

Markscheme

May 2021

Mathematics

On-screen examination

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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 OE	2
	.2 4	<i>Ex:</i> $49 = 45 + x$.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.

- 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 as 1.9 ; 12,000 or 12 000 as 12000
- Accept notation errors in intermediate steps.
- Ignore further working after a correct answer **unless** noted otherwise.
- In the case when a correct result is obtained using incorrect seen method, do not award the mark for the result.
- Where candidates have written two solutions to a question, mark the first solution.
- 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 $\frac{1}{2}$ 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%
- 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 equation not in-line.
- Calculator screenshots are accepted as working steps. And when a calculator screenshot is taken, accept not seeing the whole operation.
- 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.
- ACCEPT using the correct values regardless their previous result.

Question		Answers	Notes	Total
1	a	correctly place all four values		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
	c	.1 correctly write their probability of $A \cap B'$.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 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)%	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	.1 their $\frac{4}{10} \times$ their $\frac{6}{9}$ OE , ACCEPT 0.266(66..) or 0.267 seen .1 consider their 4 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 their 4 from their probability used in 1c .3 their $\frac{8}{15}$ OE , ACCEPT 0.533(33...)	3

Question	Answers	Notes	Total																				
<p>2 a</p>	<p>.1 correctly write one value .2 correctly write second value .3 correctly write third value</p>	<table border="1" style="width: 100%; text-align: center;"> <tr> <td rowspan="3" style="background-color: #e0e0e0; width: 15%;">Addition grid</td> <td style="width: 10%;">+</td> <td style="width: 10%;">$\sqrt{5}$</td> <td style="width: 10%; background-color: #f8d7da;">$-\sqrt{5}$</td> </tr> <tr> <td>$\sqrt{20}$</td> <td style="background-color: #f8d7da;">$3\sqrt{5}$</td> <td>$\sqrt{5}$</td> </tr> <tr> <td>$\sqrt{45}$</td> <td style="background-color: #f8d7da;">$4\sqrt{5}$</td> <td>$2\sqrt{5}$</td> </tr> </table> <p>OR</p> <table border="1" style="width: 100%; text-align: center;"> <tr> <td rowspan="3" style="background-color: #e0e0e0; width: 15%;">Addition grid</td> <td style="width: 10%;">+</td> <td style="width: 10%;">$\sqrt{5}$</td> <td style="width: 10%; background-color: #f8d7da;">$-\sqrt{5}$</td> </tr> <tr> <td>$\sqrt{20}$</td> <td style="background-color: #f8d7da;">$\sqrt{45}$</td> <td>$\sqrt{5}$</td> </tr> <tr> <td>$\sqrt{45}$</td> <td style="background-color: #f8d7da;">$\sqrt{80}$</td> <td>$2\sqrt{5}$</td> </tr> </table> <p>ACCEPT only the forms and notations above</p>	Addition grid	+	$\sqrt{5}$	$-\sqrt{5}$	$\sqrt{20}$	$3\sqrt{5}$	$\sqrt{5}$	$\sqrt{45}$	$4\sqrt{5}$	$2\sqrt{5}$	Addition grid	+	$\sqrt{5}$	$-\sqrt{5}$	$\sqrt{20}$	$\sqrt{45}$	$\sqrt{5}$	$\sqrt{45}$	$\sqrt{80}$	$2\sqrt{5}$	<p>3</p>
Addition grid	+	$\sqrt{5}$		$-\sqrt{5}$																			
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	$\sqrt{45}$	$\sqrt{80}$	$2\sqrt{5}$																				
<p>b</p>	<p>.1 correctly write two values .2 correctly write third value .3 correctly write fourth value</p>	<table border="1" style="width: 100%; text-align: center;"> <tr> <td rowspan="3" style="background-color: #e0e0e0; width: 15%;">Multiplication grid</td> <td style="width: 10%;">×</td> <td style="width: 10%;">$2b$</td> <td style="width: 10%; background-color: #f8d7da;">$4ab^{-2}$</td> </tr> <tr> <td>$\frac{7}{2}a$</td> <td style="background-color: #f8d7da;">$7ab$</td> <td>$14a^2b^{-2}$</td> </tr> <tr> <td style="background-color: #f8d7da;">$3a^4b$</td> <td style="background-color: #f8d7da;">$6a^4b^2$</td> <td>$12a^5b^{-1}$</td> </tr> </table> <p>If any of the values are correct but not in exactly the form and notation above, award marks as appropriate then subtract one mark</p>	Multiplication grid	×	$2b$	$4ab^{-2}$	$\frac{7}{2}a$	$7ab$	$14a^2b^{-2}$	$3a^4b$	$6a^4b^2$	$12a^5b^{-1}$	<p>3</p>										
Multiplication grid	×	$2b$		$4ab^{-2}$																			
	$\frac{7}{2}a$	$7ab$		$14a^2b^{-2}$																			
	$3a^4b$	$6a^4b^2$	$12a^5b^{-1}$																				

