mathmmoeengtz0xxm

Markscheme

November 2024

Mathematics

On-screen examination

34 pages

The markscheme abbreviations:

The markscheme may make use of the following abbreviation: **OE** – **'**or equivalent'

• Bullet notation means award 1 mark – see example below

Example 1
.1 mark awarded and corresponding notes are aligned

b	.1 Show clear line of reasoning in the method .2 4	.1 45 and 49 seen **OE** *Ex:* $49 = 45 + x$ .2	**2**

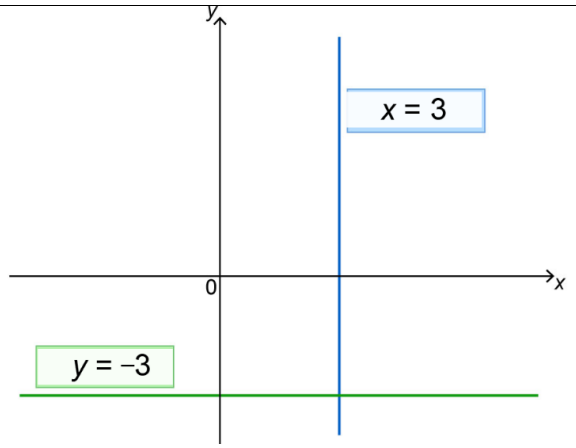
Error Carried Forward (ECF) marks

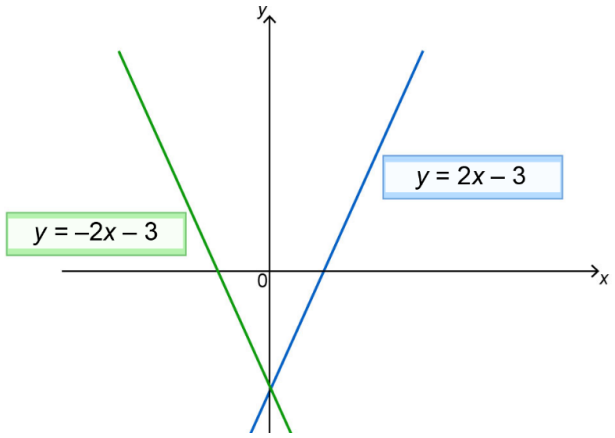
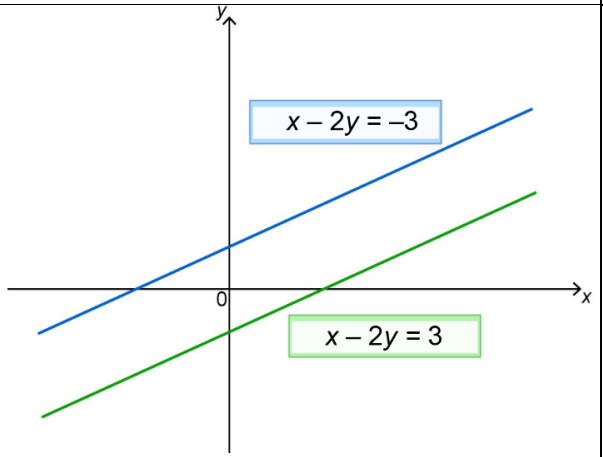
Errors made at any step of a solution affect all working that follows. In general, **Error Carried Forward (ECF)** marks are awarded after an error.

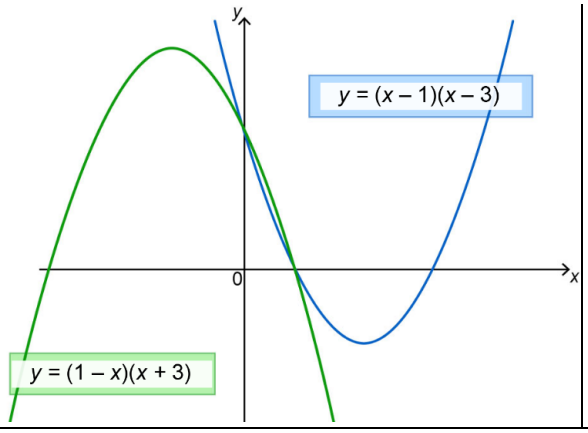
a) **ECF** applies from one part of a question to a subsequent part of the question and also applies within the same part.
b) If an answer resulting from **ECF** is inappropriate (eg, negative distances or sin$x$ > 1) then subsequent marks should not be awarded.
c) If a question is transformed by an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

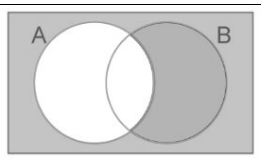
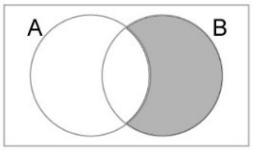
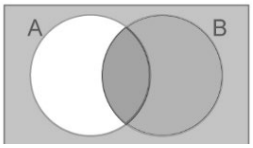
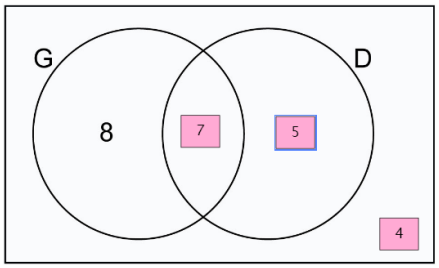
General notes

