} = -\frac{1}{4 \times 6}$, or $24 = 4 \times 6$ and my value in the table is $1/24$, they are equal

$$\frac{y_A - y_c}{x_A - x_c} = \frac{k(x_A)^2 - y_c}{x_A - 0} = 1$$

Proving the rule:

$$y_c = k(x_A)^2 - x_A = k\left(\frac{1}{2k}\right)^2 - \frac{1}{2k} = \frac{k}{4k^2} - \frac{1}{2k} = -\frac{1}{4k}$$

MARKSCHEME

MAY 2016

MYP MATHEMATICS

ON-SCREEN EXAMINATION

22 pages

This markscheme is **confidential** and for the exclusive use of examiners in this examination session.

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The markscheme may make use of the following abbreviations:

RM Assessor has the following annotations that should be used to award marks:

A0 only use to award a zero mark for an answer that has no merit e.g. awarded for the candidate that has a wrong answer with no working



NR only use when the candidate has not made any response also stamp the response with

Marks awarded by stamping the tick

Seen; must be stamped on all blank response areas and on concatenated responses

unclear

- Bullet notation means award 1 mark – see example 1 below

ECF Marks that can be awarded as **error carried forward** from previous results in the question

BOD Benefit of the doubt

MR misread

NWS no working shown

SC special case

OE or equivalent

WTTE or words to that effect

AG Answer given

Example 1

- 1 mark awarded and corresponding notes are aligned

b	<ul style="list-style-type: none"> Show clear line of reasoning in the method 4 	45 & 49 seen OE e.g. $49 = 45 + x$ ACCEPT $45+x/10=4.9$ <u>and</u> 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) 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.
- c) Where candidates have written two solutions to a question, mark the response that deserves more marks.
- d) 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 $x \div 2$
- e) 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.
- f) Special case marks **SC** can be allocated instead of but not in addition to the marks prescribed in the markscheme.

Questions marked using Holistic markscheme in task 3 questions.

Some questions in the markscheme are indicated to be marked holistically. In these questions follow the following procedure to award the marks:

- 1) Best-fit the work in a certain band by taking an overview of the first two columns, the strand and the specified criteria.
- 2) Use best judgement to award the work the specific mark within the band; whether in lower, middle (if appropriate), or highest.

Task 1

Answers			Notes	Total
1	a	• ¹ $x = 0$	Accept the y axis	1
	b	• ¹ translation of shape B correctly placed (labelled C or not) • ² the two orange shapes have a horizontal line of reflection • ³ the two orange shapes have a horizontal line of reflection in the line $y=1$	The shapes must be correct within tolerance of half a square, otherwise no mark Allow ECF for • ² and • ³ 3 or more unlabelled shapes mark • ¹ only In case there are labelled and unlabelled shapes, only mark the labelled shapes and ignore unlabelled shapes	3
	c	• ¹ 180 (degree clockwise or anticlockwise) • ² centre (4,0)	• ¹ The requirement is description of rotation of their shape D into A (It has to be description of rotation) • ² “Centre 4” award no marks Note: if their rotation is by 90 degrees Accept 90° for anticlockwise or 90° for clockwise Do not accept left or right for direction.	2

2	a	<ul style="list-style-type: none"> •¹ 1st mark for two from the points below •² 2nd mark for four from the points below <p>correct comment comparing median or LQ or UQ or min or max correct comment comparing IQR or range correct values of median or LQ or UQ or min or max correct values of IQR or range</p>	<p>A comment for comparison would have higher or lower or same in both countries or WTTE</p> <p>Any reference to mode e.g. “most/usually shoe sizes” is incorrect Accept use of average for the median Accept values of IQR given as (LQ-UQ) Accept values of range given from min to max</p> <p>SC If there is not enough comments or correct values but the candidate states: that the shoes sizes in Brazil are bigger than in Egypt WTTE: award 1mark</p>	2
	b	<ul style="list-style-type: none"> •¹ 45 – 37 (or 37 to 45) •² 8 	<ul style="list-style-type: none"> •¹ 45 and 37 seen: award 1 mark •² 8 without working: award 2 marks 	
	c	<ul style="list-style-type: none"> • 0.4 and 0.95 	OE Allow 40 % and 95 % (not 40)	
	d	<ul style="list-style-type: none"> •¹ one multiplication correct •² second multiplication and addition correct •³ their 0.08 after addition 	<ul style="list-style-type: none"> •¹ OE 6% or 0.06 seen or 2% or 0.02 •² OE 0.06+0.02 •³ OE 0.08 without working: award 2 marks <p>Allow their values as ECF from (c) only if less than 1</p>	

3	<p>a</p> <ul style="list-style-type: none"> •¹ for cross multiplication •² for re-arranging y on one side and x in the other •³ for correct expression of y in terms of x 	<p>•¹ $2y - 1 = 2x$</p> <p>•² $2y = 2x + 1$ accept not seeing this step</p> <p>•³ $y = \frac{2x+1}{2}$ (If a further step is written as $y=x+1$ do not award •³)</p> <p>Alternative method $y - \frac{1}{2} = x$</p> <ul style="list-style-type: none"> •¹ first term y •² second term $-\frac{1}{2}$ •³ $y = x + \frac{1}{2}$ <p>SC Award 1 mark For a correct equation written in words without working</p> <p>SC Award 2 marks $y = \frac{2x+1}{2}$ or $y = x + \frac{1}{2}$ without working</p> <p>SC Award 3 marks $y = \frac{2x+1}{2}$ or $y = x + \frac{1}{2}$ with at least one correct working step Accept seeing the equation not in-line</p>	3
b	<ul style="list-style-type: none"> •¹ for equating $\frac{x+5}{2}$ with their expression for L_1 •² a correct algebraic step leading to the value of x •³ $x = 4$ or their value of x •⁴ for substituting in any of the two formulas •⁵ $(4, 4.5)$ or their coordinate correctly evaluated 	<ul style="list-style-type: none"> •¹ (their) $\frac{2x+1}{2} = \frac{x+5}{2}$ •² e.g. $2x+1 = x+5$ accept not seeing this step •⁴ $y = \frac{4+5}{2}$ accept not seeing this step •⁴ Accept solving by elimination •⁵ Accept 4 and 4.5 OE •⁵ $(4, 4.5)$ without any working award 3 marks <p>SC Many candidates have $y = x+1$ in 7a) which leads to non-intersecting lines in 7b) in this case if they recognise that lines are parallel and do not intersect: award 4 marks</p>	5

4	a	<ul style="list-style-type: none"> • (Radius =) 5 substituted in area formula 	(Area =) $\pi \times 5^2 = 25\pi$ Accept describing in words	1
	b	<ul style="list-style-type: none"> •¹ correct use of Pythagoras •² a correct algebraic step leading to the value of l^2 •³ their l written as exact value 	<ul style="list-style-type: none"> •¹ $(l^2 =) 5^2 + 5^2$ or $l^2 + l^2 = 10^2$ or $a^2 + b^2 = 10^2$ •² $l^2 = 50$ or $l^2 = 50$ or $2l^2 = 100$ Accept not seeing this step •³ $l = \sqrt{50}$ <i>or</i> $5\sqrt{2}$ without working: award 2 marks <p>Alternative method</p> <ul style="list-style-type: none"> •¹ Evidence of using sin45 or cos45 •² $\frac{1}{\sqrt{2}} = \frac{5}{l}$ <i>or</i> $\frac{1}{\sqrt{2}} = \frac{l}{10}$ •³ $l = \sqrt{50}$ ($= 5\sqrt{2}$) <p>If a further step is showing 7.07.. do not award •³</p>	3
	c	<ul style="list-style-type: none"> •¹ area of square calculated =50 •² subtracting areas •³ their value approximated to 1 decimal place 	<ul style="list-style-type: none"> •² 28.53981634... or $25\pi - 50$ or accept 25π - area of square Accept not seeing this step •³ 28.5 •³ 28.53981634... without working: award 1 mark •³ 28.5 without working: award 2 marks 	3
	d	<ul style="list-style-type: none"> •¹ recognising radius is 25 m •² correctly substituting their radius into perimeter formula •³ calculating their value using the circumference formula 	<ul style="list-style-type: none"> •¹ Accept not seeing this step •² $(c =) 2\pi \times \text{their radius}$ or $(c =) \pi \times \text{their diameter}$ •³ 50π or 157.0796... exact or correctly rounded 	3

5	a	<ul style="list-style-type: none"> •¹ (the maximum height occurs at $x=15$) •² ($h(15) = 9(m)$) 	<ul style="list-style-type: none"> •¹ Can be seen as substitution in the equation •² ECF only for x values [13,17] •² 9 without working: award 1 mark 	2
	b	<ul style="list-style-type: none"> •¹ $x=26$ or any evidence of substituting it •² $h = 4.16$ •³ Their $4.16 > 3$ m (therefore score) 	<ul style="list-style-type: none"> •¹ Accept not seeing this step •² 4.16 without working: award 2 marks •³ $4.16 > 3$ m, without working award 3 marks Their 4.16 must be greater than 3 	3
	c	<ul style="list-style-type: none"> •¹ for setting numerator = 0 •² for correct factorisation or evidence of correct substitution into the quadratic formula •³ for both correct values of x 	<ul style="list-style-type: none"> •¹ $-x^2 + 30x - 125 = 0$ accept not seeing this step •² $(x-5)(x-25) = 0$ accept not seeing this step •³ $x = 5, x = 25$ accept (5,0) (25,0) •³ $x = 5, x = 25$ without working: award 3 marks 	3
	d	<ul style="list-style-type: none"> •¹ no •² correct justification with correct values 	<ul style="list-style-type: none"> •² because it hits the ground before the post at 25 m or •² $x = 26$ to $h(26) = -0.84$ •² ECF for their x values only 	2

Task 2

		Answers	Notes	Total
6	a	• the values increase	WTTE: Accept: the values double	1
	b	• 440 880	Both correct	1
	c	• ¹ evaluates 3520 • ² because their values are above 20 and below 20 000	• ¹ 3520 must be seen • ² Accept “because 20< their A<20 000” OE • ² Accept their 3520 is less than 20 000 :Award 2 marks	2
	d	• ¹ $\frac{220}{27.5} = 8$ • ² $8 = 2^3$ • ³ $k = 3$	• ¹ 27.5 seen • ³ 2^3 or 3 or k=3 without working: award 2 marks	3
	e	• ¹ 1 term correct • ² both terms correct and multiplied $(F_n =) 27.5 \times 2^n$	• ¹ $F_n = F_0 \times 2^n$ award 1 mark • ² Allow alternative fully correct formula i.e. $55 \times 2^{n-1}$ OE	2
	f	• ¹ continuing the pattern or using the formula • ² yes	• ¹ 27.5×2^8 or 7040 or 14 080 or 28 160/27.5 or $14080 \times 2 = 28160$ or 2^{10} • ² Yes or No without working: award A0 marks	2

g	<p>This table gives some key values which might be seen – the table goes over two pages</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; padding: 5px;">Aspect</th><th style="text-align: center; padding: 5px;">1 mark</th><th style="text-align: center; padding: 5px;">2 marks</th></tr> </thead> <tbody> <tr> <td style="padding: 10px;">IR: Identification of relevant information</td><td style="padding: 10px;"> One numerical factor mentioned from: <ul style="list-style-type: none"> – Octave (either width 194.5mm or number of octaves 9) – Keys (either width 23mm or number 63-66) – Arm span 1.65m – Width of the piano as shown 148cm – Room/door size (eg. average room 3x4) – Human hearing 20HZ to 20 000HZ </td><td style="padding: 10px;">More than one numerical factor mentioned</td></tr> <tr> <td style="padding: 10px;">CM: Calculation of measurements including width</td><td style="padding: 10px;"> Relevant calculation without mentioning gaps or extra width Example: Calculating the number of keys ie $52 + 2 \times 7$ Accept answer is in the range 63-66 OR Calculating the width of the piano keys $(63-66) \times 23$ ACCEPT any reasonable value </td><td style="padding: 10px;"> Calculating width including gap or adding extra width Examples: 9×194.5 9 octaves and includes gap between keys gap width: $(194.5 - 8 \times 23) / 7$ or 8 gaps = $1.5 / \dots$ mm $Key + its\ gap = 23 + 1.5 = 24.5$ Hence width = $66 \times 24.5 + 1.5$ (1 extra gap at the end) = 1618.5 mm OR Calculating extra width at the end in the original piano: In normal piano of width 1480mm there are 52 keys so extra width both sides is $1480 - (52 \times 24.5 + 1.5) = 204.5$ mm So the 66 keys piano needs to be 1618.5 mm + 204.5 = 1823mm </td></tr> <tr> <td style="padding: 10px;">JD: Justification of degree of accuracy</td><td style="padding: 10px;">Rounding used in any element</td><td style="padding: 10px;">Justifies their choice of rounding</td></tr> <tr> <td style="padding: 10px;">PD: Practicality of new design</td><td style="padding: 10px;"> Limited argument: Some examples: Not acceptable because people are used to smaller pianos Acceptable as it will include all octaves that people can hear </td><td style="padding: 10px;"> Justified argument Some examples: Referring to price in anyway: Not acceptable because the added octaves will increase the price of the machine and at the same time 2 octaves will not add much Referring to the difference in width between normal piano and this one in any way: Acceptable because the added width will be only about 30 cm which can fit in a standard room width </td></tr> <tr> <td style="padding: 10px;">QD: Quality of overall discussion (Holistic judgement on the whole response)</td><td style="padding: 10px;">Limited discussion</td><td style="padding: 10px;">Balanced discussion</td></tr> </tbody> </table>	Aspect	1 mark	2 marks	IR: Identification of relevant information	One numerical factor mentioned from: <ul style="list-style-type: none"> – Octave (either width 194.5mm or number of octaves 9) – Keys (either width 23mm or number 63-66) – Arm span 1.65m – Width of the piano as shown 148cm – Room/door size (eg. average room 3x4) – Human hearing 20HZ to 20 000HZ 	More than one numerical factor mentioned	CM: Calculation of measurements including width	Relevant calculation without mentioning gaps or extra width Example: Calculating the number of keys ie $52 + 2 \times 7$ Accept answer is in the range 63-66 OR Calculating the width of the piano keys $(63-66) \times 23$ ACCEPT any reasonable value	Calculating width including gap or adding extra width Examples: 9×194.5 9 octaves and includes gap between keys gap width: $(194.5 - 8 \times 23) / 7$ or 8 gaps = $1.5 / \dots$ mm $Key + its\ gap = 23 + 1.5 = 24.5$ Hence width = $66 \times 24.5 + 1.5$ (1 extra gap at the end) = 1618.5 mm OR Calculating extra width at the end in the original piano: In normal piano of width 1480mm there are 52 keys so extra width both sides is $1480 - (52 \times 24.5 + 1.5) = 204.5$ mm So the 66 keys piano needs to be 1618.5 mm + 204.5 = 1823mm	JD: Justification of degree of accuracy	Rounding used in any element	Justifies their choice of rounding	PD: Practicality of new design	Limited argument: Some examples: Not acceptable because people are used to smaller pianos Acceptable as it will include all octaves that people can hear	Justified argument Some examples: Referring to price in anyway: Not acceptable because the added octaves will increase the price of the machine and at the same time 2 octaves will not add much Referring to the difference in width between normal piano and this one in any way: Acceptable because the added width will be only about 30 cm which can fit in a standard room width	QD: Quality of overall discussion (Holistic judgement on the whole response)	Limited discussion	Balanced discussion
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10																			

