



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Cycle 2024

Marking Scheme

Mathematics

Higher Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

Structure of the marking scheme

Candidate responses are marked according to different scales, depending on the types of response anticipated. Scales labelled A divide candidate responses into two categories (correct and incorrect). Scales labelled B divide responses into three categories (correct, partially correct, and incorrect), and so on. The scales and the marks that they generate are summarised in this table:

Scale label	A	B	C	D
No of categories	2	3	4	5
5-mark scale	0, 5	0, 2, 5	0, 2, 3, 5	0, 2, 3, 4, 5
10-mark scale		0, 5, 10	0, 5, 7, 10	0, 4, 6, 8, 10
15-mark scale			0, 5, 10, 15	0, 4, 8, 12, 15
20-mark scale				0, 5, 10, 15, 20

A general descriptor of each point on each scale is given below. More specific directions in relation to interpreting the scales in the context of each question are given in the scheme, where necessary.

Marking scales – level descriptors

A-scales (two categories)

- incorrect response (no credit)
- correct response (full credit)

B-scales (three categories)

- response of no substantial merit (no credit)
- partially correct response (partial credit)
- correct response (full credit)

C-scales (four categories)

- response of no substantial merit (no credit)
- response with some merit (low partial credit)
- almost correct response (high partial credit)
- correct response (full credit)

D-scales (five categories)

- response of no substantial merit (no credit)
- response with some merit (low partial credit)
- response about half-right (mid partial credit)
- almost correct response (high partial credit)
- correct response (full credit)

In certain cases, typically involving incorrect rounding, omission of units, a misreading that does not oversimplify the work, or an arithmetical error that does not oversimplify the work, a mark that is one mark below the full-credit mark may also be awarded. This level of credit is referred to as *Full Credit –1*. Thus, for example, in Scale 10C, *Full Credit –1* of 9 marks may be awarded.

The only marks that may be awarded for a question are those on the scale above, or *Full Credit –1*.

A rounding penalty is applied only once in each question. A penalty for an omitted unit is applied only once in each question. There is no penalty for omitted units if the question specifies the unit to be used in the answer, and there is generally no penalty for an omitted euro symbol in questions involving money.

In general, accept a candidate's work in one part of a question for use in subsequent parts of the question, unless this oversimplifies the work involved.

Summary of mark allocations and scales to be applied

Question 1 (15)

- (a) 5D
(b),(c) 10C

Question 2 (20)

- (a),(b) 5C
(c),(e) 10D
(d) 5C

Question 3 (30)

- (a) 10C
(b) 10C
(c) 10D

Question 4 (20)

- (a),(b) 10D
(c) 10C

Question 5 (15)

- (a) 5C
(b) 10C

Question 6 (10)

10C

Question 7 (15)

- (a) 5B
(b) 5D
(c) 5C

Question 8 (25)

- (a),(b) 10D
(c) 15C

Question 9 (25)

- (a),(b)(i) 10C
(b)(ii) 15C

Question 10 (15)

- (a),(b) 15D

Question 11 (25)

- (a),(b) 10D
(c),(d) 15D

Question 12 (25)

- (a),(b) 5D
(c) 20D

Question 13 (30)

- (a), (b) 10D
(c) 20D

Palette of annotations available to examiners

Symbol	Name	Meaning in the body of the work	Meaning when used in the right margin
	Tick	Work of relevance	The work presented in the body of the script merits full credit
	Cross	Incorrect work (distinct from an error)	The work presented in the body of the script merits 0 credit
	Star	Rounding / Unit / Arithmetic error Misreading	
	Horizontal wavy	Error	
	P		The work presented in the body of the script merits a partial credit for B scales
	L		The work presented in the body of the script merits low partial credit
	M		The work presented in the body of the script merits mid partial credit
	H		The work presented in the body of the script merits high partial credit
	F star		The work presented in the body of the script merits Full Credit (– 1)
	Left Bracket		Another version of this solution is presented elsewhere and it merits equal or higher credit
	Vertical wavy	No work on this page (portion of the page)	
WOM			The candidate has presented work or merit

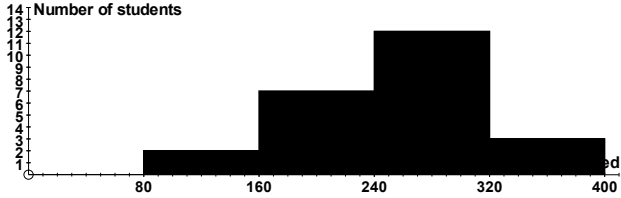
Detailed marking notes

Model Solutions & Marking Notes

Note: The model solutions for each question are not intended to be exhaustive – there may be other correct solutions. Any Examiner unsure of the validity of the approach adopted by a particular candidate to a particular question should contact his / her Advising Examiner.

