Markscheme

May 2019

Mathematics

On-screen examination

31 pages

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

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

RM Assessor has the following annotations that should be used to award marks:
A0 only use to award a zero mark for an answer that has no merit e.g. awarded for the candidate that has a wrong answer with no working

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

 Marks awarded by stamping the tick

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

 unclear

The markscheme makes use of the following abbreviations:

ECF Marks that can be awarded as **error carried forward** from previous results in the question **BOD** Benefit of the doubt
MR misread
NWS no working shown
SC special case
OE or equivalent
WTTE or words to that effect or accept incomplete calculator display
AG Answer given

• Bullet notation means award 1 mark – see example below

Example 1
- 1 mark awarded and corresponding notes are aligned

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

Error Carried Forward (ECF) marks

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

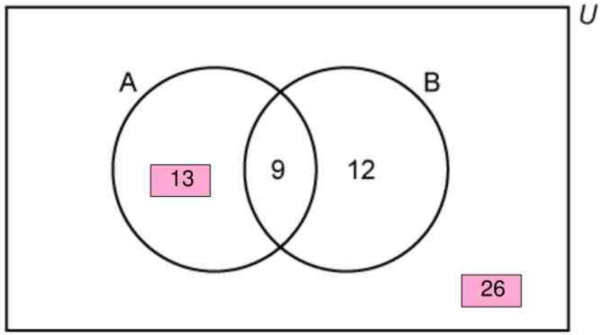
a) **ECF** applies from one part of a question to a subsequent part of the question and also applies within the same part.
b) If an answer resulting from **ECF** is inappropriate (*eg*, negative distances or sin$x$ > 1) then subsequent marks should not be awarded.
c) If a question is transformed by an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

General points

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

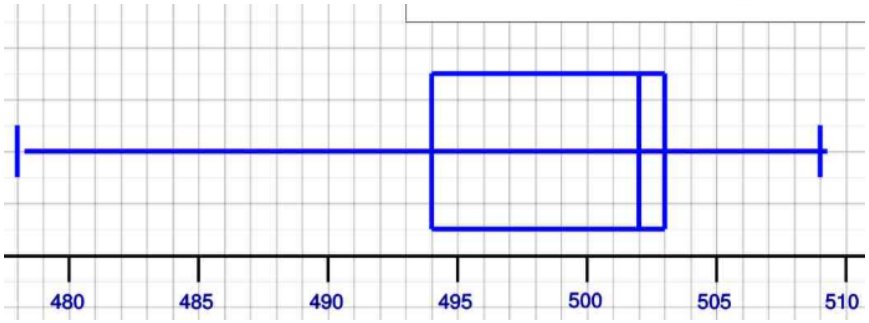
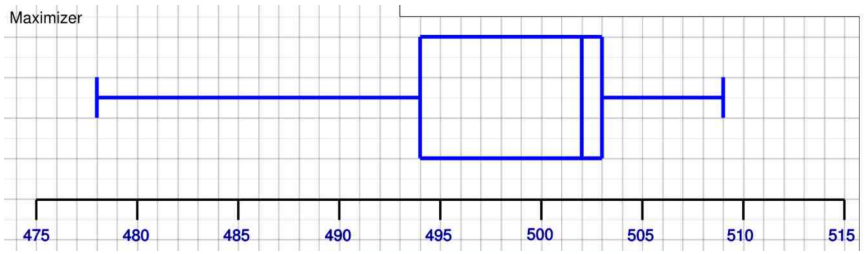
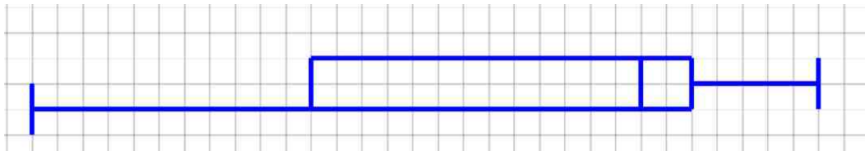
Question		Answers	Notes	Total
1	a	•[1] correctly place one expression •[2] correctly place the other expression **SC** 3 expressions placed and two correct award 1 mark 3 expressions placed and one correct award 0 marks 4 expressions placed award 0 marks	$3x + 4$ Expression 1: $2x + 1 + x + 3$ Expression 2: $(4x + 2) – (x – 2)$	**2**
	b	•[1] correctly place one expression •[2] correctly place another expression •[3] correctly place the third expression **SC** 4 expressions placed and three correct award 2 marks 4 expressions placed and two correct award 1 mark 4 expressions placed and one correct award 0 marks 5 or 6 expressions placed award 0 marks	$6x – 5$ Expression 1: $\frac{12x^2 – 10x}{2x}$ Expression 2: $2(3x + 4) – 13$ Expression 3: $\frac{(3x)^2}{x} – \frac{6x + 10}{2}$	**3**