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 $13.4(164.....)$	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 .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 .2 Ex: $\frac{\text{their } 163 \times 1000}{0.2}$ OE .3 $(\frac{163000}{0.2} =) 815000$</p> <p>AM2 (when they start by doing operations to number of viewers)</p> <p>.1 815000 .2 Ex: their $815000 \times \frac{0.2}{1000}$.3 Ex: their $163 \times 4 - 150$</p> <p>AM3 (when they set an equation)</p> <p>.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 $812500 \times 0.2 = 162500$, $163000 \div 0.2 =) 815000$</p>	3
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Question	Answers	Notes	Total
<p>5 a</p>	<p>AM1 (using sin or cos ratios) .1 correctly divide by two the 150 AND 5.4 .2 correctly substitute into trig ratio .3 correct value of r before rounding AG 2.80</p> <p>AM2 (using sine rule) .1 correctly substitute into sine rule .2 correctly rearrange for r on one side .3 correct value of r before rounding AG 2.80</p> <p>AM3 (using cos rule) .1 correctly substitute into cosine rule .2 correctly rearrange for r^2 on one side .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 .2 correctly substitute tan15 or tan75 ratio into Pythagoras .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 .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 (r =)2.79(52....) .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 .2 (r =) $\frac{5.4 \times \sin 15}{\sin 150}$ OE .3 (r =)2.79(52....) .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 .2 (r² =) $\frac{5.4^2}{2 - 2\cos 150}$ OE , or 7.81(33..) seen .3 (r =)2.79(52....) .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 .2 $r^2 = 2.7^2 + 2.7^2 \tan^2 15$ or (r² =) $2.7^2 + \frac{2.7^2}{\tan^2 75}$ OE or 7.81(33..) seen .3 (r =)2.79(52....) .3 ACCEPT their correct r due to earlier rounding provided it rounds to 2.8</p>	<p>3</p>

