

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	.1 Show clear line of reasoning	in the method	.1 45 and 49 seen O	E	
			<i>Ex:</i> 49 = 45 + x		2
	.2 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 sinx > 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÷ 4 or 2^-1; $\frac{x}{2}$ OE means we accept x / 2 or x÷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.
- I) ACCEPT using the correct values regardless their previous result.

	Ouestion Answers Notes Total			
Que	estion	Answers	Notes	Total
1	a	correctly place all four values	$ \begin{array}{c} 0 \\ 10 \\ 2 \\ 4 \\ 1 \\ 7 \\ 5 \end{array} $	1
	b	.1 correctly describe A AND the intersection in context .2 correctly describe B' in context	 .1 multiples of 2 and ACCEPT multiples of 2 but (WTTE) .2 not multiples of 3 ACCEPT multipliers DO NOT ACCEPT correct descriptions not in context or just listing the numbers of the set SC for 2 marks Multiples of 2 only (WTTE) 	2
	С	.1 correctly write their probability of A ∩ B' .2 correctly multiply their probabilities without replacement	.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 their4 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)%	2
	d	.1 multiply their probabilities for first selected numbers without replacement .2 multiply their probabilities for second selected numbers without replacement	.1 their $\frac{4}{10}$ × their $\frac{6}{9}$ OE , ACCEPT 0.266(66) or 0.267 seen .1 consider their4 from their probability used in 1c .2 their $\frac{6}{10}$ × their $\frac{4}{9}$ OE , ACCEPT 0.266(66) or 0.267 seen .2 consider their4 from their probability used in 1c	3
		.3 correctly add their multiplied probabilities	.3 their $\frac{8}{15}$ OE , ACCEPT 0.533(33…)	

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Que	estion	Answers	Notes	Total
2	а	.1 correctly write one value .2 correctly write second value	$+ \sqrt{5}$	5
		.3 correctly write third value	Addition $\sqrt{20}$ $3\sqrt{5}$ $\sqrt{2}$	5
			$\sqrt{45}$ $4\sqrt{5}$ $2\sqrt{5}$	5
			OR	3
			$+ \sqrt{5}$	√5
			Addition $\sqrt{20}$ $\sqrt{45}$ V grid	5
			√ 45 √80 2	$\sqrt{5}$
			ACCEPT only the forms and notations ab	ove
	b	.1 correctly write two values .2 correctly write third value	× 2b 4at	-2
		.3 correctly write fourth value	$\frac{Multiplication}{grid} \frac{7}{2}a \frac{7ab}{14a^2}$	b ⁻²
			3a ⁴ b 6a ⁴ b ² 12a ⁵	b ⁻¹
			If any of the values are correct but not in a above, award marks as appropriate then	exactly the form and notation subtract one mark

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Que	stion	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 <i>x</i> .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 =)their $\sqrt{180}$ or $6\sqrt{5}$ or 13.4(164)	2

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

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4	C	 AM1 (when they start by doing operations to the 500) operations: add 150 to 500 or 650 seen divide by 4 multiply by 1000 divide by 0.2 OE 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 AM2 (when they start by doing operations to number of viewers) 1 correctly write the number of viewers 2 any two operations from the operations below 3 another two operations from the operations below operations: multiply their number of viewers by 0.2 OE divide by 1000 multiply their number of viewers by 0.2 OE divide by 1000 multiply by 4 subtract 150 	AM1 (when they start by doing operations to the 500) .1 Ex: $\frac{650}{4}$ OE or 162.5 or 163 seen .2 Ex: $\frac{\text{their163} \times 1000}{0.2}$ OE .3 ($\frac{163000}{0.2}$ =)815000 AM2 (when they start by doing operations to number of viewers) .1 815000 .2 Ex: their815000 × $\frac{0.2}{1000}$.3 Ex: their163 × 4 – 150	3
		 AM3 (when they set an equation) .1 correctly write the equation .2 correctly solve their equation .3 correctly write the minimum number of viewers (after realising the rounding up) 	AM3 (when they set an equation) .1 $\frac{0.2x}{1000} \times 4 - 150 = 500$.2 their 812 500 .2 ACCEPT only if their equation is of similar complexity i.e. including at least two of: $x \times 4$, $\frac{x}{1000}$, $x \times 0.2$, $x - 150$.3 $812500 \times 0.2 = 162500$, $163000 \div 0.2 = 0.815000$	