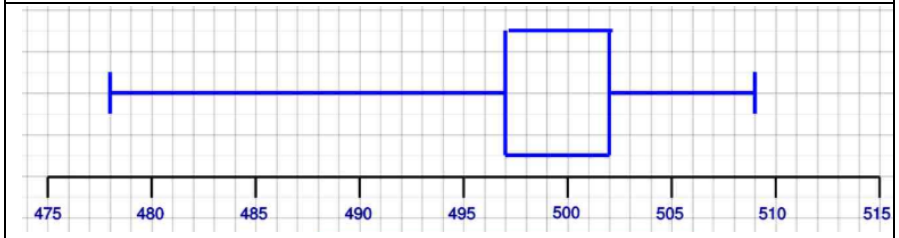
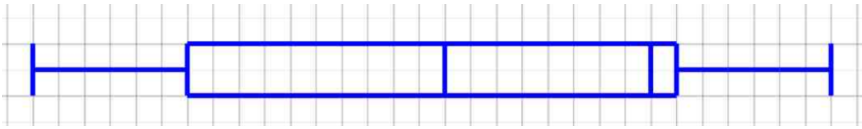
Question		Answers	Notes	Total
2	a	**AM 1** •1 Correct substitution into Pythagoras' Theorem •2 441 seen •3 Their BC correct after square root **AM 2** •1 Correctly find value of angle A or angle C •2 Correctly substitute into trigonometric ratio or sine rule to find BC •3 Their value for BC correct after using trigonometric ratio **AM 3** •1 seeing multiple **and** 3, 4, 5 •2 multiply by 7 •3 Their value for BC correct after multiplying 3 by 7	**AM 1** •1 $35^2 = 28^2 + BC^2$ or $(BC^2 =)\ 35^2 - 28^2$ or $1225 - BC^2 = 784$ •2 $(BC^2 =)\ 441$ or $(BC =)\sqrt{441}$ •3 Their 21 •3 ACCEPT their BC in surd form only if it is in its simplest form •3 Award only if 0 <their 21 < 35 •3 DO NOT ACCEPT $\sqrt{441}$ for final answer **AM 2** •1 (A=)36.869… or 37 or (C)=53.13… or 53 •2 $\sin(36.869..\text{or}\,37) = \frac{BC}{35}$ or $\cos(53.13...\text{or}\,53) = \frac{BC}{35}$ or $\tan(53.13...\text{or}\,53) = \frac{28}{BC}$ or $\frac{BC}{\sin(36.869...\text{or}37)} = \frac{35}{\sin 90}$ OE •3 Their 21 21 with any correct •1 or •2 award **(3 marks)** 21 without working award **(2 marks)** 441 without working award **(1 mark)**	**3**
	b	option B		
	c	•1 Adding 4×28 to $4 \times$ their(2a) •2 Correctly calculate their result after adding their 8 sides	•1 $4 \times 28 + 4 \times$ their 21 or 112+their4 •2 Their196 (cm) 196 without working award **(2 marks)** 98 without working award **(1 mark)** **SC for 1 mark** Calculating correctly the perimeter of half shape: $2 \times 28 + 2 \times$ their $21 =$ their 98	**2**

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

3	d	•[1] Considering three probabilities related to their(3c) with or without replacement (probabilities must be less than one)	•[1] their $\frac{9}{60}, \frac{9}{60}, \frac{9}{60}$ or $3 \times \text{their}\frac{9}{60}$ or $\left(\text{their}\frac{9}{60}, \frac{8}{59}, \frac{7}{58}\right)$, ACCEPT $\left(\text{their}\frac{3}{20}, \frac{2}{19}, \frac{1}{18}\right)$ or $\left(\text{their}\frac{9}{60}, \frac{8}{60}, \frac{7}{60}\right)$	
		•[2] Multiply their three probabilities	•[2] $\left(\text{their}\frac{9}{60}\right)^3$ or $\left(\text{their}\frac{9}{60} \times \frac{8}{59} \times \frac{7}{58}\right)$	
		•[3] The correct answer	•[2] ACCEPT $\left(\text{their}\frac{3}{20} \times \frac{2}{19} \times \frac{1}{18}\right)$ or a mistake in one fraction ex: $\left(\text{their}\frac{9}{60} \times \frac{8}{59} \times \frac{7}{55}\right)$ •[3] $\frac{504}{205320}$ or $\frac{21}{8555}$ or 0.00245(47...) or 0.245(47…)% OE •[3] ACCEPT 0.0025 or 0.25% OE $\frac{504}{205320}$ or $\frac{21}{8555}$ or 0.00245(47...) or 0.0025 or 0.25% without working award **(2 marks)** 0.002 or 0.2% or 0.0024 or 0.24% without working award **(1 mark)**	**3**

3	e	•[1] Realise it is not practical •[2] State a valid reason for the impracticality related to their result, stated here or in their(3c) or their(3d), being small	•[1] Not very practical or doesn't work or not reliable or not effective WTTE •[1] DO NOT ACCEPT unclear judgement ex: if a student is selected randomly it will have a probability 9/60 or the practicality is 9/60 •[2] The probability is very low or small or unlikely to select applicable students or most likely wrong ones will be chosen WTTE •[2] ACCEPT the odds are very low or very low chance or low percentage WTTE •[2] ACCEPT probability of selecting student who study both is lower WTTE •[2] DO NOT ACCEPT if they do not have a result stated here in part (e) or in part (c) or (d) •[2] DO NOT ACCEPT because probability is 0.00245 or only 9/60 OE •[2] DO NOT ACCEPT if they refer to probability 0.5 or more being small •[2] and •[1] can be awarded independently	**2**