7	a	<ul style="list-style-type: none"> •¹ $24+6$ or $30(m)$ •² $30(cm)$ etc 	<ul style="list-style-type: none"> •¹ Accept not seeing this step •² 30 cm without working award 2 marks 	2
	b	<ul style="list-style-type: none"> •¹ $24 \div 9$ •¹ 2.66666666666 (m/cm) •³ 2.7 	<ul style="list-style-type: none"> •² 2.66 or 2.67 (m/cm) without working award 1 mark •³ 2.7 (m/cm) without working award 2 marks 	3
	c	<ul style="list-style-type: none"> •¹ use of a trigonometric function /rule correctly •² correct rearrangement of their trigonometric function •³ calculating their value of d •⁴ round their 2.03... to the nearest cm 	<ul style="list-style-type: none"> •¹ e.g. $\tan(53) = \frac{2.7}{d}$ Accept not seeing this step •² e.g. $\frac{2.7}{\tan(53)}$ seen •³ $d = 2.03 \dots$ •⁴ 2 with 1 correct algebraic step: award 4 marks •⁴ 2 without working: award 3 marks •⁴ 2.03 without working: award 2 marks 	4
	d	<ul style="list-style-type: none"> •¹ for subtracting from 55.3 •² for multiplying by 8 •³ their 22.82 or 23.3 	<ul style="list-style-type: none"> •¹ Attempt to subtract at least one depth d from 55.3 •² Award 2 marks if: $55.3 - 8 \times 2 \times \text{their } 2$ $55.3 - 16 \times \text{their } 2$ $55.3 - 32$ •³ 22.82 or 23.3 without working award 2marks 	3

For candidates that do not apply the scale 1:100 treat as a misread **MR** on the first occasion

ECF can be awarded so candidates can gain full marks for subsequent working

The final answer for 7a) 7b) 7c) should be in the answer box. If there is not a value in the answer box, award marks for final answers in the response box

		Aspect	1 mark	2 marks	
e	Identify the relevant information required	Identify one of the following: Total measurements of the model Volume of the model Elements of the pyramid (temple and platform) the scale 1:100 Practicality of the size of the model	Identify more than one of the following: Total measurements of the model Volume of the model Elements of the pyramid (temple and platform) the scale 1:100 Practicality of the size of the model		
	Consider the degree of accuracy	Consideration the implication of the degree of accuracy on the given values. Examples: Recognizing that the lengths given to the nearest cm Recognizing that the angles given to one decimal place	Consideration the implication of the degree of accuracy on the calculated values. Examples: $2.7 \times 9 + 6 = 30.3$ and not 30cm (2.5 instead of 2.7 we get $2.5 \times 9 + 6 = 28.5$ which is far from 30 or 3cm instead of 2.7 we get $3 \times 9 + 6 = 33$ which is far from 30) The width of first platform 55.3cm while it could be 55 and in this case 9 th platform 55- $2 \times 2 \times 8 = 23$ cm The width of 9 th platform could be 23 cm instead of 23.3 and in this case the 1 st platform 55cm Recognizing the difficulty of using a model with dimensions more accurate than nearest mm because of measuring tools available		
	Comment on the validity	Comment not supported with evidence. Examples: The model will be close enough to look like the real pyramid The model was calculated with correct mathematical steps so it is valid	Comment supported with evidences. Examples: The model is practical and referring to overall size (height being about 30, width being about 50 cm) and can be carried/placed on a table easily The model is not very valid because the total height needs to be to the nearest mm like the height of the platform (27 mm). this will lead to inaccurate angles compared to real pyramid The erosion had an effect on the real pyramid and this is not taken into account in the model		

Task 3

Answers			Notes	Total
8	a	• ¹ student shows correct method for averaging AG • ² 8	• ¹ Averaging values • ² Correct limit	2
	b	• ¹ two correct from p=5 q=6 r=7 • ² all three correct	• ¹ Award 1 mark for two correct values	2
	c	• ¹ one correct pattern • ² another different correct pattern	For example Column A increases by 3 or multiples of 3 Column L increase by 1 Divide column <i>a</i> by 3 and then add 2 Adding <i>a</i> and <i>b</i> gives the next <i>a</i> <i>L</i> equals <i>a</i> minus 2 two times the row Accept column <i>b</i> are the same / all 3 Accept any correct pattern written algebraically	2
	d	• ¹ any correct working leading to the general rule • ² any correct arrangement of $L = \frac{1}{3}a + 2$	examples $L = \frac{1}{3}a + \text{any value}$ or $L = \text{any value of } a + 2$ or describing in words • ² Both terms correct: award 2 marks SC Accept correct rule involving <i>a</i> , <i>L</i> and the row number: award 2 marks	2

Mark holistically			
	Strand	Holistic markscheme	Mark band
e	Discover patterns DIS:	Nothing from below	0
	Describe patterns DES:		
	Prove, verify, justify PVJ:		
	Discover patterns DIS:	One prediction made	1 - 3
	Describe patterns DES:	Attempt to describe a pattern in words	
	Prove, verify, justify PVJ:		
	Discover patterns DIS:	More than one prediction made	4 - 6
	Describe patterns DES:	A pattern correctly described in words	
	Prove, verify, justify PVJ:	Attempt to test their described pattern	
	Discover patterns DIS:	More than one prediction made	7 - 9
	Describe patterns DES:	A pattern described as suggested general rule consistent with some of the findings	
	Prove, verify, justify PVJ:	Their general rule is tested correctly	
	Discover patterns DIS:	More than one prediction made	10 - 12
	Describe patterns DES:	A pattern described as correct general rule consistent with findings	
	Prove, verify, justify PVJ:	A general rule is fully proved or verified and justified	
SC More than one prediction made with constant value for column A without any pattern description award 3 marks Patterns need to refer to a relation involving a b and L Predictions could be seen in the table or in the answer box			
12			

Exemplification

The candidates can populate the table using the simulator.

Candidates who restrict themselves to the pattern shown can only discover simple patterns e.g.

For L in terms of row number [$L=n+3$] **and** a in terms of row number [$a = 3(n+1)$]. Simple patterns can only gain credit up to Mark band 7–9.

Candidates who use the simulator to vary a and b will be able to describe more complex patterns and find $\frac{1}{3}a + \frac{2}{3}b$.

Using random values of a and b will probably not prove useful. Some systematic approach will be more helpful. Here are some examples.

Candidates keep the same a values and change b – they will soon see that multiples of 3 are better to use.

a	b	L
3	6	5
6	6	6
9	6	7
12	6	8

They might write down a rule and test it again using the simulator.

They might try $b = 0$

a	b	L
3	0	1
6	0	2
9	0	3
12	0	4

Candidates need to use other a values. They might keep a constant and vary b . And again put $a = 0$

a	b	L
3	3	3
3	6	5
3	9	7
3	12	9

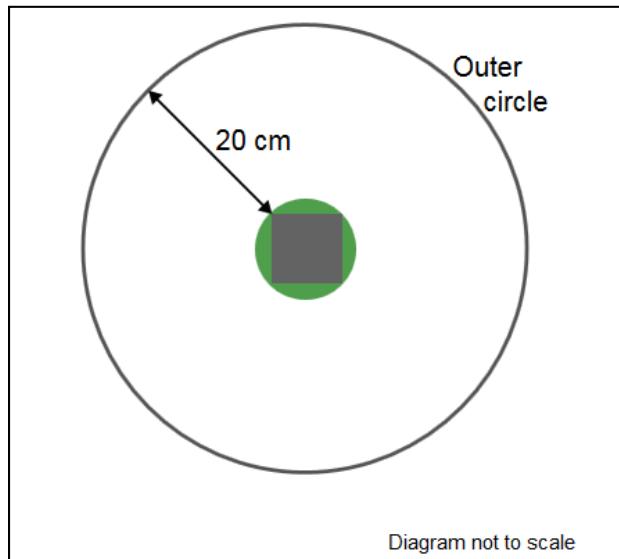
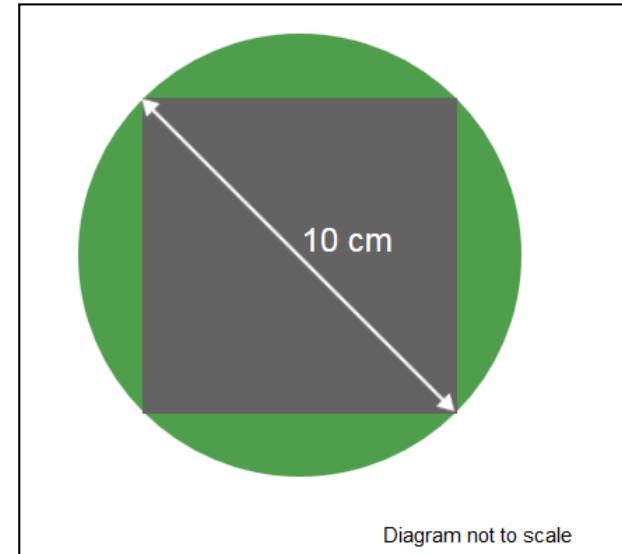
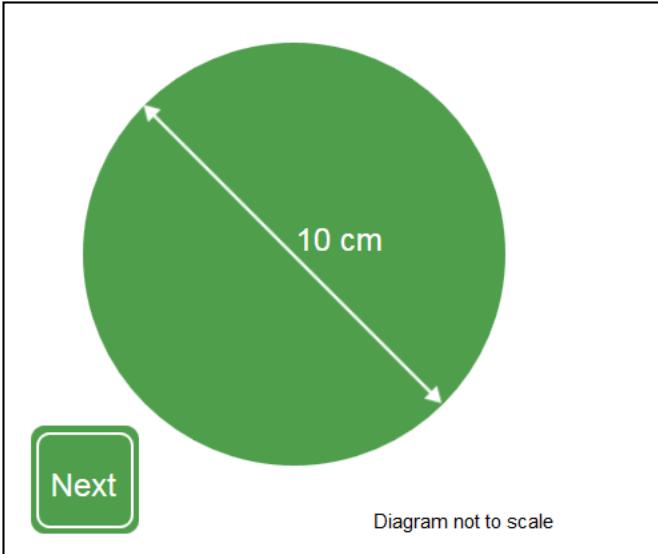
a	b	L
0	3	2
0	6	4
0	9	6
0	12	8

9	a	• an explanation	$(a+b) \div 2 = \frac{1}{2}a + \frac{1}{2}b$ or an equivalent written explanation	1																																									
	b	• ¹ 32 in denominator for 7 th term • ² both numerators correct for 7 th term • ³ 64 in denominator for 8 th term • ⁴ both numerators correct for 8 th term	Accept coefficients only i.e. no sight of a and b $\frac{11}{32}a$ and $\frac{21}{32}b$ or $11/32a$ and $21/32b$ $\frac{21}{64}a$ and $\frac{43}{64}b$ or $21/64a$ and $43/64b$	4																																									
	c	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; padding: 5px;">Strand</th> <th style="text-align: center; padding: 5px;">Holistic markscheme</th> <th style="text-align: center; padding: 5px;">Mark band</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">Describe patterns DES:</td> <td style="padding: 5px;">Nothing from below</td> <td style="text-align: center; padding: 5px;">0</td> </tr> <tr> <td style="padding: 5px;">Prove, verify, justify PVJ:</td> <td style="padding: 5px;"></td> <td style="text-align: center; padding: 5px;"></td> </tr> <tr> <td style="padding: 5px;">Describe patterns DES:</td> <td style="padding: 5px;">Attempt to describe a pattern in words</td> <td style="text-align: center; padding: 5px;">1 - 2</td> </tr> <tr> <td style="padding: 5px;">Prove, verify, justify PVJ:</td> <td style="padding: 5px;"></td> <td style="text-align: center; padding: 5px;"></td> </tr> <tr> <td style="padding: 5px;">Describe patterns DES:</td> <td style="padding: 5px;">A pattern correctly described in words</td> <td style="text-align: center; padding: 5px;">3 - 5</td> </tr> <tr> <td style="padding: 5px;">Prove, verify, justify PVJ:</td> <td style="padding: 5px;">Attempt to test their described pattern</td> <td style="text-align: center; padding: 5px;"></td> </tr> <tr> <td style="padding: 5px;">Describe patterns DES:</td> <td style="padding: 5px;">A pattern described as suggested general rule consistent with some of the findings</td> <td style="text-align: center; padding: 5px;">6 - 9</td> </tr> <tr> <td style="padding: 5px;">Prove, verify, justify PVJ:</td> <td style="padding: 5px;">Their general rule is tested correctly</td> <td style="text-align: center; padding: 5px;"></td> </tr> <tr> <td style="padding: 5px;">Describe patterns DES:</td> <td style="padding: 5px;">A pattern described as correct general rule consistent with findings</td> <td style="text-align: center; padding: 5px;">10 - 12</td> </tr> <tr> <td style="padding: 5px;">Prove, verify, justify PVJ:</td> <td style="padding: 5px;">A general rule is verified or justified</td> <td style="text-align: center; padding: 5px;"></td> </tr> <tr> <td style="padding: 5px;">Describe patterns DES:</td> <td style="padding: 5px;">A pattern described as correct general rule consistent with findings</td> <td style="text-align: center; padding: 5px;">13 - 14</td> </tr> <tr> <td colspan="4" style="padding: 5px;">SC Pattern needs to refer to the coefficients of a and b</td><td style="text-align: center; padding: 5px;">14</td></tr> </tbody> </table>				Strand	Holistic markscheme	Mark band	Describe patterns DES:	Nothing from below	0	Prove, verify, justify PVJ:			Describe patterns DES:	Attempt to describe a pattern in words	1 - 2	Prove, verify, justify PVJ:			Describe patterns DES:	A pattern correctly described in words	3 - 5	Prove, verify, justify PVJ:	Attempt to test their described pattern		Describe patterns DES:	A pattern described as suggested general rule consistent with some of the findings	6 - 9	Prove, verify, justify PVJ:	Their general rule is tested correctly		Describe patterns DES:	A pattern described as correct general rule consistent with findings	10 - 12	Prove, verify, justify PVJ:	A general rule is verified or justified		Describe patterns DES:	A pattern described as correct general rule consistent with findings	13 - 14	SC Pattern needs to refer to the coefficients of a and b			
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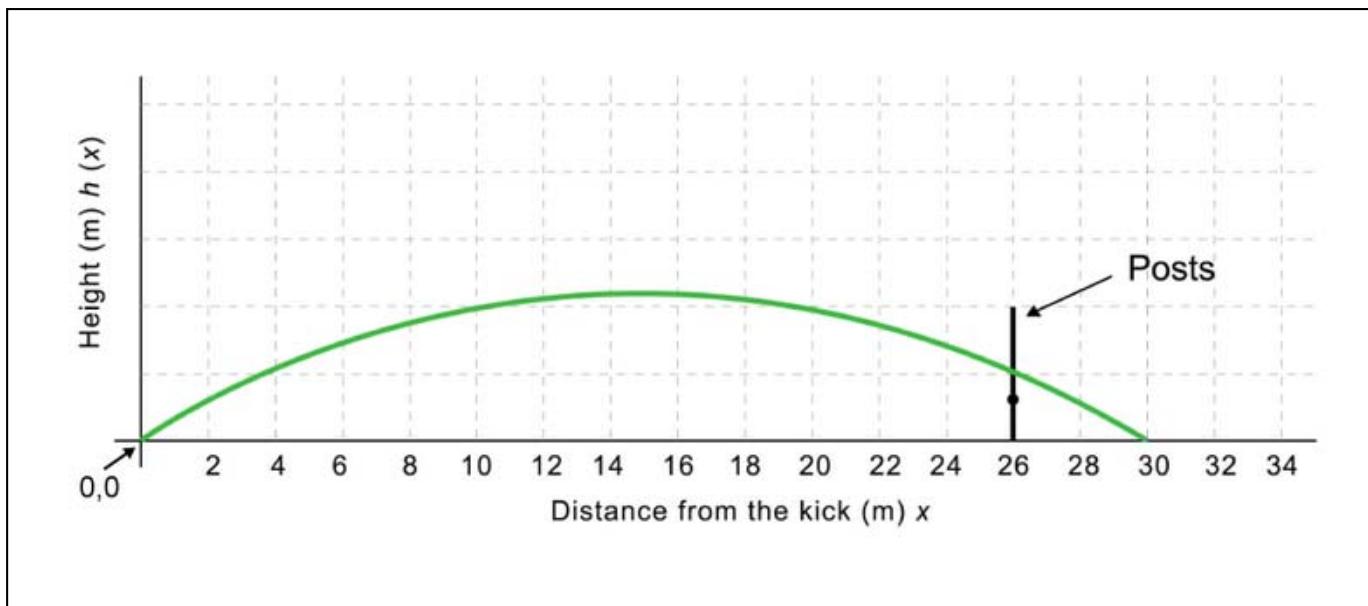
	<p>Exemplification Candidates may look at their developing table and find simple and more complex patterns. Examples of patterns</p> <p>The denominators go 1, 2, 4, 8, 16, 32, ... The denominators are 2^n The numerators always add to give the denominator e.g. $5 + 11 = 16$ The coefficients always add to give 1 The coefficient of a is always smaller than that of b</p> <p>The coefficient of a is always nearly half that of b The numerators go 1, 3, 5, 11, 21, 43, 87, ... starting at term 3 The rule for the numerator of b is double the numerator of a and then add or subtract 1 The numerators always add to the denominator The numerator of b is the numerator of a plus twice the previous numerator of a</p>	
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Appendices

