Markscheme

May 2025

Mathematics

On-screen examination

29 pages

Markscheme abbreviations

MS : Markscheme
OE : Or equivalent
SC : Special case
AM : Alternative method **AM1, AM2 etc**
[ ]: Answers within a range Ex: $[4,5]$ this means values between 4 and 5 inclusive ($4 \leq x \leq 5$) are accepted
] [: Answers within a range Ex: $]4,5[$ this means values between 4 and 5 not inclusive ($4 < x < 5$) are accepted
bp : Bullet notation Ex: **.1** (bp1) or **.2** (bp2) or **.3** (bp3) etc bullet notation means award one mark – see example below
bp2 implies bp1 : Seeing bp2 award the mark for bp2 and bp1 whether bp1 is not seen or if bp1 is incorrect

Example 1
.1 mark awarded and corresponding notes are aligned

b	**.1** Show clear line of reasoning in the method	**.1** 45 and 490 seen **OE** *Ex:* $490 = 10(45 + x)$	**Award 1 mark**
	.2 The value of x	**.2** 4	**Award 1 mark**

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.

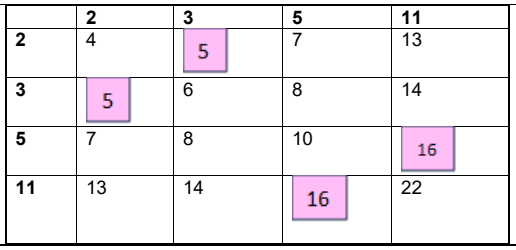
General notes

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 "their5.7(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	.1 Correct value for a	.1 (a =) 4 ACCEPT 4^4 or 4^4 or in words DO NOT ACCEPT 4x4x4x4=256	**1**
	b	The two values are b = 2 and c = – 1 .1 Correct value for one from b OR c .2 Correct value for the second from b and c	ACCEPT 2^2 or 2^2 or in words instead of b = 2 ACCEPT 3^{-1} or 3^-1 or in words instead of c = – 1	**2**
	c	.1 Correctly convert $\sqrt{45}$ into $3\sqrt{5}$ .2 Correct value for d .3 Correct value for e	.1 $(\sqrt{45} =)3\sqrt{5}$ ACCEPT three root five .2 d = 2 ACCEPT $d\sqrt{e} = 2\sqrt{k}$ or $-d\sqrt{e} = -2\sqrt{k}$ .3 e = 5 ACCEPT $d\sqrt{e} = k\sqrt{5}$ or $-d\sqrt{e} = -k\sqrt{5}$ **For this part, ACCEPT answers in words. Ex: two root five** **For this part, ACCEPT bp2 and bp3 regardless of their previous working**	**3**

Q2		Answers	Notes	Total
	a	The values are 3, 3, and 13.5 .1 Correctly write two of the values above .2 Correctly write the third of the values above	$2x + \boxed{3}y = 11.5$ $\boxed{3}x + 2y = \boxed{13.5}$	2