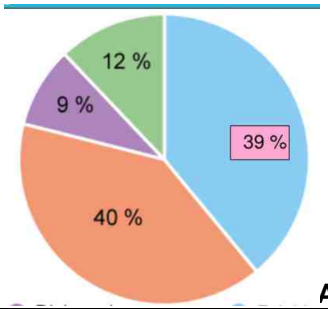
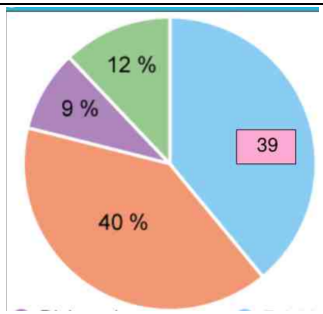
Question		Answers	Notes	Total
4	a	50 %	50(%) OE, ACCEPT the expression “at least 50%”	1
	b	The five values required of the blue box and whisker plot: Min 478, LQ 494, Median 502, UQ 503, Max 509 •[1] Correctly indicate by a vertical line three values of the above •[2] Correctly indicate by a vertical line the fourth value of the above •[3] Correct and complete box and whisker plot with the fifth value correctly indicated by a vertical line For incomplete box and whisker plot, mark with BOD the •[1] and •[2] and do not award •[3]	ACCEPT their blue box plot drawn on the red box plot ACCEPT   ACCEPT lines not being aligned or box not accurately closed. Example:  Note: Seeing their median aligned with their UQ mark with BOD for the highest mark. Ex:	3

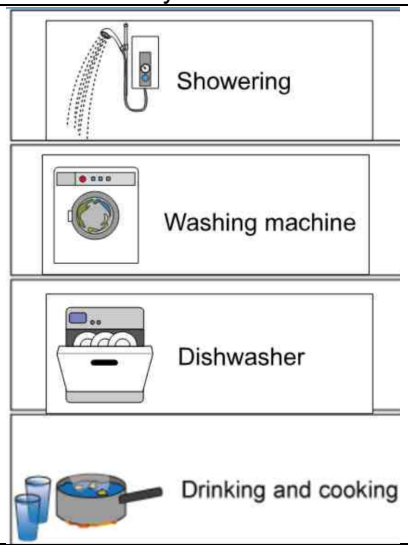
4	b		Note: Seeing their median aligned with their UQ mark with BOD for the highest mark. Ex:  Consider: Min(478), LQ(497),Med(502),UQ(502), and Max(509) Hence, 1 mark awarded for three values correct DO NOT ACCEPT the median when indicated by multiple vertical lines. Example: 	

4	c	•[1] Correct comment, related to evidence from the box and whisker plot in their(4b) implying GeneriCell is better than their Maximizer	•[1] Higher upper quartile or 25 % are above 506 for GeneriCell while 25% above their503 for Maximizer WTTE •[1] ACCEPT better upper quartile or higher Q3 •[1] ACCEPT most Genericell batteries last 506 or less while most Maximizer last their503 or less •[1] ACCEPT more Generic last over their503 •[1] DO NOT ACCEPT most Genericell batteries last 506 while most Maximizer last their503 or most GeneriCell last longer •[1] DO NOT ACCEPT bigger Inter Quartile Range •[1] DO NOT ACCEPT even if GeneriCell lasts less they could be better value for money since they are cheaper	
		•[2] Correct comment, related to evidence from the box and whisker plot in their(4b) implying their Maximizer is better than GeneriCell	•[2] Higher median or higher lower quartile or smaller Inter Quartile Range OR 75% above their494 for maximizer while less than 75% are above 488 for GeneriCell WTTE •[2] ACCEPT better lower quartile or longer median •[2] ACCEPT The IQR is their9 while for generic it is 18 •[1] DO NOT ACCEPT total lifetime for 9 Maximizer batteries is more than total time of 9 GeneriCells batteries •[2] DO NOT ACCEPT Higher average unless they mention median explicitly	**2**
			For •[1] and •[2] ACCEPT the use of abbreviations example: LQ or Q1 for Lower Quartile, Med for median, Q3 or UQ for Upper Quartile. ACCEPT for Interquartile range: IQR or Q3-Q1 or range between Q1 and Q3, but DO NOT ACCEPT inner quartile	

Question		Answers	Notes	Total
5	a	**AM 1** •[1] Correctly multiply both sides by 2 OR correctly add coefficients of x •[2] Divide the right hand side of the equation by the coefficient of x •[3] their24 correct after their first algebraic step **AM 2** •[1] Add the 24 and its half •[2] Correctly equate 24+12 with the total being 6^2 or 36 •[3] Identify the 24 as the number	**AM 1** •[1] $2x + x = 72$ or $3x = 72$ OR $1.5x = 6^2$ •[2] $\frac{72}{3}$ or $\frac{6^2}{1.5}$ or $\frac{36}{1.5}$ •[3] Their 24 **AM 2** •[1] 24 + 12 •[2] (24 + 12) = 6^2 or (24 + 12) = 36 •[3] The number is 24 OR x = 24 24 OR $\frac{72}{3}$ without working award **(2 marks)** Seeing only 24 + 12 = 36 award **(2 marks)** 24 as the answer with any correct •[1] or •[2] award **(3 marks)** 24 without working award **(2 marks)**	**3**