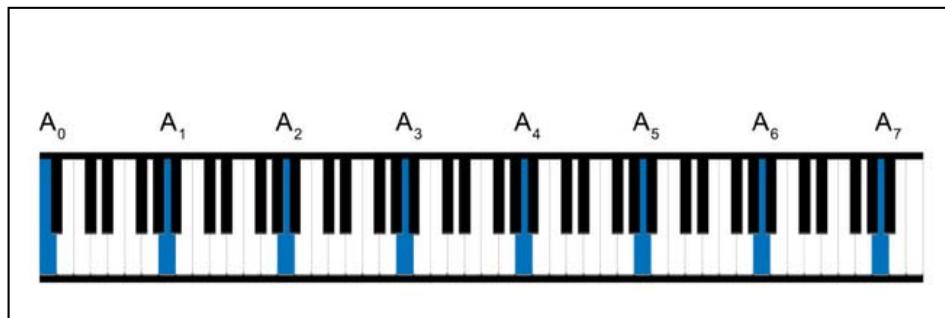
Question 4



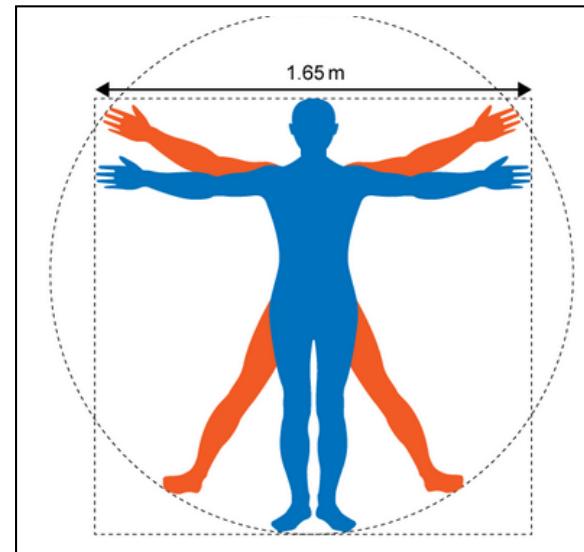
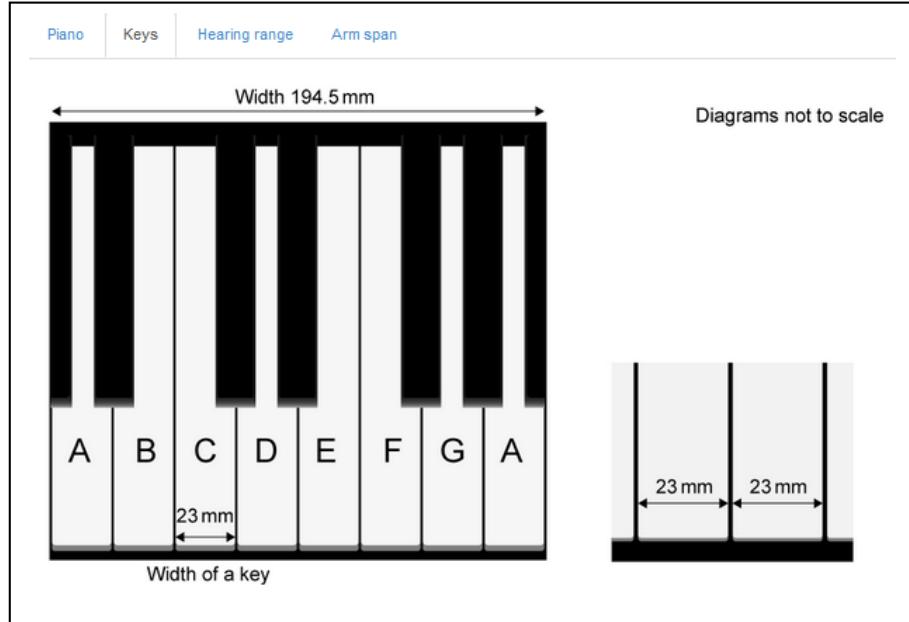
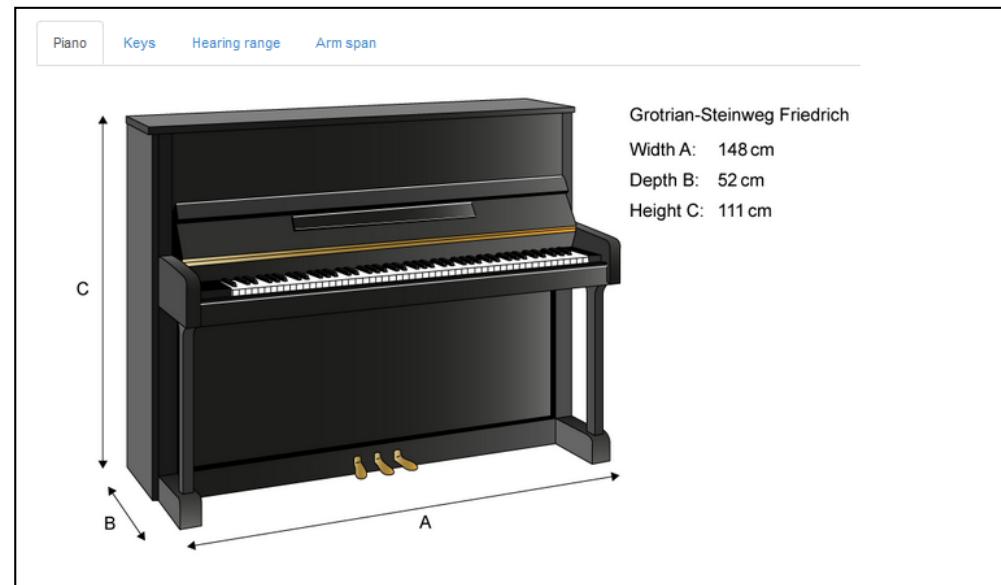
Question 5



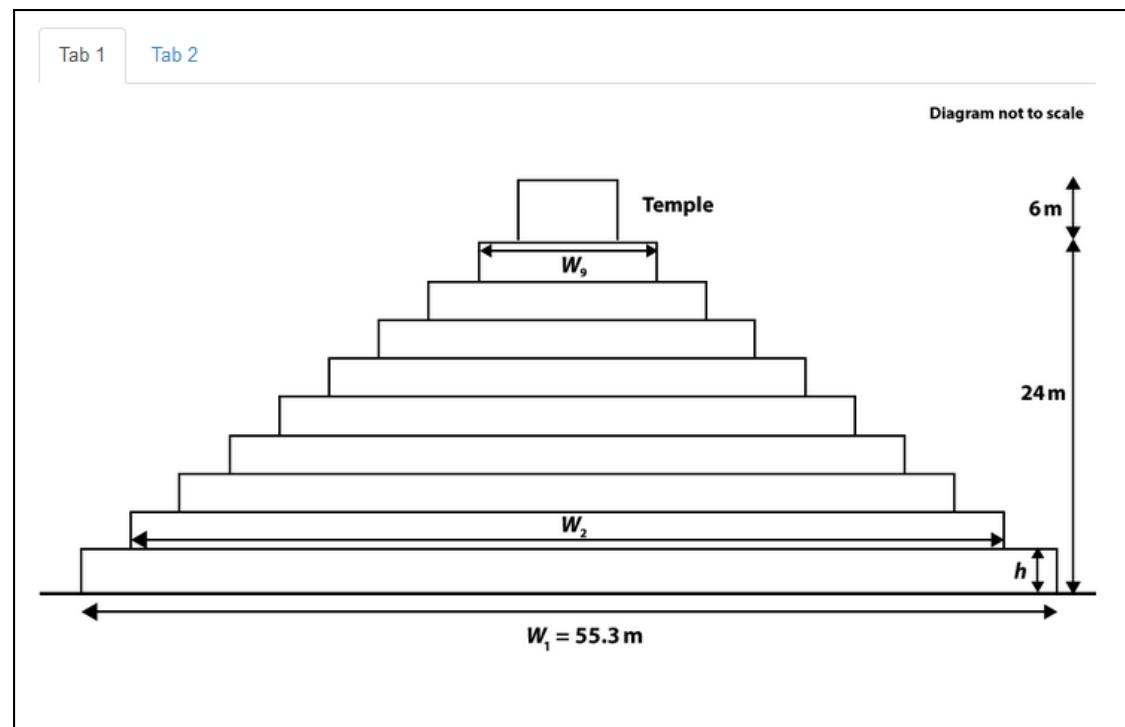
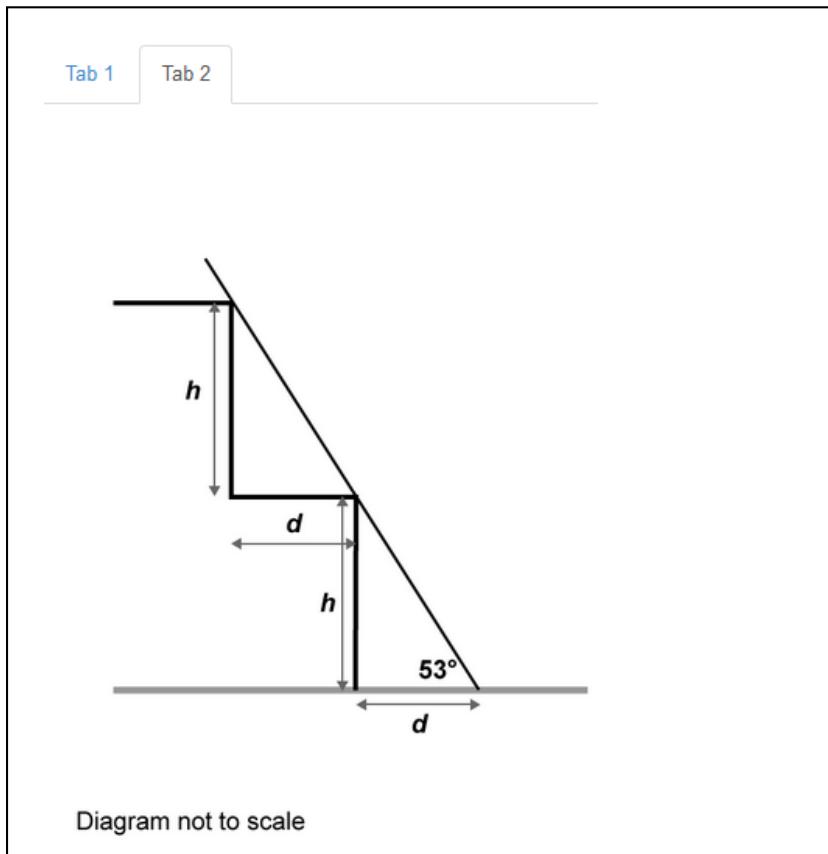
Question 6



Humans can only hear between 20 and 20 000 Hertz.



Question 7



Markscheme

May 2024

Mathematics

On-screen examination

44 pages

This markscheme is **confidential** and for the exclusive use of examiners in this examination session.