Que	stion	Answers	Notes	Total
5	а	AM1 (using sin or cos ratios) .1 correctly divide by two the 150 AND 5.4	AM1 (using sin or cos ratios) .1 75 AND 2.7 seen. ACCEPT 15 AND 2.7 seen	
		.2 correctly substitute into trig ratio	.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	
		.3 correct value of r before rounding AG 2.80	.3 (r =)2.79(52) .3 ACCEPT their correct r due to earlier rounding provided it rounds to 2.8	
		AM2 (using sine rule) .1 correctly substitute into sine rule	AM2 (using sine rule) .1 $\frac{5.4}{\sin 150} = \frac{r}{\sin 15}$ OE	
		.2 correctly rearrange for r on one side	.2 (r =) $\frac{5.4 \times \sin 15}{\sin 150}$ OE	
		.3 correct value of r before rounding AG 2.80	.3 (r =)2.79(52) .3 ACCEPT their correct r due to earlier rounding provided it rounds to 2.8	
		AM3 (using cos rule) .1 correctly substitute into cosine rule	AM3 (using cos rule) .1 $5.4^2 = 2r^2 - 2r^2 \cos 150$ OE	3
		.2 correctly rearrange for r^2 on one side	.2 $(r^2 =) \frac{5.4^2}{2 - 2\cos 150}$ OE , or 7.81(33) seen	
		.3 correct value of r before rounding AG 2.80	.3 (r =)2.79(52) .3 ACCEPT their correct r due to earlier rounding provided it rounds to 2.8	
		AM4 (using tan ratio) .1 correctly calculate the angle and correctly divide 5.4 by two	AM4 (using tan ratio) .1 15 and 2.7 or 15 and 2.7 seen	
		.2 correctly substitute tan15 or tan75 ratio into Pythagoras	.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	
		.3 correct value of r before rounding AG 2.80	.3 (r =)2.79(52) .3 ACCEPT their correct r due to earlier rounding provided it rounds to 2.8	

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5	b	AM1	AM1	
		.1 correctly substitute 2.8 into volume of sphere formula	.1 (V =) $\frac{4\pi 2.8^3}{3}$ OE or 91.95(23) ACCEPT using pi or 3.14 instead of π	
			.1 ACCEPT using 2.795(2) instead of 2.8	
		.2 correctly substitute 2.86 into volume of cone formula	.2 $\frac{\pi 2.86^2 h}{3}$ OE or 8.56(56)h , ACCEPT using pi or 3.14 instead of π	
		.3 evidence of equating their volumes	.3 their $\frac{\pi 2.86^2 h}{3}$ = their $\frac{10976\pi}{375}$ OE	
		.4 correctly calculate their h after solving their equation	.4 (h=) their10.7(3499) .4 ACCEPT their10.7(34999) only if one of .1, .2, or.3 is awarded	
		AM2 (when using sin or cos) .1 correctly substitute correct values into trig ratio OR sine rule	AM2 (when using sin or cos) .1 sin15 = $\frac{2.86}{x}$ or cos75 = $\frac{2.86}{x}$ OR $\frac{x}{\sin 75} = \frac{5.72}{\sin 30}$ OE	4
		.3 correctly substitute their slant height into Pythagoras .4 correctly calculate their h using Pythagoras	.2 $(x =)$ 11.05(019) .3 $(h^2 =)$ their 11.05 ² - 2.86 ² .4 $(h=)$ their 10.67(366) or their 10.7	
		 AM3 (only when using the tan ratio) .1 correctly calculate angle and side of the right angled triangle .2 correctly substitute into tan ratio .3 correctly rearrange their tan equation for h on one side 	AM3 (only when using the tan ratio) .1 75 and 2.86 OR 15 and 2.86 seen .2 $\tan 75 = \frac{h}{2.86}$ OR $\tan 15 = \frac{2.86}{h}$.3 $(h =)$ their 2.86 × tan 75 or $(h =)$ 2.86 × tan their 75 OR $\frac{\text{their 2.86}}{\tan 15}$ or $\frac{2.86}{\tan 15}$	
		.4 correctly calculate their h after multiplying by tan75 OR dividing by tan15	.4 (h=) their10.67(366) or their 10.7	
			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"	