a) As this is an international examination, accept all **alternative forms of notation,** for example 1,9 as 1.9 ; 1,000 or 1.000. However, **DO NOT ACCEPT** incorrect mathematical notation x^2 for x^2 unless noted otherwise in the MS.
b) **ACCEPT** notation errors in intermediate steps.
c) Unless noted otherwise, ignore further working after a correct answer even if further working is incorrect.
d) In the case when a correct result is obtained using incorrect seen method, do not award the mark for the result.
e) Where candidates have written two solutions to a question, mark the first solution.
f) In the markscheme, equivalent examples of **numerical** and **algebraic** forms or **simplified** answers will generally be written in the notes preceded by **OE** (Or Equivalent) e.g. $\frac{1}{2}$ or $1/2$ or 0.5 or $2 \div 4$; $\frac{x}{2}$ or $x/2$ or $x \div 2$; 0.23 or 23%
g) In the markscheme, information provided in brackets indicate detail that may be seen in a candidate response but is not necessary to award the marks. However, it indicates what the candidate's result represents. Ex: if last mark is for the result: (AB)=5; this means we award the mark for seeing 5 as the result of calculating AB without necessarily seeing AB=5, but it does not mean we award the mark for seeing 5 representing another length.
h) Special case marks **SC** can be allocated instead of but not in addition to the marks prescribed in the markscheme.
i) **ACCEPT** seeing equation not in-line or the fraction line missing.
j) Calculator screenshots are accepted as working steps. And when a calculator screenshot is taken, accept not seeing the whole operation.
k) In task 2 and 3 where the markscheme is set out in a table then, unless noted otherwise, awarding the highest mark in a category includes all the lower marks in that category. It is probably best to look for the top category mark answer and if you don't find it look at the next mark down.
l) Unless noted otherwise, **ACCEPT** using the correct values or working regardless their previous result.
m) Candidates will sometimes use methods other than those in the markscheme. Unless the question specifies a method, other correct methods should be marked in line with the markscheme. **If in doubt, contact your team leader for advice.**
n) Unless noted otherwise, if a note in a part says to accept the answer without working for 1 mark less than total marks, then seeing the correct answer with any acceptable working step, award full marks. Example: If the note in a part worth 3 marks says "4.3(3…) without working award 2 marks", then seeing any acceptable working step and seeing 4.3(3…) as the answer award the 3 marks.
o) For "**show that**" questions, unless otherwise noted, every bullet point has to be seen in order to be awarded.
p) When a result is written as "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.

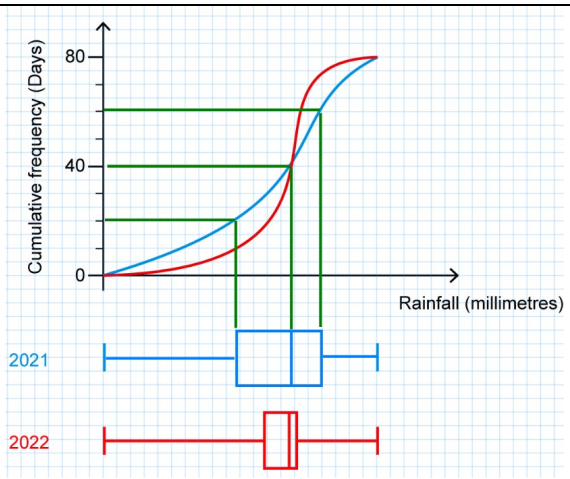
Q1		Answers	Notes	Total
	a	.1 Correctly place $x = 3$ and Correctly place $y = -3$		1

	b	.1 Correctly place $y = 2x - 3$ .2 Correctly place $y = -2x - 3$		2
	c	.1 Correctly place $x - 2y = 3$ .2 Correctly place $x - 2y = -3$		2

	d	.1 Correctly place $y = (1 - x)(x + 3)$ .2 Correctly place $y = (x - 1)(x - 3)$		2

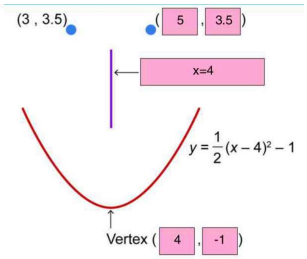
Q2		Answers	Notes	Total
	a)	.1 Correct shades for A' .2 Correct shades for $A' \cap B$ .3 Correct shades for $A' \cup B$	  	**3**
	b)	.1 Correctly write **one** value in the Venn diagram .2 Correctly write **another two** values in the Venn diagram		**2**

	c)	Correctly write their probability from **their** part b)	their $\frac{13}{24}$ OE ACCEPT $\frac{their13}{24}$ provided probability < 1	**1**
	d)	.1 Correct probability of first student from **their** part b)	.1 $their\frac{4}{24}$ OE or their0.16(66…) ACCEPT their0.17 .1 ACCEPT $\frac{their4}{24}$ provided probability < 1	**3**
		.2 Correctly write **their three** probabilities **without** replacement OR **multiply their three** probabilities **with** replacement	.2 their $\frac{4}{24}$, their $\frac{3}{23}$, their $\frac{2}{22}$ OR their $\frac{4}{24} \times$ their $\frac{4}{24} \times$ their $\frac{4}{24}$ OE .2 ACCEPT for bp2 only, applying without replacement on only numerator or only denominator, only if they multiply their three probabilities Ex: their $\frac{4}{24} \times$ their $\frac{3}{24} \times$ their $\frac{2}{24}$	
		.3 Correctly multiply **their three** probabilities **without** replacement	.3 their $\frac{24}{12144}$ or their $\frac{1}{506}$ or their0.001976(2...) OE .3 ACCEPT 0.00198 or 0.002	