<p>5</p>	<p>b</p>	<p>AM1 .1 correctly substitute 2.8 into volume of sphere formula .2 correctly substitute 2.86 into volume of cone formula .3 evidence of equating their volumes .4 correctly calculate their h after solving their equation AM2 (when using sin or cos) .1 correctly substitute correct values into trig ratio OR sine rule .2 correctly calculate slant height .3 correctly substitute their slant height into Pythagoras .4 correctly calculate their h using Pythagoras 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 .4 correctly calculate their h after multiplying by tan75 OR dividing by tan15</p>	<p>AM1 .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 $\frac{\pi 2.86^2 h}{3}$ OE or 8.56(56..)h , ACCEPT using pi or 3.14 instead of π .3 their $\frac{\pi 2.86^2 h}{3} = \text{their} \frac{10976\pi}{375}$ OE .4 (h=) their 10.7(3499...) .4 ACCEPT their 10.7(34999...) only if one of .1, .2, or .3 is awarded AM2 (when using sin or cos) .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 .2 (x =) 11.05(019...) .3 (h² =) 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 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 $2.86 \times \tan 75$ or (h =) $2.86 \times \tan \text{their } 75$ OR $\frac{\text{their } 2.86}{\tan 15}$ or $\frac{2.86}{\tan \text{their } 15}$.4 (h =) their 10.67(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"</p>	<p>4</p>
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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	<p>AM1 (using the 12-hour clock)</p> <p>.1 Maximum at 12:00 pm</p> <p>.2 Minimum at 12:00 am</p> <p>AM2 (using the 24-hour clock)</p> <p>.1 Maximum at 12:00 (am/pm)</p> <p>.2 Minimum at 24:00 (am/pm)</p> <p>AM1 (using the 12-hour clock)</p> <p>.2 ACCEPT 0:00 am</p> <p>AM2 (using the 24-hour clock)</p> <p>.2 ACCEPT 0:00</p> <p>SC for 1 mark Maximum at 24:00 (am/pm) and Minimum at 12:00 (am/pm)</p>	2
	c	.1 Amplitude 0.5 OE .2 Period 24	2
	d	.1 Maximum 37 .2 Minimum 36	2
	e	<p>.1 evidence of substituting 7.25 into the correct formula</p> <p>.2 correctly calculate their B using their substituted t</p> <p>.3 correctly round their calculated value to 1 dp</p> <p>.1 $(B =) -0.5\cos(7.25 \times 15) + 36.5$ ACCEPT incorrect use of brackets</p> <p>.2 their 36.66(071973....) , ACCEPT not seeing this step</p> <p>.3 their 36.7 ACCEPT 33 if their .2 is 32.99(8...) or 33.046(8...)</p>	3
	f	<p>.1 correctly write the equation modelling Ray's temperature</p> <p>.1 $R = -0.5\cos 15t + 36.75$ (using R or any other letter) ACCEPT $B = -0.5\cos 15t + 36.75$ ACCEPT $-0.5\cos 15t + 36.75$</p>	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=) their4 (am) or 4:00 OE</p> <p>.4 ignore incorrect time of day after seeing their 4</p> <p>.4 ACCEPT their t or their time of day after solving correctly their linear equation of .1</p> <p>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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7 c

.1 any two from

- 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]

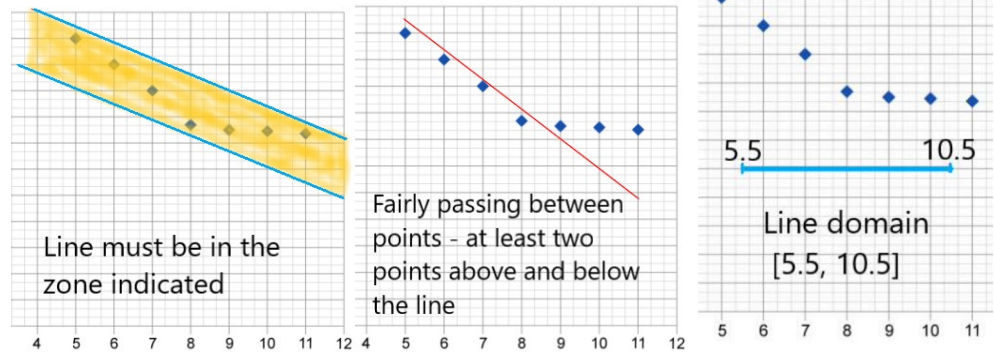
.2 the third from

- 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]

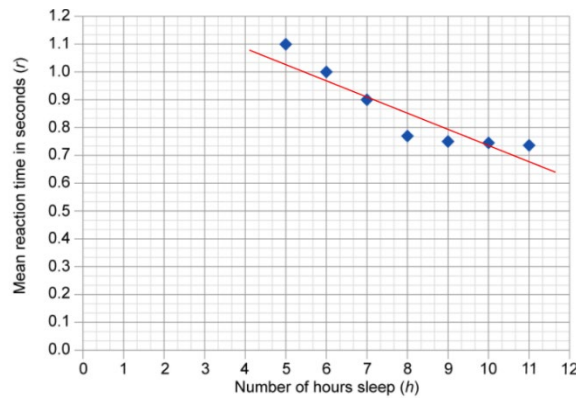
DO NOT award any marks for horizontal line