Q2		Answers	Notes	Total
	b	**For AM1 or AM2** **If they use in part 2b) equations different than what they have in part 2a), consider the equations used in part 2b)**	**<u>When their equations in part a) are not the correct equations</u>** DO NOT ACCEPT AM1 bp1 or AM2 bp2 if their equations are simpler (i.e both equations have same coefficient for x or for y OR one of the coefficients is zero) Examples: $2x + 3y = 11.5$ and $2x + 2y = 13.5$ $2x + 2y = 11.5$ and $3x + 2y = 13.5$ $2x + 3y = 11.5$ and $0x + 2y = 13.5$ $2x + 0y = 11.5$ and $3x + 2y = 13.5$	
		using elimination or substitution	**using elimination or substitution**	
		.1 **using elimination** Correctly multiply by a number **one** of **their equations from part 2a)**	.1 **using elimination** Ex: $6x + 9y = 34.5$ or $6x + 4y = 27$ or $4x + 6y = 23$ or $9x + 6y = 40.5$	
		.1 **using substitution** Correctly write their x in terms of y OR their y in terms of x using **one** of **their equations from part 2a)**	.1 **using substitution** Ex:(x =)their: $\frac{(11.5-3y)}{2}$ or $\frac{(13.5-2y)}{3}$ OE OR (y =)their: $\frac{(11.5-2x)}{3}$ or $\frac{(13.5-3x)}{2}$ OE ACCEPT the use of decimals. Ex: using 1st equation: $y = 3.8 - 0.67x$	**4**
		.2 Correctly write as one equation in one unknown **their two equations from part 2a)**	.2 Ex: $9y - 4y = 34.5 - 27$ or $9x - 4x = 40.5 - 23$ or their $\frac{3(11.5-3y)}{2} + 2y = 13.5$ or their $3x + \frac{2(11.5-2x)}{3} = 13.5$ ACCEPT the use of decimals. Ex: $3x + 2(3.8 - 0.67x) = 13.5$ **bp2 implies bp1**	
		.3 Correct value of x or y that satisfies **their equation in bp2**	.3 (x =)their3.5 OE or (y =)their1.5 OE ACCEPT notation errors Ex: $\text{their}\frac{10.5}{3}$ or $\text{their}\frac{7.5}{5}$ .3 DO NOT ACCEPT if negative .3 ACCEPT the value as decimal only if it is correct Ex: using $3x + 2(3.833 - 0.6667x) = 13.5$ they get x = 3.50 .3 DO NOT ACCEPT the use of decimals if the value is incorrect. Ex: using $3x + 2(3.8 - 0.67x) = 13.5$ they get x = 3.55	
		.4 Correctly write their corresponding unknown using **one** of their equations **from part 2a)**	.4 (x =) their3.5 OE for their (y =)their1.5 OE or (y =)their1.5 OE for their (x =)3.5 OE .4 ACCEPT notation errors Ex: $\text{their}\frac{10.5}{3}$ or $\text{their}\frac{7.5}{5}$ .4 DO NOT ACCEPT if negative	

Q3		Answers	Notes	Total
	a	.1 Correctly write the four values		**1**

REMEMBER the general note:
I) Unless noted otherwise, **ACCEPT** using the correct values or working regardless their previous result.
This means that regardless their response in part 3a), we accept 6/16 in part 3b) and 9/16 in part 3c)

	b	.1 Correctly write **their** number of prime numbers, from part 3a), in the numerator .2 Correct denominator	.1 their 6 in the numerator .2 16 in the denominator $\frac{\text{their6}}{16}$ OE or 6/16 award **2 marks**	**2**
	c	.1 Correctly write **their** sum of prime and square numbers, from part 3a), in the numerator .2 Correct denominator	.1 their9 in the numerator .2 16 in the denominator $\frac{\text{their9}}{16}$ OE or their9 /16 award **2 marks**	**2**

	d	.1 Correct mathematical terminology	mutually exclusive ACCEPT disjoint or incompatible or non-compatible DO NOT ACCEPT other descriptions. Ex: not simultaneous, not overlapping, opposing, non-related, not intersecting,...etc	**1**

<table>
<tr><th colspan="2">Q4</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td></td><td>a</td><td>.1 Correctly subtract 650 from 800

.2 Divide their difference in bp1 by 800 OR subtract their percentage from 100

.3 Correctly write their bp2 as percentage</td><td>.1 (800-650=)150

.2 $\frac{\text{their}150}{800}$ OE ACCEPT $\frac{800-\text{their}650}{800}$
OR $100-\frac{650}{800}\times 100$ ACCEPT $1-\frac{650}{800}$

.3 their 18.75(%) ACCEPT their18.8(%) or their19(%)
.3 ACCEPT only if $0<\text{their}18.75<100$
.3 DO NOT ACCEPT if denominator of their fraction is not 800

0.1875 or 0.188 or 0.19 without working award 1 mark
18.75 or 18.8 or 19 (%) without working award 2 marks

Examples of responses and respective marks
<table>
<tr><th>Response</th><th>Marks awarded</th></tr>
<tr><td>$\frac{650}{800}$</td><td>0 marks</td></tr>
<tr><td>$\frac{200}{800}=25$</td><td>1 mark (bp3 awarded)</td></tr>
<tr><td>$\frac{650}{800}=81$</td><td>1 mark (bp3 awarded)</td></tr>
<tr><td>$\frac{800-650}{800}=0.19$</td><td>2 marks (bp2 awarded as they divided their difference by 800 and bp1 awarded as the 150 is evident from the calculation of the result 0.19)</td></tr>
<tr><td>$800-650=350$ and $\frac{350}{800}=44$</td><td>2 marks (bp2 and bp3 awarded)</td></tr>
<tr><td>$\frac{800-400}{800}=0.5$</td><td>1 mark (bp2 awarded as they divided their difference by 800)</td></tr>
<tr><td>$\frac{800-400}{800}=50\%$</td><td>2 marks (bp2 and bp3 awarded)</td></tr>
<tr><td>300 so $\frac{500}{800}=62.5$</td><td>2 marks (bp2 and bp3 awarded)</td></tr>
</table></td><td>3</td></tr>
</table>