Q3		Answers	Notes	Total
	a			2
		.1 Correct vertical line for the median	.1 ACCEPT error within one square .1 ACCEPT median line not reaching the box or extended beyond the box	
		.2 Correct box for the IQR (correct vertical line for LQ and UQ)	.2 ACCEPT error within one square .2 ACCEPT The whiskers continuing through the box or not reaching the box or not drawn at all	

	b	.1 Correct comment related to **their** medians. .2 Correct comment related to **their** IQR.	.1 Medians are the same/equal WTTE .1 ACCEPT a statement about median that is true for their box plots .1 ACCEPT the medians are very close .1 ACCEPT "both medians are equal 40" WTTE only if their 2021 box-and-whisker median is same as 2022 median .2 The IQR for 2021 is larger (than 2022) WTTE .2 ACCEPT a statement about IQR that is true for their box plots .2 ACCEPT using middle 50% or quartiles instead of IQR .2 ACCEPT 2021 is more spread .2 ACCEPT correctly comparing their LQ and UQ instead of IQR .2 DO NOT ACCEPT the IQR are different	2

Q4		Answers	Notes	Total
	a	.1 Correctly substitute 9 and 8 into Pythagoras. .2 **The correct answer** before rounding 4 AG	.1 $(BC) = \sqrt{9^2 - 8^2}$ OE .1 ACCEPT $(BC^2 =)9^2 - 8^2$ OE .2 (BC=) 4.1(231…) This is a show that question so each bp must be seen to award the mark Ex: seeing only $\sqrt{9^2 - 8^2}$ OE is only bp1 Ex: seeing only 4.1(231…) is only bp2	**2**
	b	**The correct area** of triangle	16 ACCEPT using BC without rounding and getting area [16,16.5]	**1**
	c	Correctly write their area of trapezium after multiplying their part **b**) by 3	$(3 \times their16 =)$their48 ACCEPT 3xtheir16 without working	**1**
	d	**AM1 Using trapezium** .1 Correctly substitute 6, 4 and their48 into area of trapezium formula .2 Correctly calculate their FD **AM2 Using rectangle and triangle** .1 Correctly calculate FE .2 Correctly add 4 to their Bp1	**AM1** .1 their48=$\frac{\text{FD}+4}{2} \times 6$ OE ACCEPT $\frac{x}{2} \times 6 = 48$ OE .2 their12 **AM2 Using rectangle and triangle** .1 (FE=)8 .1 ACCEPT Correctly subtract 24 from their48 AND correctly substitute into area of triangle formula. Ex: $their48 - 24 = \frac{1}{2} \times 6 \times FE$ OE .2 (theirFE+4=) their12	**2**
	e	.1 Correct value of their FE after subtracting 4 from their part **d)** .2 Correctly substitute their values into trig ratio .3 **The correct value** for angle FCE	.1 (FE=) their8 ACCEPT only if it is their12-4 .2 $tanFCE = \frac{theirFE}{6}$ or $\tan^{-1}(\frac{theirFE}{6})$ ACCEPT $sinFCE = \frac{8}{10}$ or $sinF = \frac{6}{10}$ OE .2 ACCEPT theirFE not being their12-4 provided it is over 6 .3 (angle FCE=) 53.(13…)	**3**

Q5		Answers	Notes	Total
	a	From the 5 elements (5, 3.5, x=4, 4, -1) .1 Any two correct .2 third correct .3 fourth and fifth correct	 For x=4, DO NOT ACCEPT if not equation	3
	b	**AM1** .1 Correctly expand $(x-4)^2$ .2 Correctly multiply the three terms by half AG $(y=)\ \frac{1}{2}x^2-4x+7$ **AM2** .1 Correctly take ½ as common factor .2 Correctly completing the square AG $(y=)\ \frac{1}{2}(x-4)^2-1$	**AM1** .1 $(y=)x^2-8x+16$ ACCEPT $x^2-4x-4x+16$ .2 $(y=)\ \frac{1}{2}x^2-4x+8$ **AM2** .1 $(y=)\ \frac{1}{2}(x^2-8x+14)$ .2 $(y=)\ \frac{1}{2}((x-4)^2-4^2+14))$ **For both AM** This is a show that question so each bp must be seen to award the mark Ex: seeing only $(y=)x^2-8x+16$ is only bp1 Ex: seeing only $(y=)\ \frac{1}{2}x^2-4x+8$ is only bp2	2