DO NOT award any marks if they have more than one line drawn

DO NOT award any marks if their line has positive gradient



Ex:



2

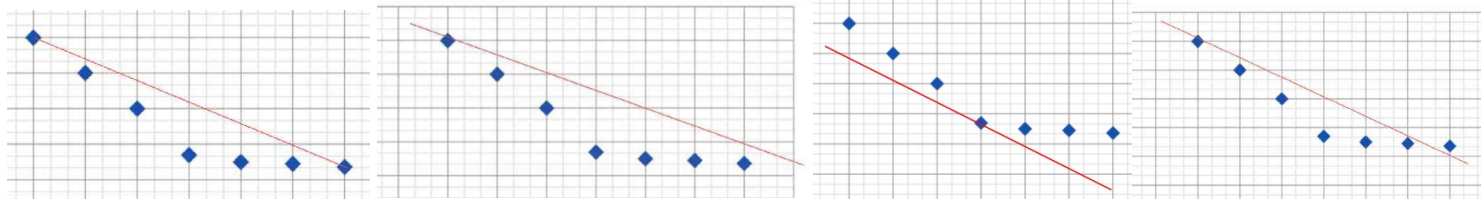
Examples acceptable for (2 marks)



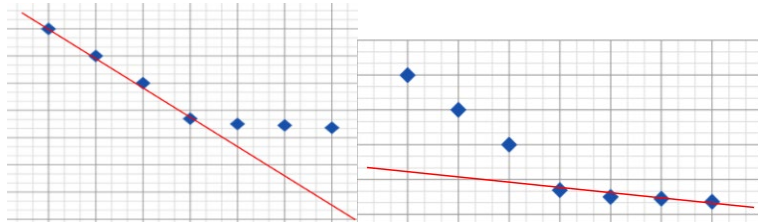
Further examples of different scenarios on the next page

7

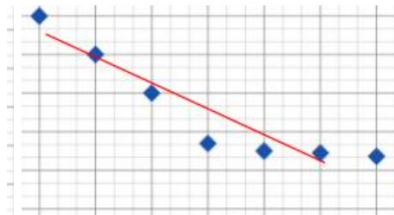
Examples acceptable for (1 mark)



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

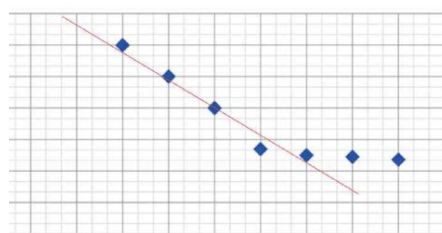


fairly passing through points **and** domain at least [5.5.10.5], **but** the line is not within the zone. Award 1 mark

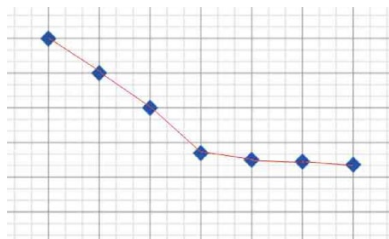


line is within the zone **and** fairly passing through points **but** domain not at least [5.5.10.5] Award 1 mark

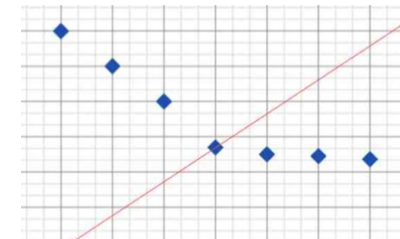
Examples not acceptable (0 marks)