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The markscheme may make use of the following abbreviation: OE – ‘or equivalent’

The markscheme abbreviations:

- 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 and 49 seen OE Ex: $49 = 45 + x$.2	2

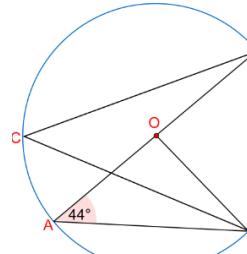
Error Carried Forward (ECF) marks

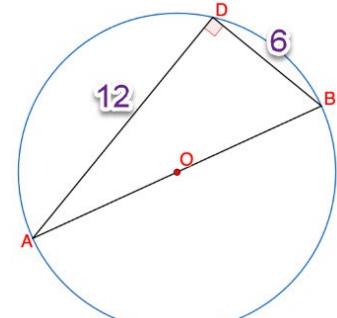
Errors made at any step of a solution affect all working that follows. In general, **Error Carried Forward (ECF)** marks are awarded after an error.

- 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 considered an error that allows ECF afterwards even if the rest of the question requires “the” result and not “their” result.

General notes

- a) As this is an international examination, accept all **alternative forms of notation**, for example 1,9 as 1.9 ; 1,000 or 1.000. However, **DO NOT ACCEPT** incorrect mathematical notation x^2 for x^2 unless noted otherwise in the MS.
- b) **ACCEPT** notation errors in intermediate steps.
- c) Unless noted otherwise, ignore further working after a correct answer even if further working is incorrect.
- 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 0.5 or $2 \div 4$; $\frac{x}{2}$ or $x/2$ or $x \div 2$; 0.23 or 23%
- 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. However, it indicates what the candidate's result represents. Ex: if last mark is for the result: (AB)=5; this means we award the mark for seeing 5 as the result of calculating AB without necessarily seeing AB=5, but it does not mean we award the mark for seeing 5 representing another length.
- 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 or the fraction line missing.
- 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) Unless noted otherwise, **ACCEPT** using the correct values or working regardless their previous result.
- m) Candidates will sometimes use methods other than those in the markscheme. Unless the question specifies a method, other correct methods should be marked in line with the markscheme. **If in doubt, contact your team leader for advice.**
- n) Unless noted otherwise, if a note in a part says to accept the answer without working for 1 mark less than total marks, then seeing the correct answer with any acceptable working step, award full marks. Example: If the note in a part worth 3 marks says “4.3(3...) without working award 2 marks”, then seeing any acceptable working step and seeing 4.3(3...) as the answer award the 3 marks.
- o) For “**show that**” questions, unless otherwise noted, every bullet point has to be seen in order to be awarded.
- p) When a result is written as “their 5.7(37...)” it means accept their result if its minimum accuracy is 1 dp. Providing higher accuracy is of course accepted but not required. Rounding their result incorrectly to nearest 1 dp is not accepted.
- q) When there are multiple alternative methods (multiple AM), mark the response using one specific AM. Do not add different marks from different AM.

Q1		Answers	Notes	Total
	a	Angle AOD 92 Angle DOB 88 Angle DCB 44	<p>Angle AOD 92 °</p> <p>Angle DOB 88 °</p> <p>Angle DCB 44 °</p> 	3
	b	The correct reason	<p>ACCEPT (AB) diameter, passes by the centre, $AB=2r$ A, O, and B are on the same line semi-circle, half circle (angle) ADB is half (angle) AOB WTTE</p> <p>DO NOT ACCEPT seeing only 90 is half 180 O is midpoint, OA and OB are radius AB doesn't move regardless how we move D Triangle inside a circle A and B positioned at both ends</p>	1

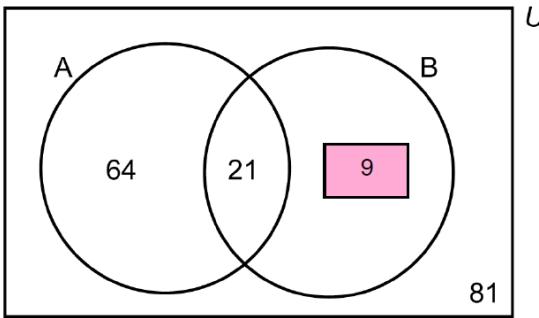
	c	<p>.1 correctly substitute into Pythagoras theorem .2 correctly write the result in simplified surd form</p>	 <p>.1 $(AB^2 =) 12^2 + 6^2$ or 180 or $\sqrt{180}$ or $3\sqrt{20}$ OE .1 ACCEPT 13.(416...)</p> <p>.2 $6\sqrt{5}$ ACCEPT $6\sqrt{3}$ only if their bp1 is $12^2 - 6^2$ or 108 or $\sqrt{108}$</p>	2
	d	<p>.1 correctly substitute their radius as half their diameter from c) into area of circle formula .2 correctly calculate their area after squaring their radius seen in bp1 and multiplying by π</p>	<p>.1 $\pi \times \left(\frac{\text{their } 6\sqrt{5}}{2}\right)^2$ or $\pi \times (\text{their } 3\sqrt{5})^2$ or $\pi \times \left(\frac{\text{their } (13.416...)}{2}\right)^2$ or $\pi \times \text{their } 6.5^2$ OE .1 ACCEPT using 3.14 or $\frac{22}{7}$ instead of π</p> <p>.2 $\text{their } 45\pi$ ACCEPT $\text{their } 141.37...$.2 ACCEPT their result using 3.14 or $\frac{22}{7}$ instead of π</p>	2

(See important examples next page)

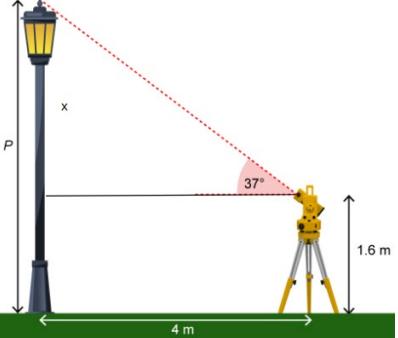
Important examples showing concepts of marking that can be applied in all your marking

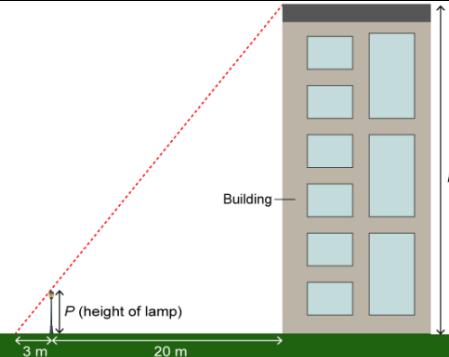
Part	Student work	Marking
1c	$\sqrt{180} = 6\sqrt{5} = 14$	<p>bp1 awarded because we see $\sqrt{180}$</p> <p>bp2 awarded because we see $6\sqrt{5}$ and we ignore further working (see point c in general notes)</p>
1d	$\pi 7^2 = 154$	<p>bp1 not awarded because their diameter from c) is $6\sqrt{5}$ (and this is what they were awarded the mark for in their 1c) So only $\pi \times (3\sqrt{5})^2$ or $\pi \times (6.7(08\dots))^2$ as their radius would be accepted in this case)</p> <p>bp2 awarded because they correctly calculate their area after squaring their radius seen in bp1 and multiplying by π and their result is correct to nearest whole number since we ACCEPT their 141(.37...)</p>

Part	Student work	Marking
1c	$12 + 6 = 18$	<p>bp1 not awarded because they are not adding 12^2 to 6^2</p> <p>bp2 not awarded because the result is not $6\sqrt{5}$</p>
1d	$3.14 \times 9^2 = 255$	<p>bp1 awarded because their diameter from c) is 18 so 9 here is their radius and we accept using 3.14 instead of π</p> <p>bp2 not awarded because for their result we accept only 254.34 or 254.3 or 254 since we ACCEPT their 141(.37...)</p>

Q2		Answers	Notes	Total
	a	Correctly write ($K=$) 9 on the diagram		1
	b	Correct description of K in context	ACCEPT Performer(s) (that are, but, and) not academy/students Performer(s) excluding academy/students Performer(s) exclusively Performer(s) regardless academy/students Performer(s) only (DO NOT ACCEPT students who perform only) ACCEPT using "present at the show" or "presenter" or "participate in the show" or "artist" instead of Performer	1
	c	.1 Correctly write 21 in numerator OR correct denominator from their part a) .2 Correctly write their probability from their part a)	.1 21 in numerator OR $21+9$ in denominator .2 $\frac{21}{30}$ or their 0.7 OE	2

	d	<p>.1 Correct probability of first person from their part a)</p> <p>.2 Correctly write their three probabilities without replacement OR multiply their three probabilities with replacement</p> <p>.3 Correctly multiply their three probabilities without replacement</p>	<p>.1 $\frac{21+\text{their}9}{175}$ OE or 0.17(14...)</p> <p>.2 their $\frac{30}{175}$, their $\frac{29}{174}$, their $\frac{28}{173}$ OR their $\frac{30}{175} \times$ their $\frac{30}{175} \times$ their $\frac{30}{175}$ OE</p> <p>.2 ACCEPT applying without replacement on only numerator or only denominator, <u>only if they multiply</u> their three probabilities</p> <p>Ex: their $\frac{30}{175} \times$ their $\frac{29}{175} \times$ their $\frac{28}{175}$</p> <p>.3 their $\frac{24360}{5267850}$ or their $\frac{4}{865}$ or their 0.0046(2...) OE</p> <p>.3 ACCEPT 0.005 only if bp2 is awarded without replacement</p>	3
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Q3	Answers	Notes	Total
a	<p>.1 Correctly substitute into trig ratio</p> <p>.2 Correct value of x</p> <p>.3 Correct result after adding their <u>bp2</u> to 1.6</p>	 <p>.1 $\tan 37 = \frac{x}{4}$ OR $(x =) 4 \tan 37$ OR $\tan 53 = \frac{4}{x}$ OR $(x =) \frac{4}{\tan 53}$ OR $\frac{x}{\sin 37} = \frac{4}{\sin 53}$ OR $(x =) \frac{4 \sin 37}{\sin 53}$ OE</p> <p>.1 ACCEPT $\left(\frac{4}{\cos 37}\right)^2 - 4^2$ OE</p> <p>.2 (x=)3.(0142...)</p> <p>.2 ACCEPT only if bp1 is awarded</p> <p>.2 ACCEPT not seeing this step</p> <p>.2 ACCEPT value in cm</p> <p>.3 $(1.6 + \text{their } 3.0142...) = \text{their } 4.6(1...)$</p> <p>.3 ACCEPT only if their 3.(01) is positive</p>	3

<p>b</p> <p>AM1 (using similarity ratio)</p> <p>.1 Correct ratio of similarity seen</p> <p>.2 Correctly apply their similarity ratio on their4.6 from a)</p> <p>.3 Correctly calculate their height of building after correctly rearranging their similarity ratio</p> <p>.4 Correctly round their height of building to the nearest metre</p>	 <p>AM1 (using similarity ratio)</p> <p>.1 $\left(\frac{H}{\text{their}4.6}\right) = \frac{23}{3}$ OE or $\left(\frac{\text{their}4.6}{H}\right) = \frac{3}{23}$ ACCEPT seen in the working or implied</p> <p>.2 $(H =) \text{their}4.6 \times \frac{\text{their}23}{3}$ OE</p> <p>.2 ACCEPT applying their ratio correctly on hypotenuse and substitute correctly into Pythagoras. Ex: $(H^2 =) \left(\frac{\text{their}23}{3} \times \sqrt{\text{their}4.6^2 + 3^2}\right)^2 - 23^2$ OE</p> <p>.3 $(\text{their}4.6 \times \frac{\text{their}23}{3}) = \text{their}35.3(75\dots)$ ACCEPT not seeing this step</p> <p>.3 ACCEPT only if bp1 or bp2 is awarded</p> <p>.4 $\text{their}35$ (m)</p> <p>.4 ACCEPT only if bp1 or bp2 is awarded</p> <p>.4 ACCEPT only if their result needs rounding</p>	<p>4</p>
<p>Next page for AM2 using trigonometry</p>	<p>Next page for AM2 using trigonometry</p>	

	<p>AM2 (using trigonometry)</p> <p>.1 Correctly calculate angle in the triangle using their4.6 from a)</p> <p>.2 Correctly substitute their bp1 into the correct trig ratio</p> <p>.3 Correctly calculate their height of building after correctly rearranging their trig ratio</p> <p>.4 Correctly round their height of building to the nearest metre</p>	<p>AM2 (using trigonometry)</p> <p>.1 ($\theta = \tan^{-1}(\frac{\text{their4.6}}{3})$) or their57</p> <p>.1 ACCEPT ($\theta = \tan^{-1}(\frac{3}{\text{their4.6}})$) or 33 ACCEPT [33 , 33.2[</p> <p>.2 $\tan \text{their57} = \frac{H}{23}$ or $\tan \text{their33} = \frac{23}{H}$ or $\frac{H}{\sin \text{their57}} = \frac{23}{\sin \text{their33}}$ OE</p> <p>.2 ACCEPT ($H = 20 \tan \text{their57} + \text{their4.6}$)</p> <p>.2 DO NOT ACCEPT $\tan 37 = \frac{H}{23}$ or $\frac{\sin 37}{\sin 53} = \frac{H}{23}$ OE or $20\tan37 +\text{their4.6}$ OE</p> <p>.3 (23 x $\tan \text{their57} =$) their35.3(75...) ACCEPT not seeing this step</p> <p>.3 ACCEPT their result using their57 or their33 being correctly rounded to a whole number</p> <p>.3 ACCEPT only if their trig ratio is exact or at least 2 dp.</p> <p>.3 ACCEPT only if bp1 or bp2 is awarded.</p> <p>.4 their35 (m)</p> <p>.4 ACCEPT only if bp1 or bp2 is awarded</p> <p>.4 ACCEPT only if their result needs rounding</p>
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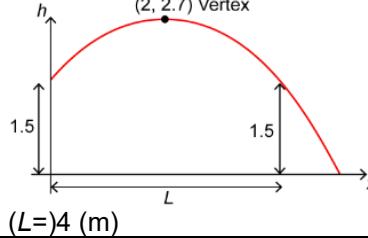
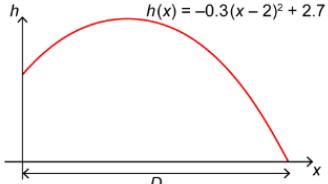
Q4		Answers	Notes	Total
	a	<p>AM1 (solving quadratic)</p> <p>.1 Correctly rearrange and simplify the quadratic on one side</p> <p>.2 Correctly factorize their quadratic from bp1 OR substitute their coefficients into quadratic formula OR correctly write both solutions of their quadratic</p> <p>.3 Correctly identify both of the x values</p>	$x^2 + x - 4 = 1 - 3x$ <p>AM1 (solving quadratic)</p> <p>.1 $x^2 + 4x - 5 (= 0)$ or $-x^2 - 4x + 5 (= 0)$</p> <p>.2 their $(x + 5)(x - 1) (= 0)$ OR their $\frac{-4 \pm \sqrt{4^2 - 4 \times 1 \times -5}}{2}$ OE</p> <p>.2 ACCEPT one notation mistake in substitution Ex: with their coefficients $\frac{-4 + \sqrt{4^2 - 4 \times 1 \times -5}}{2}$ or $\frac{-4 \pm \sqrt{4^2 - 4 \times 1 \times 5}}{2}$ OE</p> <p>.2 ACCEPT their simpler quadratic, $ax^2 + c = 0$ or $ax^2 + bx = 0$, only if they solve it correctly Ex: if their bp1 is $x^2 - 5 = 0$ and they correctly write solutions $(x =) \sqrt{5}$ and $(x =) -\sqrt{5}$</p> <p>.2 ACCEPT 1.56(...) <u>and</u> -2.56(...)</p> <p>.2 DO NOT ACCEPT their $(x + 5)(x - 1) (= 0)$ OR their $\frac{-4 + \sqrt{4^2 - 4 \times 1 \times -5}}{2}$ if we don't see their quadratic</p> <p>.2 The correct bp2 implies bp1: $(x + 5)(x - 1) (= 0)$ or $\frac{-4 \pm \sqrt{4^2 - 4 \times 1 \times -5}}{2}$ OE</p> <p>.3 $(x =) -5$ and $(x =) 1$</p> <p>ACCEPT seeing any part a) bp in their response box of part b) but stamp SC in part a)</p>	3