	b	.1 Correctly write two of the values .2 Correctly write a third value .3 Correctly write a fourth value .4 Correctly write a fifth value		**Female**	**Male**	**4**
			Lower quartile	2.4 kg	1.1 ACCEPT [1,1.1]	
			Median	3.1 kg	4 ACCEPT [4,4.1]	
			Upper quartile	3.7 ACCEPT [3.65,3.75]	5.9 kg	
			IQR	their 1.3	their 4.8	
	c	.1 Correct statistical term .2 Correct statistical term	.1 median .1 DO NOT ACCEPT if additional statistic is mentioned. Ex: median and LQ .2 interquartile range or IQR .2 DO NOT ACCEPT if additional statistic is mentioned. Ex: IQR and UQ			**2**

Q5		Answers	Notes	Total
	a	.1 Correct equation	.1 $5x(x+3)=140$ OE ACCEPT notation errors. Ex: $5x \times x+3=140^2$ .1 DO NOT ACCEPT $5x+(x+3)=140$	4
		.2 Correctly write **the** quadratic in the form ax^2+bx+c (= 0)	.2 $5x^2+15x-140(=0)$ or $x^2+3x-28(=0)$ OE **bp2 implies bp1**	
		.3 Correctly factorize **their quadratic in bp2** OR correctly substitute **their** coefficients into the quadratic formula	.3 **their:** $5(x-4)(x+7)$ or $(5x-20)(x+7)$ or $(x-4)(x+7)$ OE OR **their:** $\frac{-15\pm\sqrt{15^2-4\times5\times-140}}{2\times5}$ or $\frac{-3\pm\sqrt{3^2-4\times1\times-28}}{2}$ .3 ACCEPT for the quadratic formula to see only the $+\sqrt{\ }$ and not $\pm\sqrt{\ }$ .3 ACCEPT the root sign not extended. Ex: $\frac{-15+\sqrt{15^2-4\times5\times-140}}{2\times5}$ **The correct quadratic in bp3 implies bp1 or bp2 but not both**	
			.3 ACCEPT their simpler quadratic, $ax^2+c=0$ or $ax^2+bx=0$ only if they solve it correctly for the positive value Ex: If their quadratic is $5x^2+15=140$ and they get $x=5$	
		.4 Correctly identify **the** value of x as 4	.4 $(x=)4$ .4 ACCEPT if we see in part 5a) x =4 and x =−7 then we see they used x =4 in part 5b)	

	b	.1 Correctly determine their Length and Width	.1 (their4 + 3 =) their7 AND (5xtheir4 =) their20	**1**
	c	.1 Correct area ratio .2 Correct length ratio .3 Correctly multiply **3** by **their** Length AND **their** Width	.1 $\frac{1260}{140}$ or 9 ACCEPT $\frac{1}{9}$ OE .2 $(\sqrt{9})$ = 3 ACCEPT $\frac{1}{3}$ OE **bp2 implies bp1** .3 (L=3xtheir7=) their21 AND (W=3xtheir20=) their60 .3 ACCEPT if their L and their W here are different from their part 5b)	**3**