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Questi	on 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	AM1 (using the 12-hour clock) .2 ACCEPT 0:00 am	
		AM2 (using the 24-hour clock)	2
	AM2 (using the 24-hour clock) .1 Maximum at 12:00 (am/pm)	.2 ACCEPT 0:00 SC for 1 mark Maximum at 24:00 (am/pm) and Minimum at 12:00 (am/pm)	
С	.1 Amplitude 0.5 OE .2 Period 24	ACCEPT .5	2
d	.1 Maximum 37 .2 Minimum 36		2
е	.1 evidence of substituting 7.25 into the correct formula	.1 (B =) $-0.5\cos(7.25 \times 15) + 36.5$ ACCEPT incorrect use of brackets	
	.2 correctly calculate their B using their substituted <i>t</i> .3 correctly round their calculated value to 1 dp	.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 = -0.5cos15t + 36.75 (using R or any other letter) ACCEPT B = -0.5cos15t + 36.75 ACCEPT -0.5cos15t + 36.75	1

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6	g	.1 evidence of correctly equating their expression in	.1 their $-0.5\cos 15t + 36.75 = 36.5$	
			ACCEPT using x instead of t	
		.2 correctly rearrange their equation for $\cos 15t$ on one side	.2 $\cos 15t = \frac{\text{their}(-0.25)}{-0.5}$ or their 0.5 OE	
			3 15t - their 60 ACCEPT not seeing this step	
		.3 correctly remove their cosine		1
		.4 correct value of their first <i>t</i> or their first time of day	.4 (t=) their4 (am) or 4:00 OE	-
			.4 ignore incorrect time of day after seeing their 4 .4 ACCEPT their <i>t</i> or their time of day after solving correctly their linear eq	uation 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	
			0.500515	

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Que	stion	Answers	Notes	Total
7	а	.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	$\begin{array}{c} .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 \ \text{OE} \\ .1 \ \text{ACCEPT 15.4 seen} \\ .1 \ \text{ACCEPT not seeing the whole operation from calculator screenshot provided it shows at least 4 correct products. Ex:} \\ \hline & (4 \times 0.75 + 3 \times 0.76 + 5 \times 0.77 + 6 \times 0.78 + 1 \times 0.8) \\ \text{Or} \\ \text{Screenshot} \\ \hline & 3 \times 0.76 + 5 \times 0.77 + 6 \times 0.78 + 1 \times 0.79 + 1 \times 0.8) \\ \text{.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} \text{ACCEPT } \frac{15.4}{20} \text{ seen} \\ \text{.2 ACCEPT not seeing the whole operation from calculator screenshot Ex:} \\ \hline & \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} \text{ACCEPT } \frac{15.4}{20} \text{ seen} \\ \text{.2 ACCEPT not seeing the whole operation from calculator screenshot Ex:} \\ \hline & \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}{20} \text{ACCEPT } \frac{15.4}{20} \text{ seen} \\ \text{.2 ACCEPT not seeing the whole operation from calculator screenshot Ex:} \\ \hline & \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}{20} \text{ACCEPT } \frac{15.4}{20} \text{ seen} \\ \text{.2 ACCEPT not seeing the whole operation from calculator screenshot Ex:} \\ \hline & 4 \times 0.75 + 3 \times 0.76 + 5 \times 0.77 + 6 \times 0.78 + 1 \times 0.79 $	2