	c	**AM1 using the form $\frac{1}{2}(x-4)^2-1$** .1 Correctly substitute 0 into the equation .2 Correct rearrangement for **the** $(x-4)^2$ on one side .3 Correctly solve **the** quadratic .4 **The correct x-intercepts** to nearest one decimal place (as coordinates) **AM2 using the form $\frac{1}{2}x^2-4x+7$** .1 Correctly substitute 0 into the equation .2 Correctly substitute **the** coefficients into quadratic formula .3 Correctly solve **the** quadratic .4 **The correct x-intercepts** to nearest one decimal place (as coordinates)	**AM1** .1 $\frac{1}{2}(x-4)^2-1=0$ OE .2 $(x-4)^2=2$ .3 $(x=)4-\sqrt{2}$ or 2.585(786…) AND $(x=)4+\sqrt{2}$ or 5.414(21…) .3 ACCEPT 4-1.41 or and 4+1.41 .4 (2.6, 0) AND (5.4 , 0) ACCEPT 2.6 and 5.4 **AM2** .1 $\frac{1}{2}x^2-4x+7=0$ OE .2 $(x=)\frac{4\pm\sqrt{(-4)^2-4(0.5)(7)}}{2(0.5)}$ OE ACCEPT if only one mistake in a sign or in substituting a coefficient Ex: $(x=)\frac{4\pm\sqrt{(-4)^2-4(0.5)(7)}}{2(0.5)}$ or $\frac{4+\sqrt{(4)^2-4(0.5)(7)}}{2(0.5)}$ or $\frac{4-\sqrt{(-4)^2-4(0.5)(7)}}{2(0.5)}$ or $\frac{4\pm\sqrt{-16-4(0.5)(7)}}{2(0.5)}$ or $\frac{-(-4)\pm\sqrt{(4)^2-4(0.5)(7)}}{2}$ or $\frac{4\pm\sqrt{(4)^2-4(7)}}{2(0.5)}$ or $\frac{4\pm\sqrt{(-4)-4(0.5)(7)}}{2(0.5)}$ or $\frac{4\pm\sqrt{(-4)^2-4(0.5)}}{2(0.5)}$ .3 $(x=)4-\sqrt{2}$ or 2.585(786…) AND $(x=)4+\sqrt{2}$ or 5.414(21…) ACCEPT 4-1.41 or and 4+1.41 .4 (2.6, 0) AND (5.4 , 0) ACCEPT 2.6 and 5.4 **For any AM:** **bp2 implies bp1**	**4**

Q6		Answers	Notes	Total
	a	**AM1** .1 divide 1620 by 2840 .2 correct result **AM2** .1 multiply 55% by 2840 .2 correct result A road with separated cycle path more than 55% AG	**AM1** .1 1620/(40+1180+1620) or 1620/2840 .2 0.57(042…) OE (which is more than 55%) **AM2** .1 0.55x(40+1180+1620) or 0.55x2840 .2 1562 (which is less than 1620)	**2**
	b	Correctly set the equation y=6-x AG	x+0.4+y+y+0.4+x=12.8 or 2(x+y+0.4)=12.8 or x+y+0.4=6.4 or 2x+2y=12 ACCEPT the following whether seen calculations or explained in words 12.8-0.8=12 AND 12/2=6 or 6=y+x 12.8/2=6.4 AND 6.4-0.4=6 or 6=y+x	**1**
	c	.1 Correct step to solving simultaneous equations .2 **The correctly solution** for one unknown x OR y .3 Correctly write **their** corresponding value of the other unknown that satisfies one of their equations	.1 Correct substitution: $\frac{3}{2}x = 6 - x$ or $y = 6 - \frac{2y}{3}$ or $y = \frac{3}{2}(6 - y)$ OR correct coefficient for elimination: $0=6-5/2x$ or $0=-6+5/2x$ .1 ACCEPT substituting into 2x+2y=12 OE instead of y=6-x .2 (x=)2.4 OE OR (y=)3.6 OE .3 (x=)their 2.4 OE OR (y=)their3.6 OE	**3**

	d	.1 **one** from: multiply the three components by 2 regardless the units multiply the three components by 3 regardless the units the three components with consistent units .2 **the second** from: multiply the three components by 2 multiply the three components by 3 the three components with consistent units .3 **the correct** total cost 22.89	For bp1 and bp2 Examples: 2x0.6, 2x115, 2x3.1 OR 7.63 3x6000, 3x115, 3x3.1 OR 11.445 0.6, 0.115, 3.1 OE .3 22.89 (million) OE ACCEPT in $ or in million of $	**3**

Q7		Answers	Notes	Total
	a	.1 Substitute 15 and 240 into volume of cone formula .2 Correctly calculate their volume .3 Correctly calculate their answer after subtracting 32720 from their bp2 .4 Correctly round to nearest 10 cm^3	.1 $(V =)15^2 \times \pi \times \frac{240}{3}$ ACCEPT using $\frac{22}{7}$ or 3.14 instead of π .2 (V=) their56 548.66776 or 56 548.67 or 56 549 or 56520 using 3.14 or 56571.(4…) using $\frac{22}{7}$ .2 ACCEPT [56 520, 56 572] .2 ACCEPT their calculated volume if **only one** of the following is **incorrect, or missing, in their multiplication**: 15, 240, 1/3, π .3 (their56 548.66776 – 32 720 =) 23 828.6(6776) or 23829 ACCEPT [23800,23852] .4 their23 830 .4 ACCEPT correctly rounding their result in bp2 to nearest 10 cm^3 .4 DO NOT ACCEPT if their result does not need rounding	**4**
	b	**AM1** .1 Multiply their volume of pot by 0.9 .2 Correctly write their calculated result in litres. **AM2** .1 Correctly write their23830 in litres .2 Correctly multiply their volume by 0.9	**AM1** .1 their 23830 x 0.9 OE or their21 447 .2 (their 21 447 / 1000 =) their21(.447) or 21.5 **AM2** .1 their23.8(3…) .2 (their23.8(…)x0.9=) their21(.447) or 21.5	**2**
	c	.1 Multiply their 7b by 0.4 .2 Correctly add the cost of their **three** components for one plant	.1 their21 x 0.4 or their8.4 .2 (their8.4 + 6 + 1.5 =) their15.9 .2 ACCEPT if their8.4 is 0.4 or any other number	**2**
	d	Correct value for L1	160	**1**

	e	.1 Correctly substitute 40 and 80 into Pythagoras OR correct substitution into trig ratio .2 **The correct** vertical distance between two centres .3 Correctly add 80 to their bp2	.1 $x^2+40^2=80^2$ OE OR $\frac{40}{tan30}$ or $40 \times tan60$ or $80 \times sin60$ or $80 \times cos30$ .2 69(.282…) ACCEPT 70 .3 (their69.28.. + 80 =) their149(.282…) ACCEPT 150 .3 ACCEPT even if none of bp1 or bp2 are awarded	**3**