Next page for AM2 numbers trials

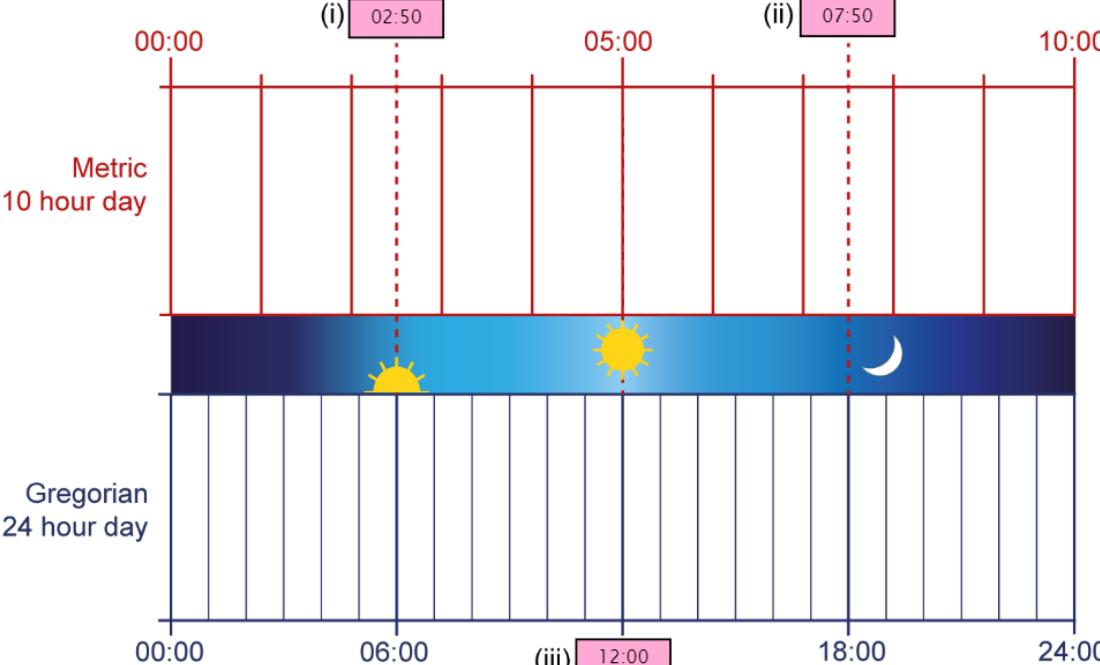
Next page for AM2 numbers trials

		<p>AM2 (numbers trials)</p> <p>.1 Correctly substitute 1 into f(x) and g(x) .2 Correctly substitute -5 into f(x) and g(x) .3 Correctly identify both of the x values</p>	<p>AM2 (numbers trials)</p> <p>.1 $1^2 + 1 - 4$ and $1 - 3 \times 1$.2 $-5^2 - 5 - 4$ and $1 - 3 \times -5$.3 $(x =) - 5$ and $(x =) 1$</p> <p>ACCEPT seeing any part a) bp in their response box of part b) but stamp SC in part a)</p>	
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	b	<p>.1 Correctly substitute their -5 or their 1 from part a) into the $f(x)$ or the $g(x)$</p> <p>.1 $1 - 3(\text{their} - 5)$ or $1 - 3(\text{their1})$ OR $(\text{their} - 5)^2 + (\text{their} - 5) - 4$ or $(\text{their1})^2 + (\text{their1}) - 4$.1 DO NOT ACCEPT just a sentence “by substituting the x values in $f(x)$ or $g(x)$” .1 ACCEPT substituting 1.56... or -2.56... into $f(x) = 1 - 3x$ but not into $g(x) = x^2 + x - 4$.1 ACCEPT substituting 1/3 OE into $g(x) = x^2 + x - 4$ but not into $f(x) = 1 - 3x$.1 DO NOT ACCEPT seeing this substitution in their response box of part a)</p> <p>.2 Correctly calculate their y-coordinate for A after substituting their -5 from part a) into the $f(x)$ or the $g(x)$.2 their16 ACCEPT only if positive .2 DO NOT ACCEPT their16 without working .2 DO NOT ACCEPT if it is the result of substituting 1.56... or -2.56... or 1/3 OE .2 ACCEPT seeing bp2 in their response box for part a) only if they identify it is y-coordinate of A</p> <p>.3 Correctly calculate their y-coordinate for B after substituting their 1 from part a) into the $f(x)$ or the $g(x)$.3 $\text{their } -2$ ACCEPT only if negative .3 DO NOT ACCEPT their-2 without working .3 DO NOT ACCEPT if it is the result of substituting 1.56... or -2.56... or 1/3 OE .3 ACCEPT seeing bp3 in their response box for part a) only if they identify it is y-coordinate of B</p>	3
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Q5		Answers	Notes	Total
	a	Correct value of L		1
	b	.1 Correctly substitute $h = 1.5$ and $x = 0$ or 4 .2 Correctly rearrange for a on one side AG -0.3	.1 $1.5 = a(0 - 2)^2 + 2.7$ or $1.5 = a(-2)^2 + 2.7$ or $1.5 = a(4 - 2)^2 + 2.7$.2 $(a =) \frac{-1.2}{4}$.2 ACCEPT $(a =) \frac{1.5 - 2.7}{4}$ or $4a = 1.5 - 2.7$.2 ACCEPT $-1.2 = 4a$	2
	c	AM1 .1 Correctly substitute 0 into the equation .2 Correct rearrangement for $(D - 2)^2$ on one side .3 Correctly square root their both sides of their quadratic in bp2 .4 Correctly identify the value of D as 5	ACCEPT using x or any symbol instead of D  AM1 .1 $0 = -0.3(D - 2)^2 + 2.7$ or $0.3(D - 2)^2 - 2.7 = 0$.2 $(D - 2)^2 = \frac{2.7}{0.3}$ OE .3 $D - 2 = \pm 3$ ACCEPT $D - 2 = 3$.4 $(D =) 5$	4

	<p>AM2</p> <p>.1 Correctly substitute 0 into the equation</p> <p>.2 Correctly write the quadratic in the form $ax^2 + bx + c = 0$</p> <p>.3 Correctly factorise their quadratic or substitute correctly the coefficients of their quadratic into quadratic formula or correctly write the solution(s) of their quadratic</p> <p>.4 Correctly identify the value of D as 5</p> <p>AM3 (using numbers)</p> <p>.1 Correctly substitute a number $D \neq 5$ and correctly calculate corresponding h</p> <p>.2 Correctly substitute 5 and equate to 0</p> <p>.3 Correctly substitute another number $D \neq 5$ and correctly calculate corresponding h</p> <p>.4 Correctly identify the value of D as 5</p>	<p>AM2</p> <p>.1 $-0.3(D - 2)^2 + 2.7 = 0$ or $0.3(D - 2)^2 - 2.7 = 0$</p> <p>.2 $-0.3D^2 + 1.2D + 1.5 = 0$ or $D^2 - 4D - 5 = 0$ OE</p> <p>.3 $(D-5)(D+1)$ OR their coefficients in $\frac{-1.2 \pm \sqrt{1.2^2 - 4 \times -0.3 \times 1.5}}{2(-0.3)}$ OE</p> <p>.3 ACCEPT one notation mistake in substitution</p> <p>Ex with their coefficients: $\frac{-1.2 \pm \sqrt{1.2^2 - 4 \times -0.3 \times 1.5}}{2(0.3)}$ or $\frac{-1.2 + \sqrt{1.2^2 - 4 \times -0.3 \times 1.5}}{2(-0.3)}$</p> <p>.3 ACCEPT their simpler quadratic, $ax^2 + c = 0$ or $ax^2 + bx = 0$, only if they solve it correctly at least for the positive value Ex: if their bp2 is $0.3D^2 - 2.7 = 0$ and $D = 3$ (and/or -3)</p> <p>.4 ($D =$) 5</p> <p>AM3 (using numbers, ignore additional incorrect substitutions/calculations)</p> <p>.1 Ex: $-0.3(4 - 2)^2 + 2.7 = 1.5$</p> <p>.2 $-0.3(5 - 2)^2 + 2.7 = 0$</p> <p>.3 Ex: $-0.3(1 - 2)^2 + 2.7 = 2.4$</p> <p>.4 ($D =$) 5</p> <p>For any AM: bp2 implies bp1</p>	
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Q6	Answers	Notes	Total
6a	<p>.1 Correctly write one time</p> <p>.2 Correctly write another two times</p>	<p>ACCEPT 2:50 or 2h50 or 250 or 2.50 or 2.5 2.5:00 OE DO NOT ACCEPT 2:5 or 25 or 2:30 OE ACCEPT 7:50 or 7h50 or 750 or 7.50 or 7.5 7.5:00 OE DO NOT ACCEPT 7:5 or 75 or 7:30 OE ACCEPT 12:00 or 12h00 or 1200 or 12.00 or 12 or 12pm OE</p> 	2
6b	<p>.1 Correct number of hours in the hours box</p> <p>.2 Correct number of minutes in the minutes box</p>	<p>.1 2 in the hours box .1 ACCEPT $\frac{24}{10}$ or 2.4 OE in the hours box .1 ACCEPT 2 or 2.4 hours in the response box <u>only if the hours box is empty</u></p> <p>.2 24 in the minutes box .2 ACCEPT 24 minutes in the response box <u>only if the minutes box is empty</u></p>	2

6c		School event	Metric time	Metric seconds in standard form	
		Examination	90 minutes	9×10^3	
		School day	2 hours and 40 minutes	2.4×10^4	
		Time to run 10 kilometres	53 minutes	5.3×10^3	
		Climbing mount Kilimanjaro	4 days, 2 hours and 5 minutes	4.205×10^5	
.1	Correctly write first row	.1	9×10^3 ACCEPT 9.0×10^3		
.2	Correctly write second row	.2	2.4×10^4 ACCEPT 2.40×10^4		
.3	Correctly write third row	.3	53 min .3 ACCEPT 53.00 mins or half hour and 3 mins or 50 minutes and 300 sec OE .3 DO NOT ACCEPT without units Ex: 53		4
.4	Correctly write fourth row	.4	4.205×10^5 For bp1, bp2, and bp4 ACCEPT if the value in seconds is <u>correct</u> but written in <u>incorrect standard form</u> , and deduct only one mark from the total Do not deduct if the value incorrectly written in standard form is already 0 marks (incorrect value of seconds) Examples: 90×10^2 , 24×10^3 , 53 minutes, 4205×10^2 → Award $(1 + 1 + 1 + 1) - 1 = 3$ marks 90×10^3 , 2.4×10^4 , 5 hours and 3 minutes, 4205×10^2 → Award $(0 + 1 + 0 + 1) - 1 = 1$ mark 9×10^3 , 24×10^4 , 53 mins, 4.2×10^5 → Award $(1 + 0 + 1 + 0) - 0 = 2$ marks		

Equation	Description in words
$S + D = 160$	
$20S + 40D = 4000$	

d)

6d	.1 One correct description	<p>.1 The total number of single and double lessons (in a year) is 160 lessons WTTE .1 ACCEPT Total of lessons is 160 WTTE Total number of single and double is 160 WTTE Single and (accept +) double lessons are 160 WTTE Using the word “amount” or “count” instead of “number”</p> <p>.1 DO NOT ACCEPT essential word(s) missing or incorrect descriptions. Example: Single and double are 160 or 160 (the word number or “lessons” is missing) Total number of single and double (160 is missing) Total of single and double lessons is 160 minutes (incorrect description) One (or a) single lesson and one (or a) double lesson are 160 (incorrect description)</p>	2
	.2 The other correct description	<p>.2 The total duration for single and double lessons (in a year) is 4000 minutes WTTE .2 ACCEPT Total duration is 4000 WTTE Duration of single and double is 4000 WTTE Single and (accept +) double are 4000 minutes WTTE 20 minutes times single lessons and 40 minutes times double lessons are 4000 minutes WTTE Using the word “time” instead of “duration”</p> <p>.2 DO NOT ACCEPT essential word(s) missing or incorrect descriptions. Example: Total of single and double lessons is 4000 (the word “duration” or “minutes” is missing) Total duration of single and double (4000 is missing) Duration of 20 single lessons and 40 double lessons is 4000 minutes (incorrect description) Duration of one (or a) single lesson and one (or a) double lesson is 4000 minutes (incorrect description)</p> <p>SC for 1 mark correct description in both but they don't write 160 and 4000. Example: WTTE .1 single and double lessons AND .2 duration for single and double lessons .1 total number of lessons AND .2 total number of minutes</p> <p>SC for 1 mark correct description in both but they don't write lessons and duration Example: WTTE .1 total single and double 160 AND .2 total single and double 4000</p>	

Equation

$$\begin{array}{l} S + D = 160 \\ 20S + 40D = 4000 \end{array}$$

e)

6e	<p>.1 Correct step towards solving their equations</p> <p>.2 Correct equation in one unknown</p> <p>.3 Correctly solve for S or D</p> <p>.4 Correctly write their corresponding value of the other unknown satisfying one of the equations</p>	<p>ACCEPT using x and y instead of S and D</p> <p>.1 correct step for elimination. Example: $20S+20D=3200$ or $40S +40D = 6400$ or $S+2D=200$ or correct step for substitution. Example $S = 160 - D$ or $D = 160 - S$ or $S = 200 - 2D$ or $D = 100 - 0.5S$</p> <p>.2 Example: $20S+40(160-S)=4000$ or $20(160-D)+40D=4000$ OR $20D=800$ or $20S=2400$ OR $S = 200 - 2(160 - S)$ or $D = 100 - 0.5(160 - D)$OE</p> <p>.2 ACCEPT $D = \frac{800}{20}$OE or $S = \frac{2400}{20}$OE only if there is evidence of using elimination method</p> <p>.2 DO NOT ACCEPT substituting the separated unknown into the same equation Ex: $20 \times (200 - 2D) + 40D = 4000$ or $20S + 40(100 - 0.5S) = 4000$ OE</p> <p>.2 bp2 implies bp1</p> <p>.3 ($S =$) 120 OE OR ($D =$) 40 OE</p> <p>.4 ($S =$) their120 for their ($D =$)their40 OR ($D =$) their40 for their ($S =$)120</p> <p>.4 ACCEPT only if <u>both</u> of their120 and their40, are positive integers</p> <p>For bp3 and bp4 ACCEPT seeing values directly substituted into equations. Examples $120+40=160$ or $20 \times 120 + 40 \times 40 = 4000$ is accepted for bp3 and bp4 $130+30=160$ or $20 \times 100 + 40 \times 50 = 4000$ is accepted for bp4</p>	4
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The MYP 5 chemistry class is creating copper sulphate crystals from a solution.