Q1	Model Solution – 15 marks					Marking Notes
(a)						Scale 5D (0, 2, 3, 4, 5) There are 15 entries required. Note: Brackets not required. Note: Reverse order in couple is FC <i>Low Partial Credit:</i> • 1 correct entry • Adds all the entries, for example: (1, 7) given as 8 <i>Mid Partial Credit:</i> • 7 correct entries <i>High Partial Credit:</i> • 11 correct entries <i>Full Credit –1:</i> • 14 correct entries
			7	8	9	10
Red counters	1	(1, 7)	(1, 8)	(1, 9)	(1, 10)	
	2	(2, 7)	(2, 8)	(2, 9)	(2, 10)	
	3	(3, 7)	(3, 8)	(3, 9)	(3, 10)	
	4	(4, 7)	(4, 8)	(4, 9)	(4, 10)	

Q1	Model Solution – 15 marks	Marking Notes
(b) & (c)	(b) $\frac{4}{16} = \frac{1}{4} \text{ or equivalent}$ (c) (2, 7), (3, 7)	Scale 10C (0, 5, 7, 10) Note: Accept (1, 7) for work of merit in (c) <i>Low Partial Credit:</i> • Work of merit in (b) or (c), for example: correct numerator 4 or denominator 16 in (b); one couple correct in (c) <i>High Partial Credit:</i> • One part correct • Work of merit in both parts <i>Full Credit –1:</i> • 1 : 4 or 4 : 16

Q2	Model Solution – 20 marks	Marking Notes
(a) & (b)	(a) $0 + 2 + 7 = 9 \text{ [students]}$ (b) 	Scale 5C (0, 2, 3, 5) Note: Accept 9 without work in (a) <i>Low Partial Credit</i> - Part (a) correct - Work of merit in (a) or (b), for example: any two correct number of students in (a); one correct bar drawn in (b) <i>High Partial Credit:</i> - Part (a) correct and one error in the histogram, for example all bars of correct height but with gaps between them - Histogram fully correct but (a) incorrect <i>Full Credit –1</i> - One height incorrect in (b), otherwise correct (b) correct but in (a) writes $2 + 7 = x$, where $x \neq 9$

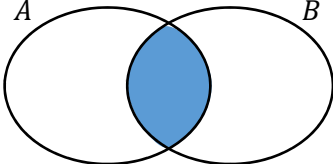
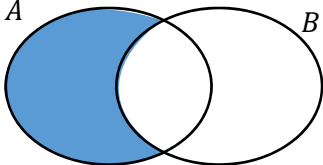
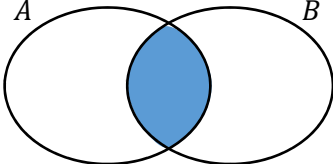
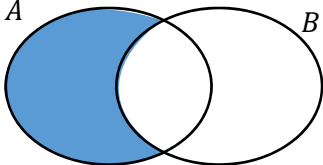
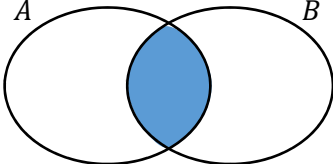
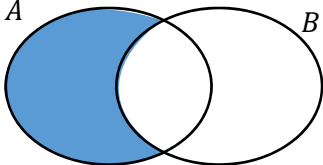
Q2	Model Solution – 20 marks	Marking Notes
(c) & (e)	(c) $7 + 12 + 3 = 22$ [students] (e) Median is student $\left(\frac{24+1}{2}\right) = 12.5$ This student lies in the 240 – 320 interval, between the 3rd and 4th student out of 12. So closer to 240 than 320. Approx $\approx 240 + 20 = 260$ [cm]	Scale 10D (0, 4, 6, 8, 10) Accept correct answer without units In (e), accept any value in the interval 240 – 319 inclusive, with work <i>Low Partial Credit:</i> • Work of merit in either part, for example: any 2 relevant values given in (c); shows some understanding of median - $\frac{25}{2}$ or indicates 12th/13th person or some work on diagram in (e) • Any value in the interval 240 – 319 given in (e) without work relevant to the median <i>Mid Partial Credit:</i> • 1 part correct • Work of merit in both parts <i>High Partial Credit:</i> • 1 part correct and work of merit in the other part <i>Full Credit –1:</i> • Correct interval identified with work relevant to the median but estimate not given in (e)