5	b	**AM 1 (to be used when the equation is written)** •1 Correctly set the equation •2 Correctly factorize the equation OR correctly substitute into quadratic formula •3 (x =) 7 •4 (x =) – 8 **AM 2 (to be used when the equation is not written)** •1 Correctly show that the sum of 7 and its square is 56 •2 Identify the 7 as the number •3 Correctly show that the sum of -8 and its square is 56 •4 Identify the -8 as the number	**AM 1 (to be used when the equation is written)** •1 $x^2 + x = 56$ or $x(x+1) = 56$ OE •2 $(x-7)(x+8) = 0$ or $x = \frac{-1 \pm \sqrt{1^2 - 4(1)(-56)}}{2(1)}$ OE •3 7 seen , ACCEPT $7^2 + 7 = 56$ or $49 + 7 = 56$ •4 -8 seen , ACCEPT $-8^2 - 8 = 56$ or $64 - 8 = 56$ **Note for AM1:** seeing •1 or •2 implies the use of AM1 not AM2 seeing •2 correct implies •1 seeing •1 or •2 correct then 7 or -8 award **(3 marks)** seeing •1 or •2 correct then 7 and -8 award **(4 marks)** **AM 2 (to be used when the equation is not written)** •1 $7 + 49 = 56$ or $7 + (7)^2 = 56$ •2 The number is 7 or $x = 7$ •3 $-8 + 64 = 56$ or $-8 + (-8)^2 = 56$ •4 The number is -8 or $x = -8$ 7 or -8 without working award **(1 mark)** 7 and -8 without working award **(2 marks)**	**4**

Question		Answers	Notes	Total
6	a	39 (%)	 **ACCEPT** 	**1**
	b	•[1] Multiply 40 % by 120 •[2] The correct answer	•[1] 0.4×120 OE •[2] 48 (L) 48 without working: Award **(2 marks)** **SC for 1 mark** Correctly calculating the value of $\text{their(6a)}\%\times120$	**2**
	c	•[1] Divide their(6b) by 8 •[2] Correctly calculate their result after a division by 8	•[1] $\frac{\text{their } 48}{8}$ OE •[2] their 6 6 without working: Award **(2 marks)** **SC for 1 mark** Their6 correct without working	**2**
	d	•[1] Multiply their(6c) by 5 •[2] Correct result after a multiplication by 5	•[1] $5\times\text{their6}$ •[2] Their 30 30 without working: Award **(2 marks)** **SC for 1 mark** Their30 correct without working **SC for 1 mark** Candidates MR “reduces by 5L” and getting the result of 18(L)	**2**
	e	**AM1** •[1] Recognize 95(%) •[2] Multiply 95% by 14.4 •[3] Correct result after multiplying their percentage by 14.4	**AM1** •[1] 100 – 5 (= 95) or 95 or 0.95 •[2] $95\%\times14.4$ or 0.95×14.4 OE •[3] Their13.68 (L), ACCEPT 13.7	**3**

6	e	**AM1** •[1] Recognize 95(%) •[2] Multiply 95% by 14.4 •[3] Correct result after multiplying their percentage by 14.4 **AM2** •[1] Multiply 5 % by 14.4 •[2] Subtract 0.72 from 14.4 •[3] Correct result after subtracting from 14.4	**AM1** •[1] 100 – 5 (= 95) or 95 or 0.95 •[2] $95\% \times 14.4$ or 0.95×14.4 OE •[3] Their13.68 (L), ACCEPT 13.7 •[3] ACCEPT Their13.68 (L) only if their percentage is less than 100% **AM2** •[1] 0.05 x 14.4 or evidence of cross multiplication using 5% or 0.72 seen •[2] $14.4 - 0.72$ or $14.4 - (0.05 \times 14.4)$ •[3] Their 13.68 (L), ACCEPT 13.7 •[3] ACCEPT Their13.68 (L) only if positive 13.68 without working: Award **(2 marks)** 13.68 with any correct •[1] or •[2] award **(3 marks)**	**3**
	f	Correctly order the three activities		**1**

6	g	•[1] Recognise that showering **saves** (not uses) more water than washing machine	•[1] showering saves more than machine or reduces the most WTTE; •[1] ACCEPT Showering saves their18 or 37.5% •[1] DO NOT ACCEPT referring to the use or consumption of water instead of water saving or 40% being the biggest •[1] DO NOT ACCEPT "eco-friendly" to express saving water	
		•[2] Values of saving for showering **AND** washing machine seen	•[2] their18 and $(14.4-\text{their}13.68=)\text{their}0.72$ seen •[2] ACCEPT Showering saves their18 while machine saves less than 1 •[2] DO NOT ACCEPT Showering saves their18 which is more than their13.68 or Showering saves their18 which is more than washing machine	**3**
		•[3] Recognise that washing machine uses more water than dishwasher **AND** they have same eco (5%) saving	•[3] 12% is more than 9% **and** in eco-setting they both save 5% •[3] ACCEPT washing machine uses more **and** they save the same or 5% of 12% is more than 5% of 9% •[3] ACCEPT $(14.4-\text{their}13.68=)\text{their}0.72$ and $(0.09\times120\times0.05=)0.54$ Note: seeing •[2] implies •[1] **SC for 3 marks** All three values of saving calculated Example: showering their18, washing machine their 0.72, and dishwasher 0.54	