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7	е	.1 correctly substitute 0.77 into the formula	.1 $(w =) 24(100)^{-0.77}$	
		.2 correct value of <i>w</i> .3 correctly round their <i>w</i> to 2 sf	.2 0.692(1675608) ACCEPT not seeing this step .3 their 0.69 OE	3

Question	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 <i>w</i> value from their <i>r</i> without working OR At least two incorrect <i>w</i> values from their <i>r</i> with working seen ACCEPT <i>w</i> > 1 ACCEPT <i>w</i> and its corresponding <i>r</i> value seen in the table or in the response box ACCEPT their rounding of <i>w</i> provided it correctly rounds to 1 d.p Ex: <i>w</i> =0.6867 and they write 0.68 DO NOT ACCEPT <i>w</i> for <i>r</i> =0.77	Two correct <i>w</i> values from their <i>r</i> without working ACCEPT $w > 1$ ACCEPT <i>w</i> and its corresponding <i>r</i> value seen in the table or in the response box ACCEPT their rounding of <i>w</i> provided it correctly rounds to 1 d.p Ex: <i>w</i> =0.6867 and they write 0.68 DO NOT ACCEPT <i>w</i> for <i>r</i> =0.77	Three correct <i>w</i> values from their <i>r</i> without working ACCEPT $w > 1$ ACCEPT <i>w</i> and its corresponding <i>r</i> value seen in the table or in the response box ACCEPT their rounding of <i>w</i> provided it correctly rounds to 1 d.p Ex: <i>w</i> =0.6867 and they write 0.68 DO NOT ACCEPT <i>w</i> for <i>r</i> =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 <i>w</i> =0.8 while sleeping 4h has <i>w</i> =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			

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Marks	1	2	3
Justify degree of Accuracy (A)	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 with good justification inaccurate AND state that the relation between reaction time and sleeping cannot be linear WTTE	
	-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	OR inaccurate AND state that the line equation may not be valid beyond the data given WTTE	
	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.		
	ACCEPT accurate due to rounding only if they mention the degree of accuracy of their rounding 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 DO NOT ACCEPT just seeing their values rounded		

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

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8	d	.1 correctly substitute $n \ge 5$ into their general rule (from 8c or 8b)	.1 Ex: $2 \times 5 + 2$	
		.2 correctly calculate their value of L after substituting $n \ge 5$.2 Ex: 12 (for <i>n</i> = 5)	
	.3 recognise that their correctly		.3 same as when we continue the pattern and explains how the pattern continues	
	calculated value of L is the their predicted value	their predicted value of L is the same as	Ex: how 12 is obtained from pattern of adding 2 to 10	3
			.3 ACCEPT seeing their value in the table in 8a and seeing their matching calculated <i>L</i> using $n \ge 5$	
			Ex: we see their calculated $L=12$ and we see $L=12$ in their table	