Q2	Model Solution – 20 marks	Marking Notes
(d)	$\frac{0(40) + 2(120) + 7(200) + 12(280) + 3(360)}{0 + 2 + 7 + 12 + 3}$ $= \frac{0 + 240 + 1400 + 3360 + 1080}{24}$ $= \frac{6080}{24} = 253 \cdot 333 \dots$ $= 253 \text{ [cm]} \text{ } [\in \mathbb{N}]$	Scale 5C (0, 2, 3, 5) Accept correct answer without units Accept correct answer without work <i>Low Partial Credit:</i> • Work of merit, for example: indicates division by 24; one correct mid-interval value; numerator with consistent incorrect mid-interval values <i>High Partial Credit:</i> • Consistent incorrect mid-interval values and finishes correctly • First line in solution <i>Full Credit –1:</i> • No rounding or incorrect rounding

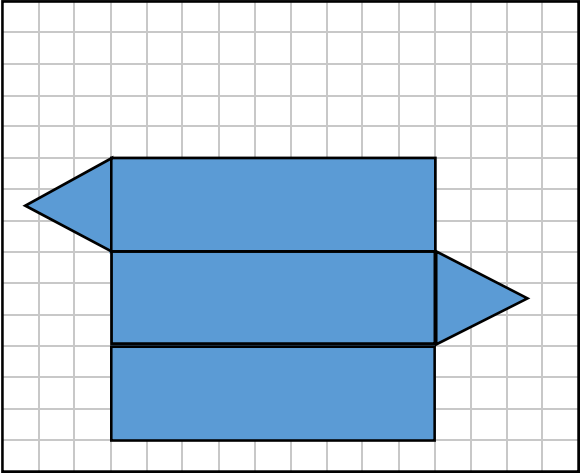
Q3	Model Solution – 30 marks	Marking Notes
(a)	(a) (i) $7 + 8 = 15 \text{ hours}$ $15 \times \text{€}19 = [\text{€}] 285$ (ii) $1.5 \times \text{€}19 = \text{€}28.50 \text{ per hour}$ $6 \times \text{€}28.5 = \text{€}171$ OR $6 \times \text{€}19 = \text{€}114$ $1.5 \times \text{€}114 = [\text{€}] 171$	Scale 10C (0, 5, 7, 10) Accept correct answers without work Accept correct answers without units <i>Low Partial Credit:</i> - Work of merit in (i) or (ii), for example: works out 15 or writes 7+8 in (i); writes 1.5 or 9.50 or 28.50 in (ii) <i>High Partial Credit:</i> (i) correct and work of merit in (ii) (ii) correct
(b)	$\frac{20}{100} \times \text{€}1900 = \text{€}380$ Net Income: $1900 - (380 - 312.50)$ $= 1900 - 67.50$ $= [\text{€}] 1832.50$	Scale 10C (0, 5, 7, 10) Accept correct answers without units Consider solution as involving 3 steps: Step 1. Finds Gross Tax Step 2. Subtracts Gross Tax from Gross Income Step 3. Deals with Tax Credit Note: Step 3 may happen before Step 2, that is, Tax Credit may be subtracted from Gross Tax, or added to Gross Income (because Tax Credit < Gross Tax). <i>Low Partial Credit:</i> - Work of merit, for example: $\frac{20}{100}$ or 0.2 <i>High Partial Credit:</i> 2 steps correct - Correct answer without work

Q3	Model Solution – 30 marks	Marking Notes
(c)	(i) $\frac{3.2}{100} \times 2500 = [\text{€}] 80$ (ii) $2500 + 80 = 2580$ end year 1 Interest year 2 = $\frac{3.2}{100} \times 2580 = 82.56$ $2580 + 82.56 = [\text{€}] 2662.56$ OR $2500 \times 1.032^2 = [\text{€}] 2662.56$	Scale 10D (0, 4, 6, 8, 10) Accept correct answers without work Accept correct answers without unit <i>Low Partial Credit:</i> - Work of merit in (i) or (ii), for example: $\frac{3.2}{100}$ or 0.032 in (i) or in (ii) carries down the answer from (i) to (ii) <i>Mid Partial Credit:</i> 1 part correct - Work of merit in both (i) and (ii) <i>High Partial Credit:</i> - One part correct and work of merit in the other part <i>Full Credit –1</i> - Early rounding in (ii)