Question		Answers	Notes	Total
7	a	(AB) = 5.30 (m)		1
	b	**AM1** •[1] Correct proportion of circle seen •[2] Correctly substitute their(7a) into circumference formula •[3] Correctly multiply their proportion of circle by their circumference **AM2** •[1] Correct proportion of quarter circle seen •[2] Multiply their proportion by 8.33 •[3] Correctly multiply their proportion of quarter of circle by 8.33	**AM1** •[1] $\frac{75}{360}$ or $\frac{5}{24}$ or 0.2083..OE , ACCEPT $\frac{360}{75}$ or 4.8 OE •[2] 2π(their 5.3) or 33.(3...) or 33.(284) seen, ACCEPT $2\pi(3.5+1.8)$ •[3] $(\text{their}\ \frac{75}{360}\times 2\pi(\text{their AB})=)$ their 6.9(3768...) or 7 •[3] ACCEPT $(\frac{2\pi(\text{their AB})}{\text{their}\,4.8}=)$ their 6.9(3768...) or 7 **AM2** •[1] $\frac{75}{90}$ or $\frac{5}{6}$ or 75 : 90 or 0.8333 OE , ACCEPT $\frac{90}{75}$ or 1.2 •[2] their $\frac{75}{90}\times 8.33$, ACCEPT $\frac{8.33}{\text{their}\,1.2}$ •[3] their 6.9(4166…) or 7 ACCEPT their calculations using 3.14 or 22/7 instead of π 6.9(3768) or 6.9(4166…) or 7 with any correct •[1] or •[2] : Award **(3 marks)** 6.9(3768) or 6.9(4166…) without working: Award **(2 marks)** 7 without working: Award **(1 mark)**	3

7	c	**AM1** •[1] Correctly substitute their(7a) in correct trig ratio •[2] Correct operation for their trig ratio to calculate DG •[3] Correctly calculate their DG after using their trig ratio •[4] Correctly round their DG to 1 dp **AM2** •[1] Correctly write down value of FG •[2] Correct operation for their trig ratio to calculate DG OR Correctly substitute into Pythagoras •[3] Correctly calculate their DG after using their trig ratio OR Pythagoras •[4] Correctly round their DG to 1 dp	**AM1** •[1] $\cos 75 = \frac{DG}{\text{their}(5.3)}$ or $\sin 15 = \frac{DG}{\text{their}(5.3)}$ or $\frac{DG}{\sin 15} = \frac{\text{their}5.3}{\sin 90}$ •[2] $(DG =)\ \text{their}(DF) \times \cos 75$ or $\text{their}(DF) \times \sin 15$ •[3] their1.37(17…) Award only if •[1] or •[2] are awarded •[3] Award only if $0 < \text{their}DG < 5.3$ •[4] their1.4 (m) •[4] DO NOT ACCEPT unless their result needs rounding •[4] ACCEPT not seeing their •[3] **AM2** •[1] $(FG = \text{their}5.3 \times \sin 75$ or $\text{their}5.3 \times \cos 15 =) 5.1(194...)$ •[2] $(DG =) \frac{\text{their}FG}{\tan 75}$ or $(DG =)\ \text{their}\ FG \times \tan 15$ OR $(DG^2 =)(\text{their}5.3)^2 - (\text{their}FG)^2$ •[3] their1.37(17…) , Award only if •[1] or •[2] are awarded •[3] ACCEPT1.36(65..) •[3] Award only if $0 < \text{their}DG < 5.3$ •[4] their1.4 (m) •[4] DO NOT ACCEPT unless their result needs rounding •[4] ACCEPT not seeing their •[3] 1.4 with any correct •[1] or •[2] or •[3] : Award **(4 marks)** 1.4 without working: Award **(3 marks)** 1.37(17) without working: Award **(2 marks)**	**4**
	d	Correctly subtract their(7c) from their(7a)	(EG = Their 5.3 – their 1.4 =) their3.9 (m) Award only if their EG is positive ACCEPT correct result of subtraction of their 1.4 from their 5.3 without working shown	**1**

e

Mark	1	2	3
Identify factors (F)	State one factor from: - Car size (length or width) - Distance between cars or space for doors to open or yellow part - lane width - Angle (perpendicular or angled) - Length of arc - parking space dimension or area available **OR** Two factors seen in calculations without words. Ex: 28 – 2 x 4.5 + 5.5 Ignore additional irrelevant factors	State two factors from: - Car size (length or width) - Distance between cars or space for doors to open or yellow part - lane width - Angle (perpendicular or angled) - Length of arc - parking space dimension or area available Ignore additional irrelevant factors	
Design (D)	**For Perpendicular parking:** 10 to 25 cars respecting one condition **For Angled parking:** 8 to 20 cars respecting one condition The conditions for their selected parking are: 1) Car sets used inside the canvas and are not overlapping 2) Car sets used in either perpendicular or angled parking canvas but not both. ACCEPT cars in both canvas if in their text they chose one 3) Lane width 5.5 m for perpendicular or 4 m for angled ACCEPT error up to 0.5 m ACCEPT any orientation of cars In the case when they have car sets in both canvases, mark the best one.	**For Perpendicular parking:** 15 or 20 cars respecting two conditions **For Angled parking:** 12 or 16 cars respecting two conditions The conditions for their selected parking are: 1) Car sets used inside the canvas and are not overlapping 2) Car sets used in either perpendicular or angled parking canvas but not both. ACCEPT cars in both canvas if in their text they chose one 3) Lane width 5.5 m for perpendicular or 4 m for angled ACCEPT error up to 0.5 m ACCEPT any orientation of cars In the case when they have car sets in both canvases, mark the best one.	**For Perpendicular parking:** 15 cars respecting all three conditions **For Angled parking:** 16 cars respecting all three conditions The conditions for their selected parking are: 1) Car sets used inside the canvas and are not overlapping 2) Car sets used in either perpendicular or angled parking canvas but not both. ACCEPT cars in both canvas if in their text they chose one 3) Lane width 5.5 m for perpendicular or 4 m for angled ACCEPT error up to 0.5 m ACCEPT any orientation of cars