Q6	Answers	Notes	Total
a	.1 Correctly divide TV by 2 .2 Correctly substitute 1100 into a trig ratio .3 **The** correct value of h before rounding AG 3022	.1 ($\frac{2200}{2}$ =)1100 ACCEPT $\frac{2200}{2}$ seen even within working .2 tan 70 = $\frac{h}{1100}$ or (h =)1100tan70 or $\frac{1100}{\tan 20}$ or $\frac{h}{\sin 70}$ =$\frac{1100}{\sin 20}$ ACCEPT 3022 instead of h .2 ACCEPT using cosine or sine ratio and then using Pythagoras correctly Ex: $\left(\frac{h}{\sin 70}\right)^2 - 1100^2 = h^2$ or $\left(\frac{1100}{\cos 70}\right)^2 = 1100^2 + h^2$ .3 3022.2(25....) .3 ACCEPT using rounded trig ratio only if the value of h rounds to 3022. Ex: using tan70=2.747 and h being 3021.7	**3**
b	.1 Correctly substitute into area of triangle formula .2 **The** correct value of area	.1 (Area=) $\frac{1}{2} \times 2200 \times 3022$ OE ACCEPT their3022.2(25…) instead of 3022 .1 ACCEPT calculating UV then using the formula $\frac{1}{2}ab\ sinC$ Ex: $\frac{1}{2} \times (\frac{1100}{\cos 70} \times \sin 70) \times 2200 \times \sin 70$ OE .2 3 324 200 ACCEPT [3 320 000, 3 324 500] .2 ACCEPT [3.32 , 3.3245] only if they write km^2	**2**
c	.1 Correct fraction of area OR correct area of circle .2 **The** correct substitution into area of sector formula .3 **The** correct value of area before rounding AG 4 040 000	.1 $\frac{40}{360}$ or $\frac{1}{9}$ OE OR $\pi \times 3400^2$ OE ACCEPT using 3.14 or $\frac{22}{7}$ or pi instead of π .1 ACCEPT area of circle only if seen on its own or multiplied by their fraction of area .2 $\frac{40}{360}\pi \times 3400^2$ OE ACCEPT using 3.14 or $\frac{22}{7}$ or pi instead of π .3 4 035 201(.231) ACCEPT only if in the range [4 035 000 ,4 036 000]	**3**

d	.1 Correctly substitute their A **from part 6b)** into the formula .2 Correctly calculate their E **from their bp1**	.1 (E =) $\frac{1}{700} \times \text{their}3324200 \times 15^2$ ACCEPT 1/700xtheir3324200x15^2 .1 ACCEPT any number instead of their A from part 6b) only if they have NR in their part 6b) .2 Their 1 068 492.8(57) or their 1 068 493 .2 ACCEPT correctly calculating $\frac{(\text{their}3324200 \times their15)^2}{\text{their}700}$ or $\frac{\text{their}3324200 \times \text{their}15}{\text{their}700}$ Only if it is their bp1 .2 ACCEPT correctly rounded values Ex: 1 068 500 or 1 069 000 or 1 070 000 .2 DO NOT ACCEPT values rounded less than 3 significant figures.	**2**
e	.1 Correctly substitute into the formula .2 Correctly rearrange **their bp1** for their d^2 on one side .3 **The** correct value of d	.1 $1500000 = \frac{1}{700} \times 4040000 \times d^2$ .2 $\frac{1500000 \times 700}{4040000}$ OE or 259.9(0...) or 260 ACCEPT $\frac{\text{their}1500000 \times \text{their}700}{\text{their}44040000}$ or $\frac{E \times 700}{A}$ .2 ACCEPT the correct rearrangement in decimals even if the rounding is incorrect **Seeing** $\frac{1500000 \times 700}{4040000}$ **implies bp1** .3 16(.12...) **Note for part 6e: to award 3 marks, bp2 has to be seen**	**3**
f	.1 Square 1.1 .2 **The** correct percentage increase of E	.1 1.1^2 or 1.21 or 1.21% or 121(%) .1 ACCEPT seeing their 1.1d squared Ex: $(1.1 \times \text{their}16 = \text{their}17.6$ squared=)$\text{their}17.6^2$ OE .2 21(%)	**2**