Q7f total 10 marks

Mark	1	2
Factors (F)	**Two** from the factors below mentioned in the factors box WTTE ⇒Space for plant to grow ACCEPT distance between pots or distance between centres, circumference or area of the pot, the circle of the plant, space for people (to walk or to sit…), space unoccupied ⇒ Dimensions of garden ACCEPT the space available, area of the roof, the 290 and the 360, length and width of garden ⇒The arrangement of pots ACCEPT The formation, the way we place the pots, the triangular, square, calling the triangular formation honeycomb DO NOT ACCEPT number of plants able to fit DO NOT ACCEPT other irrelevant factors. Ex: enough sunlight, the budget or cost, number of pots in each row, covering shield for plants, aesthetically appealing	**The three** factors mentioned in the factors box WTTE

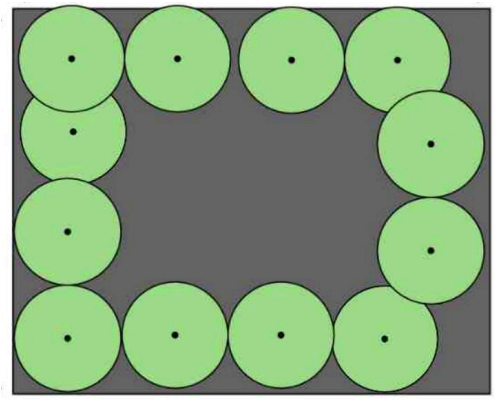
Mark	1	2	3
			ACCEPT only if D2 is achieved
Calculate (C)	Correct calculation for their horizontal direction Ex: 360/80=4.5 or their4x80	Correct calculation for **their** horizontal direction Ex: 360/80=4.5 or their4x80 Ex for triangular: their4xtheir69+80=their360 OE ACCEPT their4xtheir69+80<360 OE **AND** Correct calculation for **their** vertical direction Ex: 290/80=3.6(25) or their3x80 Ex for triangular: their3xtheir70 + 80 = their290 OE ACCEPT their3xtheir69 + 80 < 290	Correct calculation for **the** horizontal direction in the case of 15 or 16 pots Ex: 4x70+80=360 or 4x69+80<360 **AND** Correct calculation for **the** horizontal direction in the case of 15 or 16 pots Ex: 3x70 + 80 = 290 or 3x69+80<290 **AND** Correct calculation for **their** cost based on their design regardless of rounding Their number of pots x their7c
	OR Correct calculation for their vertical direction Ex: 290/80=3.6(25) or their3x80		
	OR Their cost based on their design: Their number of pots x their7c	**OR** Correct calculation for **their** cost based on their design regardless of rounding Their number of pots x their7c	
	OR Correct calculation for area of one pot as 5026.5 and area roof as 104400 or Correct calculation of area between the circles for their arrangement whether square or triangle	**AND** Correct calculation of area between the circles for **their** arrangement whether square or triangle OR correct calculation for the maximum number of pots based on area: $\frac{290\times360}{\pi\times40^2} = 20.7(69\ldots)$	

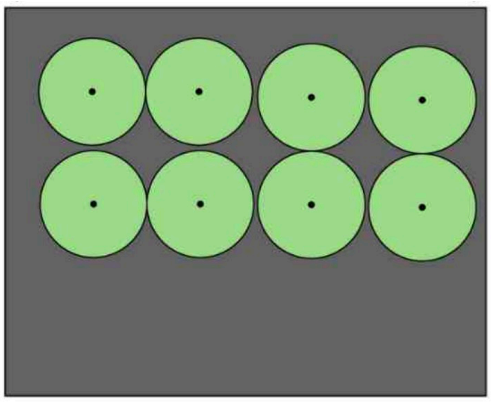
Mark	1	2
Design on canvas (D)	Design includes 12 to 14 non-overlapping plants ACCEPT minor overlaps and use professional judgement **OR** Design includes 14 to 16 with only one clear overlap between plants **See examples below**	Design includes 15 or 16 non-overlapping plants ACCEPT minor overlaps and use professional judgement **See examples below**