It takes **one** metric day for the solution to form 2.987 grams of copper sulphate crystal.

Show that the rate of production is 2.987 milligrams per minute.

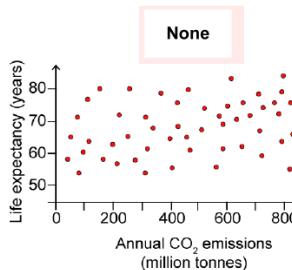
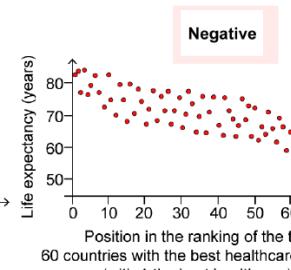
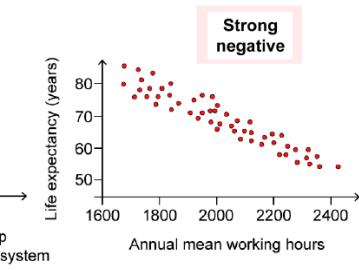
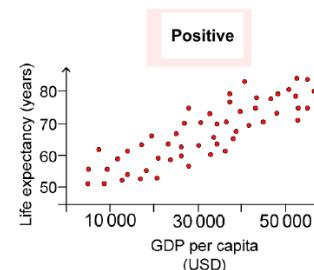
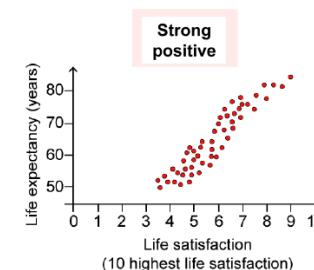
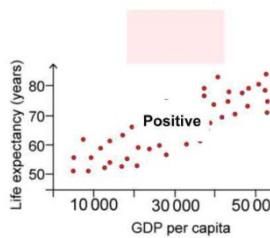
f)

<p>6f</p> <p>Correctly apply on 2.987 g per day both conversions: from g to mg and from day to minutes</p> <p>AG 2.987 (mg/min)</p>	<p>Conversions with correct mass units mentioned and divide by 1000. Example: 2987 mg (per day) and 2987/1000 OR Conversions with correct time units mentioned and multiply by 1000. Example: 0.002987 (grams) per min and 0.002987x1000</p> <p>ACCEPT</p> <p>Multiply 2.987 by 1000 and divide by 1000. Ex: $2.987 \times \frac{1000}{1000}$</p> <p>DO NOT ACCEPT any of the following to replace any part from the accepted above 2.987 mg per minute (it is the required AG) 2.987 g per day 1 day=10 hours or 1000 mins 1g=1000mg</p> <p>DO NOT ACCEPT (in any order): $\frac{2.987}{1000} = 0.002987$ g/min and 0.002987g/min=2.987mg/min (because the second part is 2.987 mg per minute AG)</p>	<p>1</p>
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Calculate the maximum number of grams that can be produced from 04:00 on Day 1 to 04:00 on Day 2. Give your answer to the nearest gram.

g)

<p>AM1</p> <p>1 Correct total duration in days OR in hours OR in minutes</p> <p>.2 Correct ratio seen in any notation or applied on their time</p> <p>.3 Correct result of 3 after the correct calculation</p> <p>AM2</p> <p>.1 Correct additional duration in days OR in hours OR in minutes</p> <p>.2 Correct ratio seen in any notation or applied on their time</p> <p>.3 Correct result of 3 after the correct calculation</p>	<p>AM1</p> <p>.1 $\frac{10.9}{10}$ or 1.09 (days) OR 10.9 (hours) OR 1090 (mins)</p> <p>.2 "if in 1 day 2.987 (g) then in their1.09 days it is or" $\frac{1}{\text{their1.09}} = \frac{2.987}{x}$ OE OR "if in 10 hours 2.987 (g) then in 10.9 it is" or $\frac{10}{\text{their10.9}} = \frac{2.987}{x}$ OE OR "if in 1000 min 2.987 (g) then in their1090 it is" or $\frac{1000}{\text{their1090}} = \frac{2.987}{x}$ OE</p> <p>.2 ACCEPT $2.987 \times \text{their1090}$.2 DO NOT ACCEPT their time being 10 or 100 or 1000</p> <p>.3 2.987×1.09 or $\frac{2.987 \times 10.9}{10}$ or $\frac{2.987 \times 1090}{1000}$ OE or $3.25583 \cong 3$ (g) .3 ACCEPT only if the calculation is correct</p> <p>AM2</p> <p>.1 0.09 (days) OR 0.9 (hours) OR 90 (mins)</p> <p>.2 "if in 1 day 2.987 (g) then in their0.09 days it is or" $\frac{1}{\text{their0.09}} = \frac{2.987}{x}$ OE OR "if in 10 hours 2.987 (g) then in their0.9 it is" or $\frac{10}{\text{their0.9}} = \frac{2.987}{x}$ OE OR "if in 1000 min 2.987 (g) then in their90 it is" or $\frac{1000}{\text{their90}} = \frac{2.987}{x}$ OE</p> <p>.2 ACCEPT $2.987 \times \text{their90}$.2 DO NOT ACCEPT their time being 10 or 100 or 1000</p> <p>.3 2.987×0.09 or $\frac{2.987 \times 0.9}{10}$ or $\frac{2.987 \times 90}{1000}$ or $0.26883 + 2.987$ or $3.25583 \cong 3$ (g) .3 ACCEPT only if the calculation is correct</p> <p>In any AM: the correct bp2 implies bp1</p>	<p>3</p>
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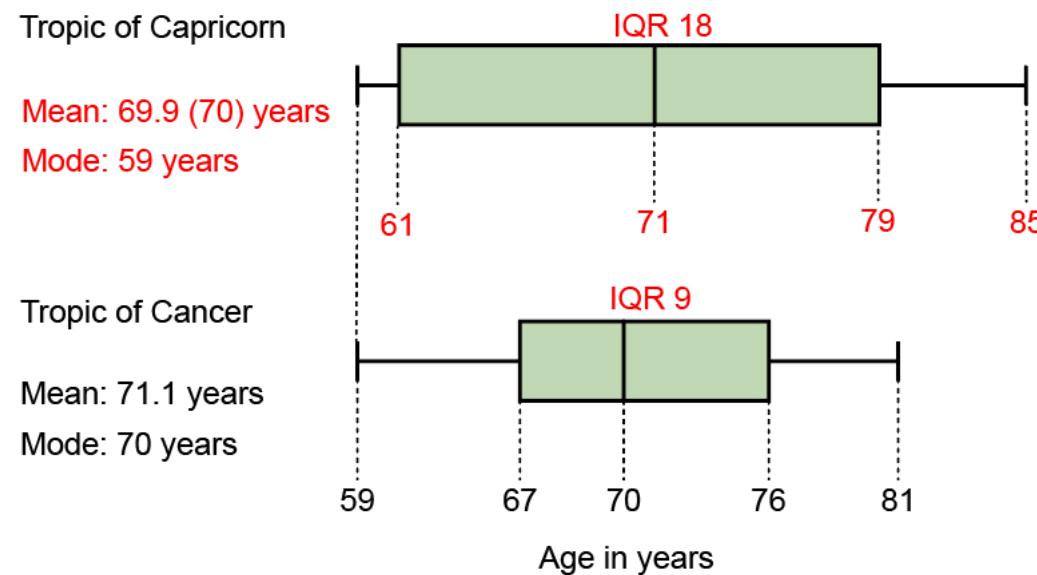
•	Answers	Notes	Total
a	<p>.1 Correctly identify 3 scatter plots</p> <p>.2 Correctly identify another 2 scatter plots</p>	     <p>ACCEPT identifying on the graph instead of the box above it. Ex:</p> 	2

b	<ul style="list-style-type: none"> .1 Two correct .2 Third correct .3 fourth and fifth correct 	<p>Mode 59 LQ 61 Median 71 UQ79 Max 85</p> <p>Tropic of Capricorn</p> <p>A box plot with the following data points: - Minimum (notched): 59 - Lower Quartile (LQ): 61 - Median: 71 - Upper Quartile (UQ): 79 - Maximum: 85 - Mode: 59</p>	3
c	<p>Range:</p> <ul style="list-style-type: none"> .1 Correctly subtract 59 from 85 <p>Interquartile range (IQR):</p> <ul style="list-style-type: none"> .2 Correctly subtract 61 from 79 	<p>Range:</p> <ul style="list-style-type: none"> .1 26 .2 ACCEPT correctly subtracting 59 from their max in their box plot in part b) i.e (their85-59=) their26 <p>Interquartile range (IQR):</p> <ul style="list-style-type: none"> .2 18 .2 ACCEPT correctly subtracting their LQ from their UQ on their box plot in part b) i.e (their79-their61=) their18 	2

7	d		10
Mark	1	2	
Identify factors (F)	<p>Note: Award F1 automatically if C3 is achieved</p> <p>OR</p> <p>Identify two from the elements below <u>in the elements box</u> (ACCEPT WTTE):</p> <p>1) Mean or Mode or Median 2) Range or IQR 3) Trend over the years or line of best fit or any description for the graph 4) Max or Min or UQ or LQ or quartiles 5) Health care or mean working hours or GDP or life satisfaction or the correlation</p> <p>DO NOT ACCEPT</p> <p>General terms like: Measures of central tendency or measures of dispersion or statistics or Box and whisker or the graph for life expectancy or the scatter graph Number of countries in each tropic (11 countries on Capricorn and 17 on Cancer) Location of countries Annual CO₂ emissions Just values for the elements</p>	<p>Identify three from the elements below <u>in the elements box</u> (ACCEPT WTTE):</p> <p>1) Mean or Mode or Median 2) Range or IQR 3) Trend over the years or line of best fit or any description for the graph</p> <p>DO NOT ACCEPT Any element from 4) or 5) (mentioned for F1)</p>	

In 2021	Mean	Mode	IQR	Range	Min	LQ	Median	UQ	Max
Capricorn	69.9.. (or 70)	59	18	26	59	61	71	79	85
Cancer	71	70	9	22	59	67	70	76	81

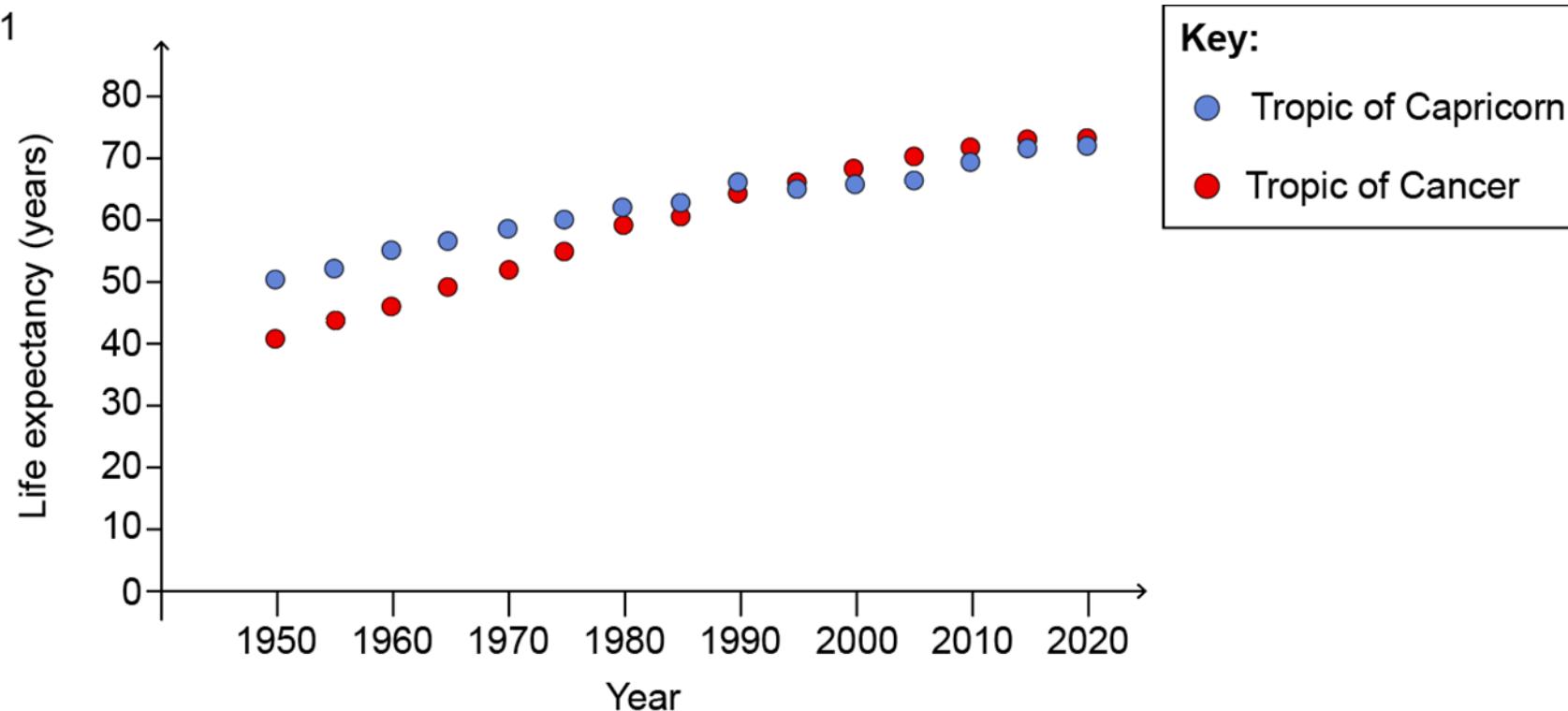
Image 2

**In 2021**

Capricorn has bigger/larger: Median, IQR and Range
 Cancer has bigger/larger: Mean and Mode