Question 8e 22 marks					
Mark	1	2	3	4	
Predictions (P)	Correctly predict three terms for <i>S</i> , <i>H</i> or <i>A</i> ACCEPT whether in the table or in the response box	Correctly predict five terms in <i>S</i> , <i>H</i> and <i>A</i> 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		
	Correctly describe a pattern in words for A ACCEPT Square numbers or perfect squares	Correctly describe a pattern in words for <i>A</i>	Correctly describe a general rule for <i>A</i> in terms of <i>n</i>	Correctly describe a pattern in words for A	
	Square of odd numbers The difference is increasing by a constant Increase is increased by 8	AND	Rule: $A = (2n + 1)^2$ or	AND	
	Second increase is 8 Difference is multiples of 8 Going up by multiples of 8 The second difference is constant Quadratic	Attempt to describe a general rule for <i>A</i> in terms of <i>n</i> or correctly describe a general rule for <i>A</i> in terms of <i>S</i> or <i>H</i>	$A = 4n^2 + 4n + 1$	Correctly describe a general rule for <i>A</i> in terms of <i>n</i>	
Description (D)	the square numbers A is the square of H odd numbers	ACCEPT non-simplified and ignore incorrect notation	ACCEPT non-simplified and ignore incorrect notation	ACCEPT non-simplified and ignore incorrect notation	
	OR Attempt to describe a general rule for <i>A</i> in terms of <i>n</i> Examples: rule in words: The square of two n plus 1 $A = (n + 1)^2$ or $A = n^2 + 8$ or $A = 4n^2 + 1$				
	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.				

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

- 24 -2 Attempt to justify the general rule for A Correctly justify the Justify their general rule

3

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4

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

Communication criteria

Mark

1

Mark	1	2	3
Notation and terminology (N)	Correct notation of <u>their general rule</u> 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</u> rule 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	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</u> rule includes errors AND Correctly describe a pattern in words for A DO NOT ACCEPT if they don't have a general rule	Correct notation of <u>the general</u> rule for <i>A</i> AND Correctly describe a pattern in words for <i>A</i>

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Mark	1	2	3	
Communication			DO NOT ACCEPT if D3 and J2 not awarded	
(L)	At least three from the following are seen:	At least four of the following are seen:	At least four of the following are seen:	
	 describe a pattern or rule in words 	describe a pattern or rule in words	 describe a pattern or rule in words 	
Organisation and	write a general rule	write a general rule	write the general rule	
coherence	 test their general rule or pattern 	• test their general rule or pattern	test the general rule	
	 verify their general rule or pattern 	verify their general rule or pattern	 verify the general rule 	
Can be awarded	• justify their general rule or pattern	• justify their general rule or pattern	• justify <u>the general rule</u>	
errors in their		AND	AND	
descriptions		For coherence, they identify the processes	For coherence, they identify the processes	
and working		correctly. At least one from the following:	correctly. At least two from the following:	
and working.		• test	• test	
		• verify	• verify	
		• justify	• justify	
		Ex:	Ex:	
		• For test:	For test:	
		they say "test" and they test using value(s) of	they say "test" and they test using value(s) of	
		<i>n</i> ≤4 only	n≤4 only	
		• For verify:	• For verify:	
		they say "verify" and they verify using value(s) of <i>n</i> ≥5 only	they say "verify" and they verify using value(s) of $n \ge 5$ only	
		For test and for verify:	 For test and for verify: 	
		they say 'test and verify' and they test using	they say 'test and verify' and they test using	
		value(s) of $n \le 4$ and then verify using	value(s) of <i>n</i> ≤4 and then verify using	
		value(s) of <i>n</i> ≥5	value(s) of h≥5	
		• For justify:	• For justify:	
		they say "justify" or "my rule works because"	they say "justify" or "my rule works because"	
		WTTE and their justification is seen	WTTE and their justification is seen	
		 For justify: 	• For justify:	
		they substitute at least two values of <i>n</i> and say	They assume quadratic model (or 2 nd diff 8 OE)	
		"the rule justified" or "it works" WTTE	and get values of coefficient(s) using any method	
		• For justify:	For justify:	
		They assume quadratic model (or $2^{n\alpha}$ diff 8 OE)	They justify the general rule for A geometrically	
		and get values of coefficient(s) using any method	and for a general rate for a geometrically	
		• For justify:		
		They justify the general rule for A geometrically		

n	Longer base of trapezium (<i>L</i>)	Smaller base of trapezium (S)	Height (<i>H</i>)	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	2 <i>n</i> + 1	$(2n + 1)^2$