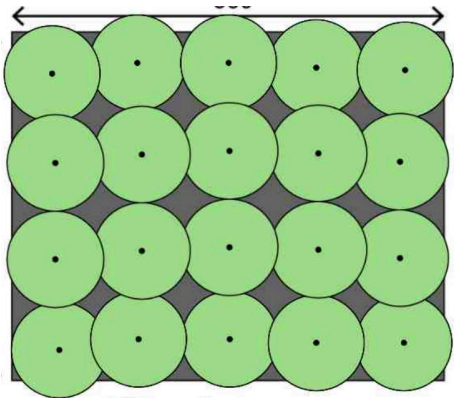
Mark	1
Accuracy (A)	Correct sensible degree of accuracy for the calculation of the product of their 7c by their number of plants on canvas: (their7cxtheir16=)their257.6 or their$258 or their$260 ACCEPT if they correctly round up their 7c , DO NOT ACCEPT if they round down their 7c DO NOT ACCEPT if accurate to more than two decimal places (more than nearest cent) ACCEPT Correct sensible rounding in any calculation Examples: For area of one pot: 5030 For total area/area of pot: 20.7 so 20 plants For the number of plants: 360/80=4.5 so 4 or one below and they use 4, or 290/80=3.6 so 3 or one below and they use 3

Mark	1	2
	ACCEPT only if D1 is achieved	**ACCEPT only if D2 is achieved**
Justify (J)	Acceptable justification for their arrangement Examples: - I respected all the requirements (and we see the canvas with requirements respected) - I provided good space for movement between plants - Not very accurate as I rounded values - My calculations are approximations	Acceptable justification for the arrangement of 15 or 16 pots Examples: - I respected all the requirements (and we see the canvas with requirements respected) - If they were square they take 3 rows but triangular (or honeycomb) I was able to fit 4 - Space for plants to grow is an estimate - Plants might not need exactly the same space to grow - The price of soil can be less if we buy multiple litres or price of plants can be less if multiple plants