Q7	Answers	Notes	Total
a	.1 Correct distance D_1	.1 (16 + 32 =)48	**1**
b	.1 **Two** from: • Subtract correct y -coordinates • Subtract correct x -coordinates • Divide their difference in y by **their** difference in x .2 **The** correct gradient .3 Correctly substitute P(16,12) or B(32,16) into **their** $y = mx + c$ OR **their** $m = \frac{y-y_1}{x-x_1}$ .4 **The** correct equation	.1 **Two** from: • 16 – 12 or 12 – 16 or 4 or –4 • 32 – 16 or 16 – 32 or 16 or –16 • Their(16 – 12)/their(32 – 16) .2 (gradient or m =)0.25 OE ACCEPT y =0.25x OE **bp2 implies bp1** .3 Ex: 16=their0.25 x 32 + c or $\text{their}0.25 = \frac{y-16}{x-32}$ or $\text{their}0.25 = \frac{y-12}{x-16}$ .3 ACCEPT 16=12m +c .4 $y = 0.25x + 8$ or $0.25 = \frac{y-16}{x-32}$ or $0.25 = \frac{y-12}{x-16}$ OE .4 DO NOT ACCEPT 0.25x+8	**4**
c	.1 Correctly substitute into distance formula OR into Pythagoras .2 **The** correct length of PB .3 Correct sum of 20 and **their**PB rounded to **two** decimal places	.1 $\sqrt{((32-16)^2+(16-12)^2)}$ or$\sqrt{16^2+4^2}$ OR $(PB^2 =)(32-16)^2+(16-12)^2$ or $(PB^2 =)16^2+4^2$ .2 (PB=) $\sqrt{272}$ or 16.49(24…) ACCEPT 16.5 .3 (D_2=20+their16.49(24…)=)their36.49 .3 DO NOT ACCEPT if theirPB does not need rounding .3 ACCEPT the rounding to two decimal places seen in bp2	**3**
d	.1 Correctly substitute into the formula $\frac{\lvert\text{their part 7c}) - \text{their part 7a})\rvert}{\text{their part 7a})} \times 100$ .2 Correctly calculate **their** k using **their** values from bp1	.1 $\frac{\lvert\text{their}36.49 - \text{their}48\rvert}{\text{their}48} \times 100$ ACCEPT $\frac{\lvert\text{their}48 - \text{their}36.49\rvert}{\text{their}48} \times 100$ .1 ACCEPT not seeing the absolute value notation .2 their23.979...(%)… or their23.98(%) or their24(%) .2 DO NOT ACCEPT if negative	**2**

7e

Mark	1	2
Identify factors (F) **ignore additional factors**	**Two** from the factors below mentioned in the factors' response box 1) Price or cost WTTE ACCEPT Robot 1 is for 1000 and Robot 2 is for 1200 2) Speed OR Time WTTE ACCEPT velocity, how fast it goes OR duration, how long it takes to deliver 3) Percentage difference or the value of k WTTE ACCEPT The way the robot moves, parallel to walls or directly, mobility, movement, covered distance or distance travelled, the trajectory	**The three** factors in F1 mentioned in the factors' response box
	DO NOT ACCEPT Incomplete factors. Ex: percentage, distance The size or dimensions or shape of the warehouse Location of point P It stops or not Type of robot	

	1	2	3	4
Calc. (C) **ACCEPT rounding in calculations**	Show correct calculation for the minimum value of k $k = \frac{48-48}{48} = 0$ ACCEPT k =0 at P(0,16) and P(32,0) DO NOT ACCEPT k =0 when D_2-D_1=0 OE	Any two from C1	Show correct calculation for the minimum value of k $k = \frac{48-48}{48} = 0$ ACCEPT k =0 at P(0,16) and P(32,0) **AND** Correct length of the diagonal (see C2)	Show correct calculation for the minimum value of k $k = \frac{48-48}{48} = 0$ **AND** Show correct calculation for **the** maximum value of k using the length of diagonal 35.777... or 35.78 or 35.8 and using 48 ACCEPT using the length of diagonal 36 only if correct working is seen in part 7e) Examples: $\frac{\lvert 35.777\ldots-48\rvert}{48} \times 100 = 25.(46\ldots)$ $\frac{48-35.8}{48} \times 100 = 25(.41\ldots)$
	OR Show correct working for the length of the diagonal Ex: $\sqrt{(32^2+16^2)}$ ACCEPT correct calculation for value of D_2 for a pick-up point other than (16,12)	**OR** Correct length of the diagonal seen even within a calculation 35.777... or 35.78 or 35.8 ACCEPT 35.7 or 35.77 ACCEPT 35 or 36 only if correct working is seen in part 7e)	**OR** Show correct calculation for **their** maximum value of k using correct length of the diagonal (see C2) and their 48 from part 7a) Examples: $\frac{\lvert 35.7-52\rvert}{52} \times 100 = 31$ Where 52 is their 48 from part a) $\frac{50-35.77}{50} \times 100 = 28(.46)$ Where 50 is their 48 from part 7a)	
	OR Show working for **their** maximum value of k using their diagonal and their 48 from part 7a) Ex: $\frac{36.49-52}{52} \times 100$ Where 52 is their 48 from part 7a) DO NOT ACCEPT $\frac{\text{their}35.777\ldots-\text{their}48}{\text{their}35.777} \times 100$ ACCEPT maximum value of k is when: P is on the diagonal or travels directly or travels in a straight line			