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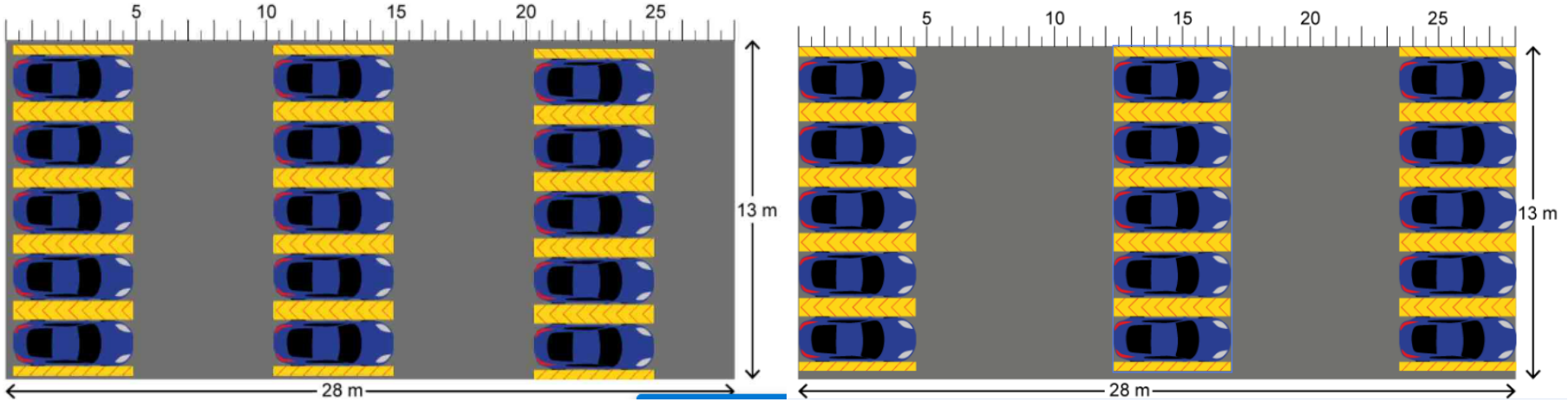
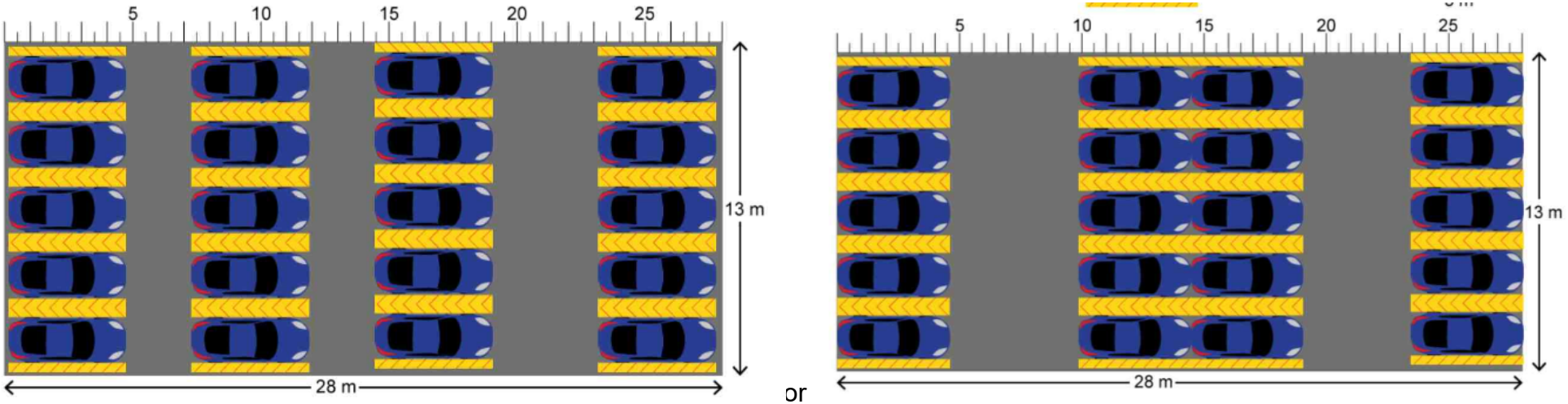
		Justify with calculations (C)	Correct calculations for their cars in Perpendicular parking **OR** their cars in Angled parking Example: For perpendicular parking with 10 cars 2 x 4.5 + 2 x 5.5 (= 20) For angled parking with 12 cars 3 x their5 + 2 x 4 (= their23) ACCEPT Calculations involving area of parking divided by area of car and lanes Example for perpendicular parking with 20 cars: $\frac{28\times13-2\times5.5\times13}{4.5\times2.5}(=19.6)$	Correct calculations for 15 cars in Perpendicular parking **OR** 16 cars in Angled parking Example: For perpendicular parking 3 x 4.5 + 2 x 5.5 (= 24.5) **OR** For angled parking 4 x their5 + 2 x 4 (= their28 less than 28) ACCEPT for perpendicular 4 x 4.5 + 2 x 5.5 = 29 and hence 15 cars can fit ACCEPT using lane width 5.3 for perpendicular parking	Correct calculations for 15 cars in Perpendicular parking **AND** 16 cars in Angled parking Example: For perpendicular parking 3 x 4.5 + 2 x 5.5 (= 24.5) **AND** For angled parking 4 x their5 + 2 x 4 (= their 28 less than 28) ACCEPT for perpendicular 4 x 4.5 + 2 x 5.5 (= 29) and hence 15 cars can fit DO NOT ACCEPT unless they select one parking as their choice		
		Justify accuracy (A)	Recognizing it is not accurate with weak justification Examples: these are approximate calculations and not accurate Inaccurate because of rounding Inaccurate because People tend to make mistakes in parking **OR** Sensible rounding used in calculations without a comment (example $\frac{28\times13}{4.5\times2.5}=32$ cars) DO NOT ACCEPT: my results are accurate WTTE	Recognizing it is not accurate with acceptable justification Examples: The lane width used from the conditions (5.5 or 4) is more than the minimum lane width required (5.3 or 3.9) or Width used is 2.5 m which is more than 1.8 m (the width of the car). or All cars have specific given dimensions			