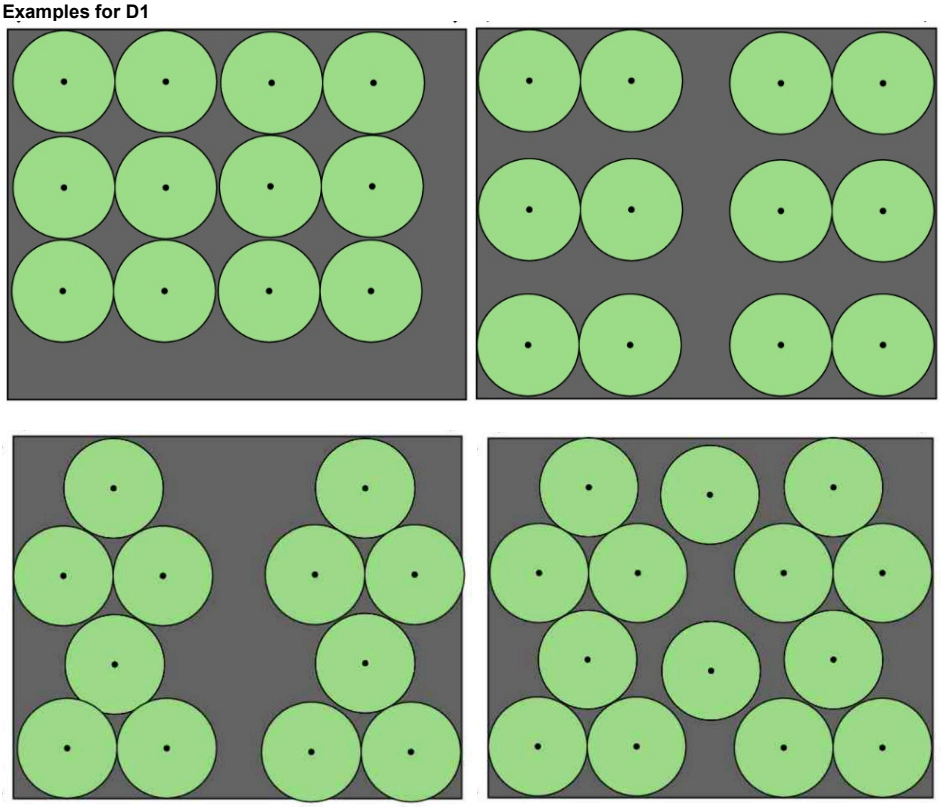
Examples for D0



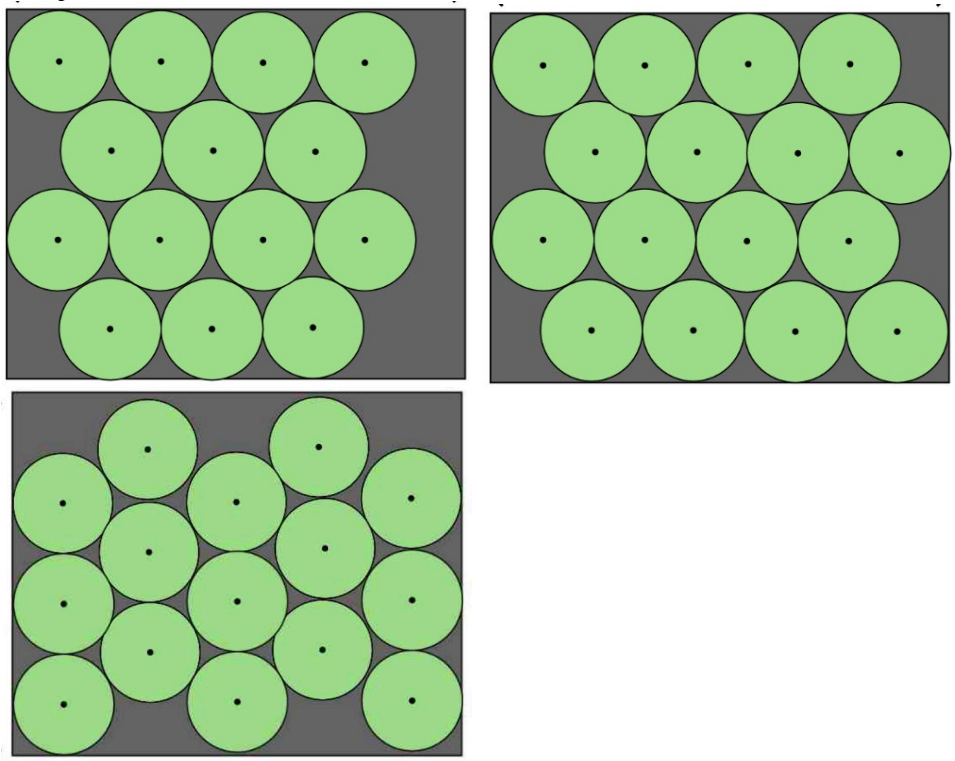




Examples for D1



Examples for D2



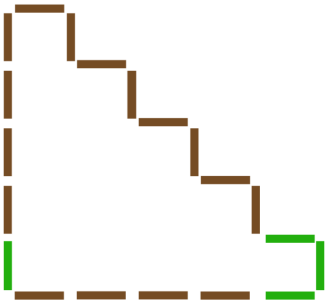
Q8 Task 3

Glossary for task 3

Term used	**Clarification**
General rule	Rule in terms of only n (if they use x, it is still general rule but penalise in notation)
The general rule	The correct general rule in terms of only n (if they use x, it is still the general rule but penalise in notation)
Their general rule	valid attempt for the general rule but in terms of only n (if they use x, it is still their general rule but penalise in notation)
Their rule	Correct rule not in terms of only n
Recursive rule	

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
$4n$	Linear	
n^2+3n	Quadratic or exponential	Linear

Q8		Answers	Notes	Total
	a	correctly place the four sticks	Stage 5 	**1**
	b	Correctly place 20 and 24	5 | 20 6 | 24	**1**
	c	.1 correctly describe one pattern for *S* in words .2 correctly describe a second pattern for *S* in words	ACCEPT complete terminology only, for example (below are four different descriptions) ➢ divisible by 4, multiples of 4, timetable of 4 ➢ 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 ➢ Even numbers ➢ Second difference zero DO NOT ACCEPT incomplete terminology, for example: Arithmetic, linear, increasing by a constant, constant difference DO NOT ACCEPT general descriptions or incorrect descriptions for example: Integers, whole numbers, positive, divisible by 2, multiples of 2, or **the** even numbers DO NOT ACCEPT the rule in words or description related to n for example: 4 times n, n multiplied by 4 , WTTE **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 4*n* or *S*=4x*n* *S*=4**n* .2 *S*=4*n* .2 ACCEPT using *Sn* instead of *S* .2 ACCEPT .2 ACCEPT using *s* and *N* DO NOT ACCEPT description in words	**2**
	e	.1 correctly substitute *n* ≥ 5 into their general rule (from 8c or 8b) .2 correctly calculate their value of *S* after substituting *n* ≥ 5 .3 recognise that their correctly calculated value of *S* is the same as their predicted value	.1 Ex: 4x5 .2 Ex: 20 (for *n* = 5) .3 If they use *n*=5 or *n*=6 ACCEPT only if they say “as seen in the table” WTTE or we see the predicted values re-written here in part e) .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, 24 is obtained from pattern of adding 4 to 24	**3**

f)

Stage number (n)	External sticks (S)	Internal sticks (L)	Total number of sticks (T)
1	4	0	4
2	8	2	10
3	12	6	18
4	16	12	28
5	20	20	40
6	24	30	54
7	28	42	70

Mark	1	2
Predictions (P)	Correctly predict two terms for L OR Correctly predict **one** term for T	Correctly predict **two** terms for T
	Ignore additional incorrect predictions	Ignore additional incorrect predictions

<table>
<tr><th>Mark</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr>
<tr><td rowspan="4">Description (D)

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

Ignore additional incorrect patterns</td><td>Correctly describe a pattern in words for T

Examples of different patterns:
The increase, or the difference, is even or multiple of 2
The increase, or the difference, increases by 2
Second difference 2

ACCEPT
“Second difference constant” only if their working shows second difference is 2

ACCEPT patterns described with incorrect terminologies but penalise in notation (N).
Ex:
(T=)T+2n+2 or X=X+2n+2 or the rule is T+2n+2
DO NOT ACCEPT increasing

DO NOT ACCEPT
Even numbers
Seeing only Quadratic
Correct pattern in words for L</td><td>Correctly describe a pattern in words for T

AND

Their general rule for L as a <u>quadratic</u> satisfying at least one value for n OR their general rule for T as exponential satisfying at least one value for n</td><td>Correctly describe a pattern in words for T

AND

Their general rule for T as a <u>quadratic</u> satisfying at least one value for n or correct recursive rule for T</td><td>Correctly describe a pattern in words or recursive rule for T

AND

The general rule for L</td><td rowspan="4">Correctly describe one pattern in words or correct recursive rule for T