Mark	1	2
Time (T)	Correctly calculate **their** time for Robot 1 using **their** D_1 from part 7a) $\frac{\text{their}48}{0.75}$=their64(sec)	Correctly calculate **the** time for Robot 1 $\frac{48}{0.75}$=64(sec) **AND** Correctly calculate **the** minimum time for Robot 2 using [35,36] $\frac{[35,36]}{0.5}$= [70,72]
	OR Correctly calculate **their** time for Robot 2 using **their** length of diagonal $\frac{\text{their length}}{0.5}$=their time ACCEPT using their36.49 from part 7c)	

Mark	1	2
Justify (J)	**Buy Robot 1** and relate to Price and speed WTTE **OR** Price and time WTTE Examples: Robot 1 is faster and cheaper Robot 1 takes less time and costs less	**ACCEPT ONLY IF C3 and T2 are achieved** **Buy Robot 1** and relate to Price and speed WTTE **OR** Price and time WTTE
	OR **Buy Robot 1** with T2 achieved	

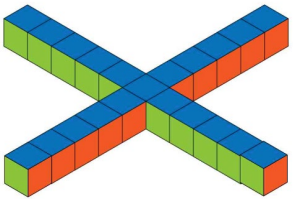
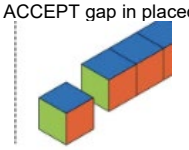
Task 3 QIG 8

Glossary for task 3

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	Incorrect 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	$U_n = U_{n-1} + d$ or $U_{n+1} = U_n + d$. Ex: $V_n = V_{n-1} + 2n + 3$ or $V_{n+1} = V_n + 2n + 5$

We accept subsequent use of their general rule (when marking D, T, V, J, N, and L) 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
$4n$ + 1	linear	constant
n^2+4n +1	Quadratic or exponential	Linear or constant

<table>
<tr><th colspan="2">Q8</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td></td><td>a</td><td>Correctly place the two cubes</td><td> 
ACCEPT gap in placed cubes provided the placed cube overlaps with the given diagram. Ex:
  </td><td></td></tr>
<tr><td></td><td>b</td><td>Correctly write 21 and 25</td><td><table><tr><th>Stage (n)</th><th>Number of cubes (C)</th></tr><tr><td>1</td><td>5</td></tr><tr><td>2</td><td>9</td></tr><tr><td>3</td><td>13</td></tr><tr><td>4</td><td>17</td></tr><tr><td>5</td><td>21</td></tr><tr><td>6</td><td>25</td></tr></table></td><td>1</td></tr>
</table>

	c	.1 correctly describe one pattern for C in words .2 correctly describe a second pattern for C in words	ACCEPT complete description only, for example (below are four different descriptions) ➢ odd numbers ➢ increasing by 4, adds 4, goes up by 4, moving up by 4, difference 4, common difference 4, linear with difference 4, arithmetic with difference 4 , bigger by 4, what we add is divisible by 4 ➢ The increase is even or the difference is divisible by 2 or what we add is a multiple of 2 ➢ second difference is zero ACCEPT spelling mistakes Example: Using "incrasin" instead of "increasing" DO NOT ACCEPT incomplete description, for example: Arithmetic, linear, increasing by a constant, constant difference, uneven DO NOT ACCEPT general description, for example: Integers, whole numbers, positive DO NOT ACCEPT the rule in words or description related to n for example: 4 times n plus 1, n multiplied by 4 + 1, WTTE DO NOT ACCEPT n goes up by 1 It is increasing general rules in terms of n , example: $C = 4n + 1$ **Note, in the case when they have more than two different patterns:** If two are accepted award 2 marks If one is accepted award 1 mark	2

	d	.1 the correct general rule .2 the correct simplified general rule with correct notation	.1 (C =) $4n$ + 1 or (C =)$4x$ + 1 or C =5 + 4(n – 1) or (C=)4xn + 1 or (C=)4*n + 1 or $C = n4 + 1$ .2 C = $4n$ + 1 or $4n$ +1=C ACCEPT using $C_n$instead of C ACCEPT using c and N DO NOT ACCEPT description in words	2
	e	·1 Correctly substitute $n \geq 5$ into their general rule (from 8c) or 8d)) ·2 Correctly calculate their value of C after substituting $n \geq 5$ ·3 Recognize that their <u>correctly calculated</u> value of C is the same as the correctly predicted value	.1 Ex: 4 x 5 + 1 .2 Ex: (4 x 5 + 1 =)21 .3 If they use n =5 or n =6 ACCEPT only if they say "as seen in the table" or "so the rule works" WTTE or we see the predicted values re-written here in part e) Ex: n =5, (C =)21 or n =6, (C =)21 .3 If they use n > 6 ACCEPT only if they say "the same as when we continue the pattern" WTTE **and** state how. Ex: for n =7, 29 is obtained from the pattern of adding 4 to 25 (or 29-4=25) **Examples for 3 marks:** 4x5+1=21 hence verified 5, 21 and 4x5+1=21	3
	f		13	1