Q4	Model Solution – 20 marks	Marking Notes
(a) & (b) (a) $1 + 4 = 5$ parts Concentrate = $\frac{1}{5}$ of 15 litres $= 3$ [litres] (b) $\frac{10\,000}{250} = 40$ glasses or $\frac{10}{0.25} = 40$ glasses $40 \times 0.20 = \text{€}8$ $\text{€}8 - \text{€}5.50 = \text{€}2.50$ profit $\frac{2.50}{5.50} = 45 \cdot 45 = 45.5$ [% profit]		Scale 10D (0, 4, 6, 8, 10) Accept correct answers without units In (a) accept correct answer without supporting work. <i>Low Partial Credit:</i> - Work of merit in (a) or (b), for example: 5 in (a); $\frac{10000}{250}$; shows some knowledge of percentages in (b) <i>Mid Partial Credit:</i> - Work of merit in (a) and (b) (a) correct and work of merit in (b) - Significant work on (b) for example: finds €2.50 or correct answer without supporting work <i>High Partial Credit:</i> (a) correct and significant work in (b) (a) correct and correct answer without supporting work in (b) (b) correct <i>Full Credit –1:</i> - No rounding, incorrect rounding or early rounding in (b)
(c) $V = \pi r^2 h$ $V = \pi(3)^2(10)$ $= 282.7 \dots$ $= 283 \text{ [cm}^3\text{] } [\in \mathbb{N}]$		Scale 10C (0, 5, 7, 10) Accept correct answer without work Accept correct answer with no or incorrect units <i>Low Partial Credit:</i> - Correct formula with some correct substitution for r or h - Finds radius <i>High Partial Credit:</i> - Fully correct substitution into $V = \pi r^2 h$ <i>Full Credit –1:</i> - No rounding or incorrect rounding - Answer given in terms of π

Q5	Model Solution – 15 marks	Marking Notes								
(a)	<table><tr><th>Set</th><th>$A \cap B$</th></tr><tr><td>Venn diagram</td><td></td></tr></table> <table><tr><th>Set</th><th>$A \setminus B$</th></tr><tr><td>Venn diagram</td><td></td></tr></table>	Set	$A \cap B$	Venn diagram		Set	$A \setminus B$	Venn diagram		Scale 5C (0, 2, 3, 5) <i>Low Partial Credit:</i> • Work of merit in one set, for example: $A \cup B$ shaded for $A \cap B$; $(A \cup B) \setminus (A \cap B)$; $U \setminus (A \cap B)$ • $B \setminus A$ shaded for $A \setminus B$ <i>High Partial Credit:</i> • One set correct • Work of merit in both sets
Set	$A \cap B$									
Venn diagram										
Set	$A \setminus B$									
Venn diagram										

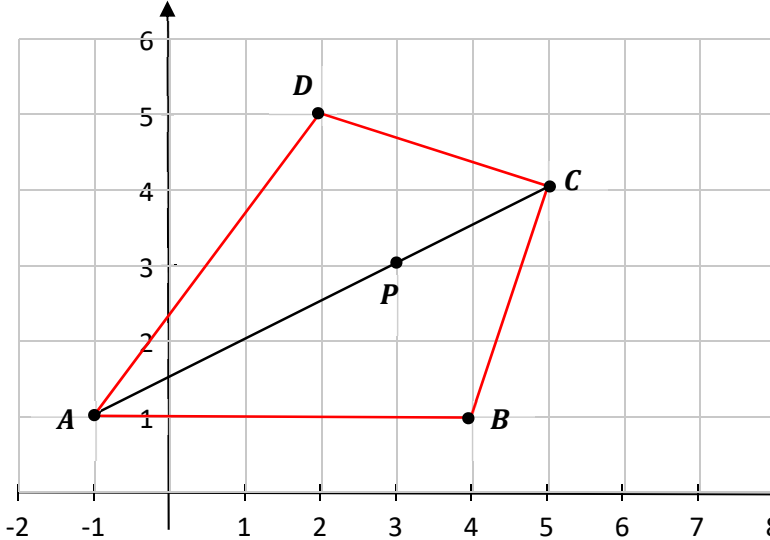
Q5	Model Solution – 15 marks	Marking Notes
(b)	(i) $P \cap Q \cap S = \{5\}$ (ii) $P \setminus Q = \{6, 9\}$	Scale 10C (0, 5, 7, 10) Note: Accept lists of elements without set brackets in (i) and (ii) Note: Answers to (i) and (ii) may be based on the given sets or on the candidate's Venn diagram <i>Low Partial Credit:</i> • Work of merit in Venn diagram, for example: 1 correct entry in the Venn diagram or some correct factors or natural numbers written where the sets are defined • Work of merit in (i) or (ii) <i>High Partial Credit:</i> • Work of merit in Venn diagram and (i) or (ii) correct • Venn diagram fully correct • (i) and (ii) correct <i>Full Credit –1</i> • One incorrect entry or one missing entry Note: LPC if (i) or (ii) correct without any new elements on Venn diagram HPC if (i) and (ii) correct without any new elements on Venn diagram