AND

The general rule for T</td></tr>
<tr><td>OR
Their general rule for T as a <u>quadratic</u> satisfying at least one values for n</td><td>OR
The general rule for L
L = $n^2 - n$ OE</td><td>OR
The general rule for T
T = $n^2 + 3n$ OE</td></tr>
<tr><td>OR
Their general rule for L as a <u>quadratic</u> satisfying at least one value for n</td><td>OR
Correct recursive rule for T
$T_{n+1}=T_n+4+2n$ OR $T_n=T_{n-1}+2+2n$ OE</td><td>OR
The general rule for T in words or partially in words</td><td></td></tr>
<tr><td>OR
The general rule for L in words or partially in words</td><td></td><td></td></tr>
</table>

Mark	1	2
Testing (T)	Attempt to test their general rule for T using $n \leq 4$ Ex: Correctly substitute in their general rule for T value of $n \leq 4$ **OR** Correctly test their described pattern or their rule (ex: recursive rule or their linear rule for T)	Correctly test their general rule for T using $n \leq 4$ Ex: correctly calculate their value for T in their general rule for T using $n \leq 4$ **AND** Recognise that <u>their</u> correctly calculated value for T is the same as <u>the</u> given value in the table **ACCEPT** Seeing their correctly calculated value for T as fraction or decimal, and the given value in the table being equal

	1	2	3
Verifying (V)	Attempt to verify their general rule for T using $n \geq 5$ Ex: Correctly substitute in their general rule for T value of $n \geq 5$ **OR** Correctly verify their described pattern or their rule (ex: recursive rule or their linear rule for T)	Correctly calculate their value for T in their general rule for T using $n \geq 5$	**ACCEPT only if they have <u>the</u> general rule for *T*** Correctly calculate the value for T in <u>the general rule</u> using $n \geq 5$ **AND** Recognise that <u>the</u> correctly calculated value for T is the same as <u>the</u> correct predicted value for T 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 *T***	**ACCEPT only if they have the general rule for *T***
	Attempt to justify their general rule for *T* Ex: Quadratic model and valid attempt to find values of coefficients using any method.	Attempt to justify: $(T =)n^2 + 3n$ OE Ex: Quadratic model and find the correct values of coefficients using any method	Good attempt to justify the general rule for *T* geometrically Use the sum of correct rules for S and *L* but without simplification Ex: $T = n^2 - n + 4n$ or $T = n(n-1) + 4n$	Correctly justify the general rule for *T* geometrically Use the sum of correct *S* and *L* rules with complete simplification: They show how the sum of the correct *S* and *L* rules simplifies to Ex: $T = n^2 - n + 4n = n^2 + 3n$
	OR Weak attempt to justify their general rule for *T* geometrically by realizing two sequences are added Ex: write *T*=*S*+*L* and substitute numbers Ex: *T*=*S*+*L* and they say as seen in the table WTTE	**OR** Weak attempt to justify their general rule for *T* by realizing their sequence *S* (in terms of *n*) is added to their sequence *L* (in terms of *n*)		
	OR Substitute at least two other values of *n* in their general rule for *T* and say they are the same or it works WTTE			
	OR Attempt to justify: $(L =)n^2 - n$ OE Ex: Quadratic model and find the correct values of coefficients using any method			

<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</u> general rule for T</td><td>ACCEPT only if they have <u>the</u> general rule for T</td></tr>
<tr><td>Correctly describe one pattern for T in words <u>using correct terminology</u> or correct recursive rule for T using correct notation

Example:
Second difference is the same
ACCEPT what we add increases by 2
DO NOT ACCEPT what goes up adds 2, the increase plusses 2
DO NOT ACCEPT if the pattern is not accepted in D1</td><td>Correctly describe one pattern for T in words <u>using correct terminology</u> (see examples in N1) <u>and</u> the notation of <u>the general</u> rule for T includes errors or not simplified or in words (see examples in N1)</td><td rowspan="3">Correctly describe one pattern for T in words <u>using correct terminology</u> (see examples in N1)

AND

Correct notation of <u>the general</u> rule for T in simplest form (see examples in N2)</td></tr>
<tr><td>OR
The notation of <u>the general</u> rule for T includes errors or not simplified or in words. Examples:
T=n^2+3n or T=1n²+3n
The rule for T is $n^2 + 3n$

The general rule in words</td><td>OR
Correct notation of <u>the general</u> rule for T in simplest form
T = n² + 3n or T=n(n+3)

ACCEPT using T_n or Tn or $T(n)$ instead of T</td></tr>
<tr><td>OR
Correct notation of <u>their</u> general rule for T.
Examples:
$T = n^2 + 3$ or $T = 4n^2 + 7$ or $T = 2^n$

ACCEPT if not simplified</td></tr>
<tr><td colspan="3">The following are considered errors in notation
using * for multiplication, using / for division , using Λ for power, using x instead of n
using U_n instead of T without mentioning that $T = U_n$</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 *T*** **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 $n \le 4$ only • **For verify:** they say “verify” and they substitute in their general rule value(s) of $n \ge 5$ 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 $n \le 4$ <u>followed by</u> value(s) of $n \ge 5$, consider it as only one identified process	**ACCEPT only if they have the general rule for *T*** **The following two items must be seen** : • write <u>the general rule for *T*</u> • justify <u>the general rule</u> (at least J2) **AND** **At least two** of the following **items** are seen: • describe a pattern or rule in words • test <u>the general rule</u> (at least T1) • verify <u>the general rule</u> (at least V1) **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 *T* value(s) of $n \le 4$ only • **For verify:** they say “verify” and they substitute in the general rule for *T* value(s) of $n \ge 5$ 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 $n \le 4$ <u>followed by</u> value(s) of $n \ge 5$, consider it as only one identified process