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

Stage number (n)	Number of cubes (V)
1	6
2	13
3	22
4	33
5	46
6	61
7	78
8	97

Mark	**1**
Predictions (P)	Correctly predict **two** terms for V ACCEPT whether in the table or in the response box ACCEPT additional incorrect predictions

<table>
<tr><th>Mark</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td rowspan="3">Description (D)

ACCEPT incorrect terminologies, notation errors, non-simplified rule, but penalize in notation (N)

Ignore additional incorrect patterns</td><td>Correctly describe one pattern in words for V
Examples of different patterns: (below are three different descriptions)

The pattern is even odd or alternates even odd WTTE

First difference (or the increase WTTE) is odd or uneven or not divisible by 2

Second difference (or the increase of the increase WTTE) is 2 or the difference goes up by 2 or quadratic with 2nd diff of 2

ACCEPT
“Second difference constant” or “Quadratic” <u>only if</u> their working shows second difference is 2</td><td>Correctly describe two patterns in words for V

OR
Correctly describe one pattern in words for V AND their general rule for V as a <u>quadratic</u> satisfying at least one value for n</td><td rowspan="2">Correctly describe two patterns in words for V (or one pattern and the recursive rule for V) AND
Their general rule for V as a <u>quadratic</u> satisfying at least one value for n</td><td rowspan="2">Correctly describe two patterns in words for V (or one pattern and the recursive rule for V)

AND

The general rule for V</td></tr>
<tr><td>OR
Their general rule for V as a <u>quadratic</u> satisfying at least one value for n</td><td>OR
The recursive rule for V :
$V_n = V_{n-1} + 2n + 3$
or $V_{n+1} = V_n + 2n + 5$</td><td>OR
The general rule for V

$(V =)n^2 + 4n + 1$</td></tr>
<tr><td colspan="4">DO NOT ACCEPT
Descriptions of how cubes are added
Goes up by 7,9,11…
Recursive rule in words
Seeing only “quadratic” or “second difference constant” or “the numbers increase in a linear sequence”
Descriptions related to stage number. Ex: “Even if stage number odd and odd if stage number even” or “increases by $2n$ +1”
Incorrect description. Ex: The second difference increases by 2</td></tr>
</table>

Mark	1	2
Testing (T)	Attempt to test their general rule for V using $n \leq 4$ Ex: Correctly substitute in their general rule for V value of $n \leq 4$ **OR** Correctly test their described pattern or their rule (ex: recursive rule or their linear rule for V)	Correctly test their general rule for V using $n \leq 4$ Ex: correctly calculate their value for V in their general rule for V using $n \leq 4$ **AND** Recognise that their correctly calculated value for V is the same as the given value in the table. ACCEPT if their correctly calculated value is the same as the one given in the table.

	1	2	3
Verifying (V)	Attempt to verify their general rule for V using $n \geq 5$ Ex: Correctly substitute in their general rule for V value of $n \geq 5$ **OR** Correctly verify their described pattern or their rule (ex: recursive rule or their linear rule for V)	Correctly calculate their value for V in their general rule for V using $n \geq 5$	**ACCEPT only if they have the general rule for V** Correctly calculate the value for V in the general rule using $n \geq 5$ **AND** Recognise that the correctly calculated value for V is the same as the correct predicted value for V obtained by continuing the pattern. ACCEPT if the correctly calculated value is the same as the one in the table