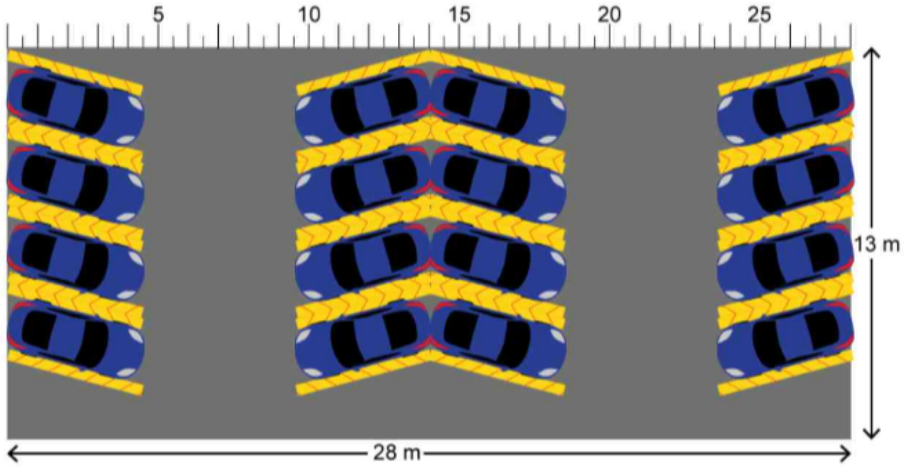
7e Pictures from Canvas:
For Perpendicular parking:
ACCEPTED 15 cars layout For D3 (provided they have layout only in Perpendicular parking Canvas or they choose in their text the perpendicular)

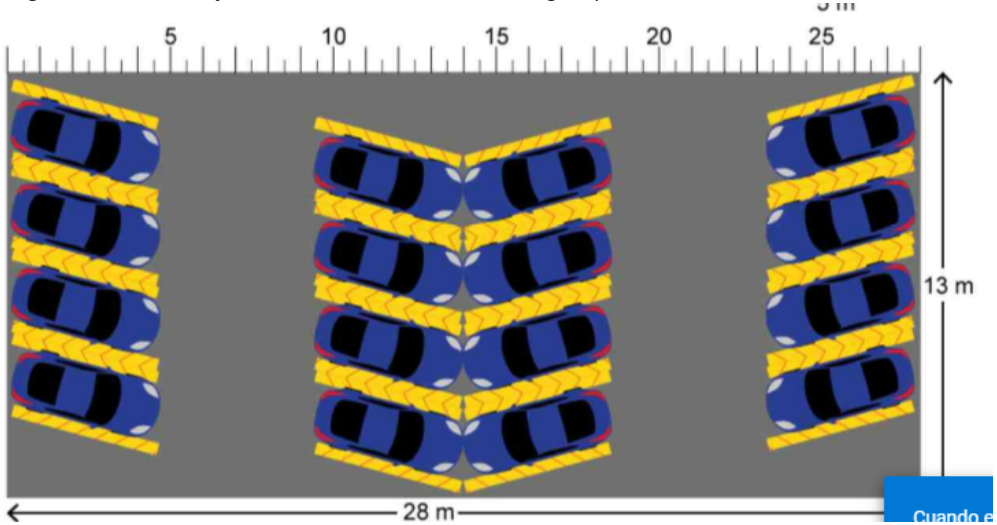


For Perpendicular parking:
ACCEPTED 20 cars layout For D2 (provided they have layout only in Perpendicular parking Canvas since only lane width condition is not met)