Q6	Model Solution – 10 marks	Marking Notes
		Scale 10C (0, 5, 7, 10) 4 faces drawn are required Note: Accept correct construction without construction lines. Tolerance: The apex of the triangle is within the relevant 1 cm² square <i>Low Partial Credit:</i> • Work of merit, for example: rough sketch drawn • 1 face correctly drawn <i>High Partial Credit:</i> • 3 faces correctly drawn • All faces drawn but scale incorrect. • All faces to scale but triangles on wrong face

Q7	Model Solution – 15 marks	Marking Notes
(a)	$x^3 = 216$ $x = 6$ [cm]	Scale 5B (0, 2, 5) Accept correct answer without supporting work Accept correct answer without units <i>Partial Credit:</i> - Work of merit, for example: the volume of a cuboid - $l \times b \times h$ written; x^3 written $x = \sqrt[3]{216}$
(b)	(i) Surface area of B $= 2[(5)(y) + (5)(6) + (y)(6)]$ $= 10y + 60 + 12y$ $= (22y + 60) \text{ [cm}^2\text{]}$ (ii) $22y + 60 = 269$ $22y = 209$ $y = \frac{209}{22} = 9.5 \text{ [cm]}$	Scale 5D (0, 2, 3, 4, 5) Accept correct answers without units Accept correct answer in (ii) without work <i>Low Partial Credit:</i> - Work of merit in (i) or (ii), for example: formula for the surface area of a rectangular solid or finds the area of one side in (i); $22y + 60 = 269$ in (ii); tries to work out the surface area for a given value of y in (ii) <i>Mid Partial Credit:</i> (i) or (ii) correct - Work of merit in (i) and (ii) <i>High Partial Credit:</i> 1 part correct and work of merit in the other part <i>Full Credit –1</i> (i) left at $10y + 60 + 12y$ or similar, without final line (i.e. without conclusion) and (ii) correct

Q7	Model Solution – 15 marks	Marking Notes
(c)	Method 1 Side $p \in \{1, 2, 4, 8, 16, 32\}$ $p = 4$ since $4 \times 12 = 48 \text{ cm}^2$ $\therefore p = 4, m = 12$ and $l = 8$ $\Rightarrow V = (8)(12)(4) = 384 \text{ [cm}^3\text{]}$ OR Method 2 $lm = 96 \Rightarrow m = \frac{96}{l}$ $pm = 48 \Rightarrow p\left(\frac{96}{l}\right) = 48 \Rightarrow 96p = 48l$ $\Rightarrow 2p = l$ $pl = 32 \Rightarrow p(2p) = 32 \Rightarrow 2p^2 = 32$ $\Rightarrow p^2 = 16 \Rightarrow p = 4$ $\Rightarrow l = 8$ $m = \frac{96}{8} = 12$ $\Rightarrow V = (8)(12)(4) = 384 \text{ [cm}^3\text{]}$ OR Method 3 $lm \times pm \times pl = 96 \times 48 \times 32 = 147456$ $\Rightarrow (lmp)^2 = 147456$ $\Rightarrow V = lmp = \sqrt{147456} = 384 \text{ [cm}^3\text{]}$	Scale 5C (0, 2, 3, 5) Accept correct answer without units Accept correct answer without work <i>Low Partial Credit:</i> • Work of merit, for example: $p = 4$ or $m = 12$ or $l = 8$; area of a rectangle or volume of a cuboid written • One pair of factors of 32 or 48 or 96 • $96 \times 48 \times 32$ <i>High Partial Credit:</i> • Works out $p = 4, m = 12$ and $l = 8$ • Works out 2 values correctly makes error in 3rd and finishes correctly • In Method 2 works out $m = \frac{96}{l}$ and $2p = l$ and $p(2p) = 32$ but fails to finish