Mark	1	2	3	4
Comparative calculations (C) ACCEPT seeing in the elements response box or under any title in their response box	Correctly compare any two from their statistics: Their Mean Their Mode Their Median Their Range Their IQR Their Max or Min or LQ or UQ Example: They have similar mean and median Highest value in Capricorn is 85 while Cancer 81 Cancer mode is 70 and compared to Capricorn 59 Capricorn less Q1 but higher median	Correctly compare any three from their statistics: Their Mean Their Mode Their Median Their Range Their IQR Their Max or Min or LQ or UQ Example: Capricorn higher median and IQR but same min	Values must be seen Correctly compare: The Mean: 69.9 or 70 AND One from Their Range or Their IQR Note: When comparing their range or their IQR ACCEPT seeing only their values for cancer (their22 or their9)	Values must be seen Correctly compare: The Mean: 69.9 or 70 AND One from The Range or The IQR AND One from The Mode or The Median Note: When comparing the range or the IQR ACCEPT seeing only the values for cancer (22 or 9) Note: If they compare by writing directly the difference then it has to be correct (4 for range or 9 for IQR)
	OR Attempt to calculate the mean for the tropic of Capricorn Ex: adding the values incorrectly and divide by 11 their $769/11=$ 69.9 or 70	OR Correctly calculate The mean for the tropic of Capricorn $(769/11=)69.9$ or 70	OR Correctly compare: The Mean AND The Mode and The Median ACCEPT only one with their value but not both	ACCEPT Spelling mistakes Ex: “medium” instead of “median” “similar” WTTE when comparing Mean or Median Q1 instead of LQ, Q3 instead of UQ, “Middle” age or “Q2” instead of “median” “most common” instead of “mode” “lowest” or “smallest” OE instead of “minimum”, “highest” or “largest” OE instead of “Maximum” IQR “more concentrated” instead of smaller
	DO NOT ACCEPT Cancer is higher WTTE when comparing their median, their IQR, or their range Using “central tendency” or “average” instead of “mean or mode or median” Using “measures of dispersion” or “spread” instead of “range or IQR”			

Image 1



Mark	1	2
Comment on the Headline (H)	Correct comment on the headline referring to the trend over the years with <u>specific years</u> (based on the graph in image 1)	C3 is achieved AND Correct comment on the headline referring to trend over the years with <u>specific years</u> (based on the graph in image 1)
ACCEPT seeing in the elements response box or under any title in their response box	<p>Ex: WTTE Correct up to [1980 , 2000] Incorrect after [1980 , 2000] After 1950 Capricorn higher for [30,50] years In the last [20,40] years cancer increased further There was a gap but it narrowed in [1980 , 2000] There was a gap for [30,50] years after 1950 then it narrowed The headline was written in the [1980 , 2000] It was true up to [1980 , 2000] but after that the opposite Capricorn had higher life expectancy until [1980 , 2000]</p>	
	<p style="text-align: center;">OR</p> <p>C1 is achieved AND Correct comment on the headline referring to <u>general</u> trend over the years (based on the graph in image 1)</p> <p>Ex: WTTE Correct in the past Incorrect recently Somehow correct but they are becoming closer Over the years the gap has narrowed The Headline is outdated Cancer has higher slope (or steeper) Capricorn has lower slope Cancer was lower but increased more Recently Capricorn became closer to Cancer and expected to increase</p>	

Mark	1	2
	ACCEPT only if C1 is achieved	ACCEPT only if C3 is achieved
Justify (J) ACCEPT seeing in the elements response box or under any title in their response box	<p>One reason Implying accurate or Inaccurate related to the data given WTTE</p> <p>1) Inaccurate as Capricorn only 11 countries or (tropics) don't have same number of countries or (tropics) don't have same number of people or we don't know the number of people</p> <p>2) Accurate as the data given in the graph "starts from 1950" or "is until 2020" or "until 2021" OR as they are based on [70,73] years of data</p> <p>3) Accurate as I compared <u>both</u> measures of central tendency and measures of dispersion OR mean (or median or mode) and range (or IQR)</p> <p>4) Inaccurate as life expectancies were rounded OR accurate/inaccurate as some (accept all) data is given to nearest 1 decimal place</p> <p>5) Inaccurate as image 1 (or the graph) does not indicate which average is graphed. e.g. image 1 does not show mean or median for life expectancy</p> <p>DO NOT ACCEPT other reasoning Ex: Inaccurate because diseases (or pandemic or storm or, wars...etc) Accurate/Inaccurate as data is from a (given) graph Inaccurate because image 2 is only about one year (2021) Inaccurate as we don't know the source of data Inaccurate as I am not sure of my calculations Accurate as I am sure of what I calculated or I used the right formula Inaccurate as I had to guess values Accurate as the data is provided </p>	<p>Two reasons from the list (1 to 5) in J1</p> <p>OR</p> <p>Implying inaccurate with the reason related to population of each country WTTE</p> <p>Ex: Inaccurate as we do not know the number of people <u>in each country</u> Inaccurate as the population of <u>each country</u> is different Inaccurate as <u>countries</u> don't have same number of people </p>

Task 3 QIG 8 & QIG 9

Glossary for task 3

Term used	Clarification
General rule	Rule in terms of only n (if they use x , it is still general rule but penalise in notation)
The general rule	The correct general rule in terms of only n (if they use x , it is still the general rule but penalise in notation)
Their general rule	valid attempt for the general rule but in terms of only n (if they use x , it is still their general rule but penalise in notation)
Their rule	Correct rule not in terms of only n
Recursive rule	$U_n = \frac{2}{U_{n-1}+d}$ or $U_{n+1} = \frac{2}{U_n+d}$ or $U_n = \frac{2}{U_{n-1}+1}$

We accept subsequent use of their general rule provided it is of similar complexity. In general, the complexity of the rule depends on its form. The table below shows examples.

The general rule	ACCEPT for their general rule	DO NOT ACCEPT for their general rule
$G = \frac{2}{n}$	$\frac{2}{\text{Linear}}$ or exponential or $\frac{2}{\text{Quadratic}}$	(G=) Linear
$L = \sqrt{\left(\frac{n^2 + 4}{4}\right)}$	Quadratic or exponential or $(L =)\sqrt{\text{quadratic}}$	(L=) Linear or $(L =)\sqrt{\text{linear}}$

Question 8 (Remember from the general notes that we ACCEPT seeing equations not inline or the fraction line missing)

Q8	Answers	Notes	Total												
a	<p>Correctly write $\frac{6-5}{4-2}$ or $\frac{5-6}{2-4}$</p> $= \frac{1}{2} \text{ AG}$	<p>ACCEPT inappropriate notations. Ex: 6-5 over 4-2 6-5 in numerator and 4-2 in denominator 6-5=1 and 4-2=2 6-5/4-2</p> <p>DO NOT ACCEPT</p> <p>Using any other values. Ex: $\frac{6-5}{3-1}$ Rise 1 over run 2 It moves 1 unit up and 2 units to the right $\frac{2}{4}$ $\frac{6}{4} - \frac{5}{2}$</p>	1												
b	<p>.1 Correctly write at least one value for G</p> <p>.2 Correctly write the other value for G and the four values for M and N</p>	<table border="1"> <thead> <tr> <th><i>n</i></th><th>M</th><th>N</th><th>Gradient MN (G)</th></tr> </thead> <tbody> <tr> <td>5</td><td>(2.5 , 5)</td><td>(5,6)</td><td>$\frac{2}{5}$</td></tr> <tr> <td>6</td><td>(3 , 5)</td><td>(6,6)</td><td>$\frac{2}{6}$</td></tr> </tbody> </table> <p>ACCEPT equivalent values for all ACCEPT incorrect notation, example: 2/5 and 2/6</p>	<i>n</i>	M	N	Gradient MN (G)	5	(2.5 , 5)	(5,6)	$\frac{2}{5}$	6	(3 , 5)	(6,6)	$\frac{2}{6}$	2
<i>n</i>	M	N	Gradient MN (G)												
5	(2.5 , 5)	(5,6)	$\frac{2}{5}$												
6	(3 , 5)	(6,6)	$\frac{2}{6}$												

c	<p>.1 correctly describe one pattern for G in words</p> <p>.2 correctly describe a second pattern for G in words</p> <p>ACCEPT complete terminology only, for example (below are four different descriptions)</p> <p>Numerator is the same or constant or always 2 or difference zero WTTE</p> <p>Denominator increases by 1 or adds 1 or goes up by 1 WTTE</p> <p>Denominator difference 1, common difference 1, linear with difference 1, arithmetic with difference</p> <p>Denominator second difference zero</p> <p>ACCEPT spelling mistakes Example: Using: "Numberator" or "Nominator" instead of "Numerator" Using: "Demurator" instead of "Denominator"</p> <p>ACCEPT "dividend" instead of "numerator" and "divisor" instead of "denominator"</p> <p>DO NOT ACCEPT Using "rise" instead of numerator or using "run" instead of "denominator"</p> <p>DO NOT ACCEPT general description. Examples: (Numerator or Denominator) Integers or whole numbers, positive, arithmetic, decreasing, composed of only fractions, numerator is even</p> <p>DO NOT ACCEPT the rule in words or description related to n for example: 2 over n or 1 over half of n or denominator equal n, WTTE</p> <p>DO NOT ACCEPT n goes up by 1 , it is decreasing , general rules in terms of n example: $G = 2/n$</p> <p>Note, in the case when they have more than two different patterns: If two are accepted and the rest are all correct: award 2 marks Ex: Denominator integers and adds 1 and Second difference is zero Ex: Denominator linear and increases by 1 and has difference of 1</p> <p>If two are accepted and any of the rest is incorrect: award 1 mark Ex: Denominator increases by 1 and Second difference is zero and G decreases by half</p> <p>If only one is accepted, ignore the rest and award 1 mark</p> <p>SC for 1 mark Two different <u>correct</u> descriptions using incorrect terminology. Examples: The top is constant and bottom increases by 1 The rise is constant and the run increases by 1 Denominator is constant and numerator increases by 1</p>	2
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d	<p>.1 The correct general rule</p> <p>.2 the correct simplified general rule with correct notation for G in terms of n</p>	<p>.1 ($G = \frac{2}{n}$ or $\frac{1}{0.5n}$ or $2 \div n$ or $2/n$ or $\frac{2}{1n}$ or $\frac{4}{2n}$ or $2 \times \frac{1}{n}$) OE</p> <p>.2 $G = \frac{2}{n}$ ACCEPT $G_n = \frac{2}{n}$ or $G(n) = \frac{2}{n}$</p> <p>ACCEPT using g and N</p> <p>DO NOT ACCEPT description in words</p> <p>SC for 1 mark If NR in 8d and the correct general rule seen in 8c or 8e</p> <p>SC for 1 mark If they write in 8d the rule in terms of a and d Ex: $\frac{1}{a+(n-1)d}$ then in 8e, when they test/verify, they directly use 1 instead of a and 1 instead of d</p>	2
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e	<p>.1 correctly substitute $n \geq 5$ into their general rule (from 8c or 8d)</p> <p>.2 correctly calculate their value of G after substituting $n \geq 5$</p> <p>.3 recognise that their <u>correctly calculated</u> value of G is the same as their predicted value</p>	<p>.1 Ex: $\frac{2}{5}$.1 DO NOT ACCEPT if their general rule for G is linear</p> <p>.2 Ex: 0.4 OE (for $n=5$) ACCEPT $\frac{2}{5}$.2 DO NOT ACCEPT incorrectly calculated result after substitution in incorrect seen rule Ex: $\frac{2}{2n+1} = \frac{2}{2\times5+1} = \frac{2}{5}$ (award bp1 only) .2 DO NOT ACCEPT if their general rule for G is linear</p> <p>.3 If they use $n=5$ or $n=6$ ACCEPT only if they say "as seen in the table" WTTE or we see the predicted values re-written here in part e)</p> <p>.3 If they use $n > 6$ ACCEPT only if they say "the same as when we continue the pattern" WTTE and state how. Example: for $\frac{2}{7}$; "same as it is obtained by adding 1 to 6" or "same as 7 is the value after 6" WTTE or they show the further predictions including 2/7 here in part e)</p> <p>Note: $n \geq 5$ directly substituted in $2/n$, award bp1 and bp2 only if their 8d is $2/n$ Example seeing <u>only</u> 2/5 or 2/8 when their 8d is $2/n$ award bp1 and bp2</p> <p>SC for 1 mark Correctly test their general rule by applying the steps of verification mentioned in the left column <u>including bp3</u> with a value of $n \leq 4$</p> <p>SC for 1 mark Verify, <u>including bp3</u>, with a value of $n \geq 5$ the correctly described pattern or recursive rule or the rule for denominator from part b) or c). Example: If their rule $G=n$; $G=5$ <u>as seen in the table</u> If their rule $G=n$; $G=7$ <u>as seen in the table and</u> it is the same as $6+1$</p>	3
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QIG 9

Question 8f (20 marks) (Remember from the general notes that we ACCEPT seeing equations not inline or the fraction line missing)

Predictions for Length MN

$\sqrt{\frac{29}{4}}$ OE
$\sqrt{\frac{40}{4}}$ OE
$\sqrt{\frac{53}{4}}$ OE

$\frac{\sqrt{29}}{4}$
$\frac{\sqrt{40}}{4}$
$\frac{\sqrt{53}}{4}$

DO NOT ACCEPT

Mark	1
	Correctly predict two terms for L Ignore additional predictions
	ACCEPT Whether in the table or in the response box.
Predictions (P)	<p>Simplified surds Ex: $\frac{\sqrt{40}}{2}$ or $\frac{2\sqrt{10}}{2}$ or $\sqrt{10}$</p> <p>Different notations or in words provided they give correct values. Ex: $\sqrt{29 \div 4}$ or $(29/4)^{0.5}$ or root(29/4)</p> <p style="text-align: center;">DO NOT ACCEPT</p> <p>Incorrect values. Ex: $\text{root } 29/4$, $29/4^{0.5}$</p> <p>In decimals. Ex: $2.69(25\dots)$ or $5.38\dots/2$ $3.16(22\dots)$ or $6.32\dots/2$</p>

The general rule for L :

$$L = \sqrt{\frac{n^2+4}{4}} = \frac{\sqrt{n^2+4}}{2} = \sqrt{0.25n^2 + 1} \text{ OE} \quad \text{DO NOT ACCEPT } L = \frac{\sqrt{n^2+4}}{4} \text{ OE}$$

The rule for M : $(0.5n, 5)$ OE

The rule for N : $(n, 6)$

For Their general rule for L

ACCEPT quadratic or exponential or $\sqrt{\text{quadratic}}$

DO NOT ACCEPT linear or $\sqrt{\text{linear}}$ as in this case it will be only considered their rule