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





Question		Answers	Notes	Total
8	a	**AM1** •1 Correctly substitute 5 and 7 into area of trapezium formula •2 Multiply by 1 **AND** equate with 6 6 AG **AM2** •1 Recognize the rectangle of area 5 squares •2 Demonstrate that the area of triangle above is 1 square **AND** that together they will be 6 **AM3** •1 Substitute correctly 2.5 in $2x+1$ •2 Multiply by 1 **AND** equate with 6	**AM1** •1 $\frac{5+7}{2}$, ACCEPT The average of 5 and 7 is 6 •2 $\frac{5+7}{2}\times 1=\frac{12}{2}=6$, DO NOT ACCEPT if $\times 1$ is not seen •2 ACCEPT not seeing $\frac{12}{2}$, ACCEPT $\frac{(5+7)1}{2}=6$ **AM2** •1 The area of rectangle is 5 or 5 blocks or 5×1 , ACCEPT 1+1+1+1+1 •2 Half of two squares above OE or $\frac{1}{2}\times 1\times 2$or $\frac{2}{2}$ or 0.75 + 0.25 **AND** The total makes 6 or Thus another square WTTE or $5+1=6$ •2 DO NOT ACCEPT two halves of squares or 0.5 + 0.5 or $\frac{2}{3}+\frac{1}{3}$ or two tiny little parts OE **AM3** •1 $2(2.5)+1$ •2 $(2(2.5)+1)\times 1=6$, DO NOT ACCEPT if $\times 1$ is not seen For all •2 ACCEPT equating with 6 by a calculator screenshot $5+\frac{7}{2}=6$ or 5+7/2 = 6 or $2\times 3=6$ or $3+3=6$, Award **(0 marks)** Seeing only 12/2=6 , Award **(0 marks)** Seeing only $5+1=6$ or $2\times 2.5+1=6$ or $\frac{5+7}{2}=6$, Award **(1 mark)**	**2**
	b	Correctly place 10 **AND** 12		**1**

	c	•1 Correctly describe one pattern for A only in words with correct terminology •2 Correctly describe a second pattern for A in words with correct terminology	Examples of accepted terminology: Even numbers, multiples of 2 Increasing by 2, adds 2 every time, goes up by 2, moving up by 2 Difference is 2 Second difference is zero Arithmetic progression, Arithmetic sequence DO NOT ACCEPT the rule in words e.g. 2 times *n*, n multiplied by 2, double of *n,* twice stage number, the product of n and 2 dividing area by 2 gets *n* the area is half the stage number $2n$ or $2\times n$ follows the 2 times table Increasing Arithmetic series Note: More than two different patterns, all correct award **(2 marks)** More than two different patterns, at least one correct award **(1 mark)**	**2**
	d	•1 The correct general rule •2 The correct simplified general rule with correct notation	•1 $2n$ or $A = 2\times n$ or $A = 2 * n$ or $A = n + n$ or $A = n + \frac{2n}{2}$ or $n = \frac{A}{2}$ or $A = 2d$ or A = 2(*n*) •2 $A = 2n$ or $2n = A$, ACCEPT $a = 2n$ or $2n = a$ DO NOT ACCEPT description in words **SC** if NR in d) and (A =)2*n* is seen in (8c) Award: **(1 mark)**	**2**

	e	•[1] Correctly substitute $n \geq 5$ into their general rule •[2] Correctly calculate their value of A after substituting $n \geq 5$ •[3] Recognise that their correctly calculated value of A is the same as their predicted value	•[1] Ex: 2×6 •[2] Ex: 12 (for $n = 6$) •[3] Same as value I predicted in table (and we find the candidate has 12 in the table for n = 6) **OR** same as when we continue the pattern and explains how 12 is obtained from pattern of adding 2 to 10 •[3] ACCEPT seeing the 12 in the table in (8b) and seeing their calculation for T when $n = 6$ as 12 **SC for 1 mark** Correctly test by applying the steps of verification mentioned in the left column with a value of $n \leq 4$ **SC for 1 mark** Correctly verify their described pattern or rule (e.g. recursive rule)	**3**

8	f	Mark	1	2	3	4	5	
		Predictions (P)	Correctly predict one term for T ACCEPT whether in the table or in the response box	Correctly predict two terms for T ACCEPT whether in the table or in the response box	Correctly predict three terms or more for T ACCEPT whether in the table or in the response box IGNORE further incorrectly predicted values			
		Description (D)	Attempt to describe a pattern in words for T OR a rule in words Ex : They are all even numbers Increases by even numbers Increases by two more each time Increases by 4,6,8,.. Adds up by 4,6,8,.. The minus between them adds 2 OR n times n + 1 Product of n and n + 1 Product of Stage number and next stage number Sum of n and its square	Attempt to describe pattern for T as general rule Ex for rule attempt: $\frac{T}{n} = n + 1$ T = n x n + 1 $T_n = T_{n-1} + 2n$ **OR** One correct pattern described in words for T Ex: The increase increases by 2 The second difference is constant Double the triangular numbers It is quadratic Increases by 4,6,8,**10,..** Adds up by 4,6,8,**10,..**	Correctly describe the pattern for T as a general rule **OR** Two correct patterns described in words for T **OR** Attempt to describe pattern for T as general rule **AND** One correct pattern described in words for T ACCEPT The rule is $n(n+1)$ or $n^2 + n$ or $T = nn + n$ or $T = n \times n + n$	Correctly describe the pattern for T as a general rule **AND** One correct pattern described in words for T **OR** Attempt to describe pattern for T as general rule **AND** Two correct patterns described in words for T ACCEPT The rule is $n(n+1)$ or $n^2 + n$ or $T = nn + n$ or $T = n \times n + n$	Correctly describe the pattern for T as a general rule **AND** Two correct patterns described in words for T Rule: $T = n(n+1)$ or $T = n^2 + n$ ACCEPT The rule is $n(n+1)$ or $n^2 + n$ or $T = nn + n$ or $T = n \times n + n$	**23**

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

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

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

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

Predictions

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