Line is not within the zone and domain is not [5.10.5] Award 0 marks



more than one line drawn. Award 0 marks



their line has positive gradient. Award 0 marks

- 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	.1 correctly substitute 0.77 into the formula .2 correct value of w .3 correctly round their w to 2 sf	.1 $(w =) 24(100)^{-0.77}$.2 0.692(1675608...) ACCEPT not seeing this step .3 their 0.69 OE	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</p> <p>inaccurate with weak justification</p> <p>Ex:</p> <ul style="list-style-type: none"> -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>OR</p> <p>Accurate with acceptable justification</p> <p>Ex:</p> <ul style="list-style-type: none"> -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>ACCEPT accurate due to rounding only if they mention the degree of accuracy of their rounding</p> <p>DO NOT ACCEPT</p> <ul style="list-style-type: none"> -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>DO NOT ACCEPT just seeing their values rounded correctly</p>	<p>Inaccurate with good justification</p> <p>inaccurate AND state that the relation between reaction time and sleeping cannot be linear WTTE</p> <p>OR</p> <p>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	<p>.1 correctly describe one pattern for longer base in words with correct terminology</p> <p>ACCEPT complete terminology only, for example (below are four different descriptions) 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</p> <p>.2 correctly describe a second pattern for longer base in words with correct terminology</p> <p>DO NOT ACCEPT incomplete terminology, for example: 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: 2 times <i>n plus 2</i>, <i>n multiplied by 2 plus 2</i>, 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</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</p> <p>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></p>	2
	c	<p>.1 the correct general rule</p> <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 $L=n^2+2$ 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

<p>8</p>	<p>d</p>	<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>	<p>3</p>
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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</p> <p>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</p> <p>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 $A = L \times S + 1$ ACCEPT non-simplified and ignore incorrect notation.</p>	<p>Correctly describe a pattern in words for A</p> <p>AND</p> <p>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</p> <p>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</p> <p>AND</p> <p>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
<p>Testing (T)</p>	<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>		
<p>Verifying (V)</p>	<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</p> <p>Ex: Substitute at least two other values of n in A and say they are the same or the rule works</p> <p>OR</p> <p>Quadratic model and valid attempt to find coefficients or correctly find one coefficient using any method</p> <p>OR</p> <p>They substitute into area of trapezium formula at least one from the $L=2n+2$, $S=2n$ and $H=2n+1$</p> <p>OR</p> <p>A is the square of H and $H=2n+1$ OE</p>	<p>Justify their general rule arithmetically</p> <p>Quadratic model and get correct values of coefficients using any method</p> <p>OR</p> <p>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</p> <p>Ex: They substitute into area of trapezium formula $L=2n+2$, $S=2n$ and $H=2n+1$ but simplify incorrectly</p> <p>OR</p> <p>They substitute into area of trapezium formula at least two from $L=2n+2$, $S=2n$ and $H=2n+1$ and simplify correctly</p> <p>Ex: $\frac{(2n+2)+2n}{2}h = (2n+1)h$</p>	<p>Correctly justify the general rule for A geometrically</p> <p>They substitute into area of trapezium formula $L=2n+2$, $S=2n$ and $H=2n+1$</p> <p>And simplify correctly</p> <p>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</p> <p>Ex: $A=(S+1)^2$ or $A=H^2$ or $A=SH+H$ or $A=(n+1)^2$ OE</p> <p>OR</p> <p>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 $T=(2n+1)^2$</p> <p>OR</p> <p>Correctly describe a pattern in words for A</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 A</p> <p>The general rule: $A=(2n+1)^2$ or $A=(2n+1)(2n+1)$ or $A=4n^2+4n+1$</p> <p>ACCEPT $A(n)=(2n+1)^2$ or $A_n=(2n+1)^2$</p> <p>OR</p> <p>The notation of <u>the general</u> rule includes errors</p> <p>AND Correctly describe a 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</p> <p>AND</p> <p>Correctly describe a pattern in words for A</p>

Mark	1	2	3
<p>Communication (L)</p> <p>Organisation and coherence</p> <p>Can be awarded even there are errors in their descriptions and working.</p>	<p>At least three from the following are seen:</p> <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>At least four of the following are seen:</p> <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:</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 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</p> <p>At least four of the following are seen:</p> <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:</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 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

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