Mark	1	2	3	4
Justify/ proof (J)	**ACCEPT only if D1 is achieved**	**ACCEPT only if D2 is achieved**	**ACCEPT only if they have the general rule for V** Good attempt to justify **the** general rule for V geometrically	**ACCEPT only if they have the general rule for V** Correctly justify **the** general rule for V geometrically
	Attempt to justify their general rule for V Ex: Quadratic model and valid attempt to find values of coefficients using any method. Showing how one or two of the coefficients are obtained	Attempt to justify: $n^2 + 4n + 1$ OE Ex: Quadratic model and find the correct values of coefficients using any method. Showing how the three coefficients are obtained	Recognize the three terms 1, 4, 9 OE are added to the sequence C Ex: There are 1^2 ,2^2, 3^2 cubes added to $4n$ +1 ACCEPT The **square numbers** are added to C	Recognize the three terms 1, 4, 9 OE are added to the sequence C **AND** Recognize that n^2 is added to the sequence C
	OR Substitute at least two other values of n in the general rule for V and say they are the same or it works WTTE	**OR** Weak attempt to justify **their** general rule for V geometrically Recognize 1, 4, 9,... or the square numbers or n^2 is added to their sequence C from part d)	**OR** Recognize that n^2 is added to the sequence C Ex: cubes on the top are n^2 added to C ACCEPT $V = C + n^2$	

<table>
<tr><th>Mark</th><th>1</th><th>2</th><th>3</th></tr>
<tr><td rowspan="5">Notation and terminology (N)

Ignore additional incorrect patterns</td><td>ACCEPT only if D1 achieved</td><td>ACCEPT only if they have <u>the general rule</u> for V</td><td>ACCEPT only if they have <u>the general rule</u> for V</td></tr>
<tr><td>Correctly describe one pattern for V in words <u>using correct terminology</u> or correct recursive rule for V using correct notation

Example: the increase increases by 2, the second difference is 2, first difference is odd, the pattern is even odd, alternates from even to odd, first difference goes up by 2, 1st diff odd

ACCEPT the difference adds by 2, what we add increases by 2
DO NOT ACCEPT first difference is uneven or not divisible by 2
DO NOT ACCEPT if the pattern is not accepted in D1</td><td>Correctly describe one pattern for V in words <u>using correct terminology</u> (see examples in N1)
AND
the notation of <u>the general rule</u> for V includes errors or not simplified or in words (see examples in N1)</td><td rowspan="3">Correctly describe one pattern for V in words <u>using correct terminology</u> (see examples in N1)
AND
Correct notation of <u>the general rule</u> for V in simplest form (see examples in N2)</td></tr>
<tr><td>OR
The notation of <u>the general rule</u> for V includes errors or not simplified or in words.
Examples:
V =n^2+4n +1, $V = n^2 + 4 \times n + 1$, $V = n \times n + 4n + 1$, $V = 1n^2 + 4n + 1$, The rule for V is $n^2 + 4n + 1$
or $V = n^2 + 4n + 4 - 3$, $V = n(n + 4) + 1$</td><td>OR
Correct notation of <u>the general rule</u> for V in simplest form
$V = n^2 + 4n + 1$ or $V = (n + 2)^2 - 3$

ACCEPT using V_n or Vn or $V(n)$ instead of V</td></tr>
<tr><td>OR
Correct notation of <u>their general rule</u> for V .
Examples:
$V = n^2 + 9$ or $V = n^2 + 4$
ACCEPT if not simplified</td></tr>
<tr><td colspan="3">The following are considered errors in notation
using * for multiplication, using / for division , using ^ for power, using x instead of n
using U_n instead of V without mentioning that $V = U_n$</td></tr>
</table>

Mark	1	2	3
Communication (L) **Organisation and coherence** **Can be awarded even if there are errors** **For items:** **Describing pattern and writing rule can be considered an item even if D0 awarded**	**At least three** from the following **items** are seen: • 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)	**ACCEPT only if they have their general rule for V** **At least four** of the following **items** are seen: • 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) **AND** **For coherence**, they identify the processes correctly. **At least one** from the following: • test • verify • justify Ex: • **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 **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	**ACCEPT only if they have the general rule for V and J2** **The following two items must be seen** : • write the general rule for V • justify the general rule (at least J2) **AND** **At least two** of the following **items** are seen: • describe a pattern or rule in words • test the general rule (at least T1) • verify the general rule (at least V1) **AND** **For coherence**, they identify the processes correctly. **At least two** from the following: • test • verify • justify Ex: • **For test:** they say "test" and they substitute in the general rule for V value(s) of $n \leq 4$ only • **For verify:** they say "verify" and they substitute in the general rule for V value(s) of $n \geq 5$ only • **For justify:** They say "justify" and they write a justification **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