Helpful notes:

Having their general rule for $L = n^2 + 4$, which is accepted as attempt for the general rule, allows maximum of:
D3 will be achieved only if they also have **Attempt to** describe one pattern in words. If not then D2

T2 if tested correctly, V2 if they correctly calculate their value for L when $n \geq 5$, J2 if they assume quadratic and find coefficients
N1 will be achieved only if they have Correctly described one pattern for L in words using correct terminology. If not then N0
L2 if they have 4 items and at least 1 coherence

Having their rule for L linear or $\sqrt{\text{linear}}$, which is not accepted as attempt for the general rule, allows maximum of:
D1 achieved only if they have **Attempt to** describe one pattern in words. If not then D0
T1 if tested correctly, V1 if verified correctly, J1 if they justify the rule for $M=0.5n$ (and achieved D1)
N1 will be achieved only if they have Correctly described one pattern for L in words using correct terminology. If not then N0
L1 if they have three items

When a response is not including the 4 under the root in their predictions

$\frac{\sqrt{29}}{4}$
$\frac{\sqrt{40}}{4}$
$\frac{\sqrt{53}}{4}$

And their general rule is $L = \frac{\sqrt{n^2+4}}{4}$ and describe the pattern as quadratic. AWARD P0 and D3

For T: If tested correctly award T2

For V: If verified correctly award V2 (Max V2 as they do not have the correct predicted value for L)

For J: If they justify using “find the correct values of coefficients using any method”, award J2

For N: Since they have correct notation of their general rule for L , award N1

For L: They have their general rule so if they have 4 items and at least one coherence award L2. If only 3 items award L1

Mark	1	2	3	4
Description (D) ACCEPT incorrect terminologies , notation errors, non-simplified rule, but penalize in notation (N)	<p>Attempt to describe one pattern in words or recursive rule for L</p> <p>Example: (for $n^2 + 4$) Difference (or the increase WTTE) increases by 2, Second difference 2 Difference (or the increase WTTE) is odd Quadratic Or (Recursive rule) $U_n = U_{n-1} + 2n - 1$ or $U_{n+1} = U_n + 2n + 1$ (Recursive rule): $L=L-1+2n-1$ or $L+1=L+2n+1$</p> <p>Example: (for $0.25n^2 + 1$) What I add increases by 1/2, Second difference 1/2 Quadratic Or (Recursive rule) $U_n = U_{n-1} + 0.5n - 0.25$ or $U_{n+1} = U_n + 0.5n + 0.25$ (Recursive rule): $L=L-1+0.5n-0.25$ OE or $L+1=L+0.5n+0.25$ OE</p> <p>DO NOT ACCEPT Patterns for denominator Seeing only “fraction under the root”</p>	<p>Attempt to describe one pattern in words or recursive rule for L</p> <p>AND</p> <p>Their general rule for L as a <u>quadratic</u> satisfying at least one value for n in their($n^2 + 4$)</p>	<p>Attempt to describe one pattern in words or recursive rule for L</p> <p>AND</p> <p>Attempt the general rule for L</p> <p>DO NOT ACCEPT The general rule for L in words or partially in words</p>	<p>Attempt to describe one pattern in words or recursive rule for L</p> <p>AND</p> <p>The general rule for L</p>
Ignore additional incorrect patterns	<p>OR</p> <p>Their general rule for L as a <u>quadratic</u> satisfying at least one value for n in their($n^2 + 4$)</p> <p>OR</p> <p>Correct general rule for M ($0.5n$, 5) ACCEPT $M = 0.5n$ DO NOT ACCEPT Correctly described pattern in words for M or N</p>	<p>OR</p> <p>The general rule for L in words or partially in words</p>	<p>OR</p> <p>The general rule for L. $(L =) \sqrt{\left(\frac{n^2+4}{4}\right)}$ OE</p> <p>DO NOT ACCEPT $(L =) \frac{\sqrt{n^2+4}}{4}$ OE</p>	

Mark	1	2
Testing (T)	<p>Attempt to test their general rule for L or $their(n^2 + 4)$ using $n \leq 4$</p> <p>Ex: Correctly substitute in their general rule for L or $their(n^2 + 4)$ value of $n \leq 4$</p> <p style="text-align: center;">OR</p> <p>Correctly test their described pattern or their rule (e.g. recursive rule) or <u>the</u> rule $M = 0.5n$ OE</p> <p>Ex: Testing $L=(4+n)/4$ when $n=1$; $(4+1)/4=5/4$</p>	<p>Correctly test their general rule for L or $their(n^2 + 4)$ using $n \leq 4$</p> <p>Ex: correctly calculate their value for L or $their(n^2 + 4)$ in their general rule for L or $their(n^2 + 4)$ using $n \leq 4$</p> <p style="text-align: center;">AND</p> <p>Recognise that <u>their</u> correctly calculated value for L or $their(n^2 + 4)$ is the same as <u>the</u> given value in the table</p> <p style="text-align: center;">ACCEPT</p> <p>Seeing their correctly calculated value for L or $their(n^2 + 4)$, as fraction or decimal, and the given value in the table being equal</p>

Mark	1	2	3
Verifying (V)	<p>Attempt to verify their general rule for L or $their(n^2 + 4)$ using $n \geq 5$</p> <p>Ex: Correctly substitute in their general rule for L or $their(n^2 + 4)$ value of $n \geq 5$</p> <p style="text-align: center;">OR</p> <p>Correctly verify their described pattern or their rule (e.g. recursive rule) or <u>the</u> rule $M = 0.5n$ OE</p> <p>Ex: Verifying $L=(24+n)/4$ when $n=5$; $(24+5)/4=29/4$</p>	<p>Correctly calculate their value for L or $their(n^2 + 4)$ in their general rule for L or $their(n^2 + 4)$ using $n \geq 5$</p>	<p style="color: red;">ACCEPT only if they have <u>the</u> general rule for L</p> <p>Correctly calculate their value for L in <u>the</u> general rule using $n \geq 5$</p> <p style="text-align: center;">AND</p> <p>Recognise that <u>their</u> correctly calculated value for L is the same as <u>the</u> correct predicted value for L obtained by continuing the pattern</p> <p style="text-align: center;">ACCEPT</p> <p>Seeing their correctly calculated value for L, as fraction or decimal, and the correctly predicted value in the table being equal</p>

Mark	1	2	3	4
Justify (J) ACCEPT seeing anywhere in the response	<p>ACCEPT only if D1 is achieved</p> <p>Attempt to justify <u>their</u> general rule for L ACCEPT justification for <u>their</u> $(n^2 + 4)$ provided it is quadratic Ex: Quadratic model and valid attempt to find values of coefficients using any method.</p>	<p>ACCEPT only if D2 is achieved</p> <p>Attempt to justify: $\frac{n^2+4}{4}$ OE or $n^2 + 4$ OE Ex: Quadratic model and find the correct values of coefficients using any method</p>	<p>ACCEPT only if they have <u>the</u> general rule for L</p> <p>Good attempt to justify <u>the</u> general rule for L geometrically using <u>the</u> rules for M and N into Pythagoras:</p> <p>Substitute the rules for M and N into Pythagoras and <u>mistakes in simplification or without simplification steps</u></p> <p>Ex: Rule for $M = 0.5n$ Rule for $N = n$ Rule for L is</p> $\sqrt{(0.5n - n)^2 + 1^2} = \frac{\sqrt{n^2 + 4}}{2}$	<p>ACCEPT only if they have <u>the</u> general rule for L</p> <p>Correctly justify <u>the</u> general rule for L geometrically using <u>the</u> rules for M and N into Pythagoras:</p> <p>Substitute the rules for M and N into Pythagoras and <u>correct simplification steps</u></p> <p>Ex: Rule for $M = 0.5n$ Rule for $N = n$ Rule for L is</p> $\sqrt{(0.5n - n)^2 + 1^2} = \sqrt{(0.5n)^2 + 1^2} = \sqrt{0.25n^2 + 1} \text{ or } = \sqrt{\frac{1}{4}n^2 + 1}$ <p>ACCEPT only if their form of the general rule is simplified (see N2 for simplified forms)</p>
	<p>OR</p> <p>Use the arithmetic sequence to justify <u>the</u> rule for M Ex: $u_1 = 0.5$ and $d = 0.5$ and $M = 0.5n$</p>	<p>OR</p> <p>Weak attempt to justify <u>their</u> general rule for L geometrically using rules for M and N into Pythagoras</p> <p>Ex: incorrectly substitute the correct rules of M and N into Pythagoras OR correctly substitute the incorrect rules of M and N into Pythagoras</p>		
	<p>OR</p> <p>Weak attempt to justify their general rule for L geometrically using values for M and N (at a certain n value) into Pythagoras. Ex: at $n=2$</p> $\sqrt{(2 - 1)^2 + (6 - 5)^2} = \sqrt{2} = \sqrt{\frac{8}{4}}$			

Mark	1	2	3
	ACCEPT only if D1 achieved <p>Correctly describe one pattern for L in words <u>using correct terminology</u> Example: The fraction under the root is quadratic, root of a quadratic The numerator under the root is increasing by odd numbers ACCEPT spelling errors and using “root” radical, surd WTTE DO NOT ACCEPT a quadratic then “add” root DO NOT ACCEPT if the pattern is not accepted in D1</p>	ACCEPT only if they have <u>the general rule for L</u> <p>Correctly describe one pattern for L in words <u>using correct terminology</u> (see examples in N1) and the notation of <u>the general rule for L</u> includes errors or not simplified or in words (see examples in N1)</p>	ACCEPT only if they have <u>the general rule for L</u> <p>Correctly describe one pattern for L in words <u>using correct terminology</u> (see examples in N1)</p> <p>AND</p>
Notation and terminology (N)	<p>OR</p> <p>The notation of <u>the general rule for L</u> includes errors or not simplified or in words. Examples:</p> $L = \sqrt{(0.5n - n)^2 + 1^2} \text{ or } L = \sqrt{0.25 \times n^2 + 1}$ <p>The rule for L is $\sqrt{\left(\frac{n^2+4}{4}\right)}$ or $L = \sqrt{\frac{1n^2+4}{4}}$</p> <p>ACCEPT $(\)^{\frac{1}{2}}$ instead of $\sqrt{\ }$</p> <p>The general rule in words: Numerator under the root is sum of n^2 and 4 then divide by 4 The top is root(n^2+4) and bottom root 4</p>	<p>OR</p> <p>Correct notation of <u>the general rule for L</u> in simplest form</p> $L = \sqrt{\frac{n^2+4}{4}} \text{ or } L = \frac{\sqrt{n^2+4}}{2} \text{ or } L = \sqrt{0.25n^2 + 1} \text{ or}$ $L = \sqrt{\frac{n^2}{4} + 1}$ <p>ACCEPT $(\)^{\frac{1}{2}}$ instead of $\sqrt{\ }$</p> <p>ACCEPT with or without brackets Ex:$L = \sqrt{\left(\frac{n^2+4}{4}\right)}$ or $L = \sqrt{\frac{(n^2+4)}{4}}$ or</p> $L = \sqrt{\left(\frac{n}{2}\right)^2 + 1}$ <p>ACCEPT using L_n or L_n or $L(n)$ instead of L</p>	<p>Correct notation of <u>the general rule for L</u> in simplest form (see examples in N2)</p>
Ignore additional incorrect patterns	<p>OR</p> <p>Correct notation of <u>their general rule for L</u>. Examples:</p> <p>The numerator = $\sqrt{n^2 + 4}$ or $N = \sqrt{n^2 + 4}$ The numerator under the root is $n^2 + 4$ ACCEPT if not simplified. Ex:</p> $L = \sqrt{\frac{n^2 + n + 4 - 2}{4}}$ <p>DO NOT ACCEPT without seeing the root ($\sqrt{\ }$)</p>		
	<p>OR</p> <p>Correct notation of <u>the rule for M</u> in simplest form</p> $M = (0.5n, 5) \text{ OE}$ <p>ACCEPT The x-coordinate of $M = 0.5n$</p>		
	<p>The following are considered errors in terminology</p> <p>Using “top” or “up” to describe “numerator”</p>	<p>The following are considered errors in notation</p> <p>using * for multiplication, using / for division , using \wedge for power, using x instead of n using U_n instead of L without mentioning that $L = U_n$</p>	

Mark	1	2	3
<p>Communication (L)</p> <p>Organisation and coherence Can be awarded even if there are errors</p> <p>For items: Describing pattern and writing rule can be considered an item even if D0 and N0 awarded</p>	<p>At least three from the following items are seen:</p> <ul style="list-style-type: none"> • describe a pattern in words • write a rule • test their general rule or rule or recursive rule or pattern (at least T1) • verify their general rule or rule or recursive rule or pattern (at least V1) • justify their general rule or rule or recursive rule or pattern (at least J1) 	<p>ACCEPT only if they have <u>their general rule for L</u> or for their($n^2 + 4$)</p> <p>At least four of the following items are seen:</p> <ul style="list-style-type: none"> • describe a pattern in words • write a general rule • test their general rule (at least T1) • verify their general rule (at least V1) • justify their general rule (at least J1) <p>AND</p> <p>For coherence, they identify the processes correctly.</p> <p>At least one from the following:</p> <ul style="list-style-type: none"> • test • verify • justify <p>Ex:</p> <ul style="list-style-type: none"> • For test: they say “test” and they substitute in their general rule value(s) of $n \leq 4$ only • For verify: they say “verify” and they substitute in their general rule value(s) of $n \geq 5$ only • For justify: They say “justify” and they write a justification <p>Note for coherence: If they say “test and verify” and they substitute in their general rule value(s) of $n \leq 4$ followed by value(s) of $n \geq 5$, consider it as only one identified process</p>	<p>ACCEPT only if they have <u>the general rule for L</u></p> <p>The following two items must be seen :</p> <ul style="list-style-type: none"> • write <u>the general rule for L</u> • justify <u>the general rule</u> (at least J2) <p>AND</p> <p>At least two of the following items are seen:</p> <ul style="list-style-type: none"> • describe a pattern or rule in words • test <u>the general rule</u> (at least T1) • verify <u>the general rule</u> (at least V1) <p>AND</p> <p>For coherence, they identify the processes correctly.</p> <p>At least two from the following:</p> <ul style="list-style-type: none"> • test • verify • justify <p>Ex:</p> <ul style="list-style-type: none"> • For test: they say “test” and they substitute in the general rule for A value(s) of $n \leq 4$ only • For verify: they say “verify” and they substitute in the general rule for A value(s) of $n \geq 5$ only • For justify: They say “justify” and they write a justification <p>Note for coherence: If they say “test and verify” and they substitute in the general rule value(s) of $n \leq 4$ followed by value(s) of $n \geq 5$, consider it as only one identified process</p>