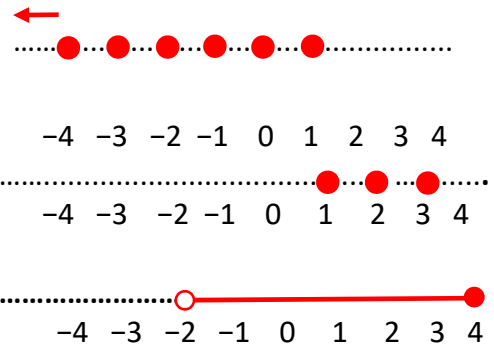
Q8	Model Solution – 25 marks	Marking Notes
(a) & (b)	(a) $g(3) = 2$ (b) $x = -1$	Scale 10D (0, 4, 6, 8, 10) <i>Low Partial Credit:</i> • Work of merit in either (a) or (b), for example: relevant work on diagram <i>Mid Partial Credit</i> • One part correct • Work of merit in both parts <i>High Partial Credit:</i> • One part correct and work of merit in the other part
(c)	The graph shows two piecewise linear functions on a Cartesian coordinate system. The x-axis is labeled from -2 to 3, and the y-axis is labeled from -2 to 5. The function $y = g(x)$ is a black line with vertices at $(-2, 0)$, $(1, 3)$, and $(3, 2)$. The function $y = g(x) - 2$ is a red line with vertices at $(-2, -2)$, $(1, 1)$, and $(3, 0)$.	Scale 15C (0, 5, 10, 15) <i>Low Partial Credit:</i> • Effort at plotting correct points, for example $(3, 0)$ or similar • Graph drawn either 2 places to left or right i.e. horizontal movement • Any correct point written <i>High Partial Credit:</i> • All integer valued points plotted correctly but not joined or joined incorrectly • One point incorrect but points joined • All points correctly calculated but not plotted <i>Full Credit –1</i> • $g(x) + 2$ drawn

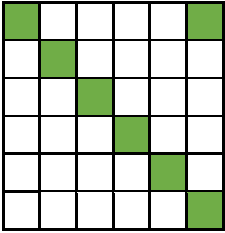
Q9	Model Solution – 25 marks	Marking Notes
(a) (b) (i)	(a) $A(-1, 1)$ $C(5, 4)$ (b)(i) <i>Point $D(2, 5)$ plotted, and quadrilateral $ACBD$ drawn:</i> 	Scale 10C (0, 5, 7, 10) <i>Low Partial Credit:</i> • Work of merit, for example: one point correct or co-ordinates reversed in (a); B and P connected with a line segment in (b)(i) • Random point D plotted and quadrilateral $ABCD$ drawn in (b)(i) <i>High Partial Credit:</i> • (a) or (b)(i) correct • Work of merit in both (a) and (b)(i) <i>Full Credit –1:</i> • Points A and C in the wrong boxes • The quadrilateral $ABCD$ not drawn, or not drawn with line segments as sides • Point D not labelled

Q9	Model Solution – 25 marks	Marking Notes
(b) (ii)	$ AB = 5$ units $ CD = \sqrt{(5-2)^2 + (4-5)^2} = \sqrt{3^2 + (-1)^2} = \sqrt{10}$ $5 \neq \sqrt{10}$ Therefore, $ABCD$ is not a parallelogram since opposite sides are not equal in length.	Scale 15C (0, 5, 10, 15) Consider solution as involving 2 Steps: Step 1. Finds AB Step 2. Finds CD, using the distance formula <i>Low Partial Credit:</i> • Work of merit, for example: $AB = 5$; some correct substitution into distance formula • Slopes of two opposite sides found correctly • Midpoints of two diagonals found correctly • $3 \cdot 1 \leq CD \leq 3 \cdot 2$ when measured <i>High Partial Credit:</i> • Finds one distance correctly and work of merit in finding the other <i>Full Credit –1:</i> • AB correct and CD correct using the distance formula but no conclusion or incorrect conclusion

Q10	Model Solution – 15 marks	Marking Notes
(a) & (b)	(a) $2x + 5 = 0$ $x = -\frac{5}{2}$ $\therefore P(-\frac{5}{2}, 0)$ (b) $m_k = 2$ $\therefore m_n = -\frac{1}{2}$ $y - 10 = -\frac{1}{2}(x - 0)$ $2y - 20 = -x$ $0 = -x - 2y + 20$ $x + 2y - 20 = 0$ OR $y = -\frac{1}{2}x + 10$ $2y = -x + 20$ $x + 2y - 20 = 0$	Scale 15D (0, 4, 8, 12, 15) Accept correct answer in (a) without work <i>Low Partial Credit:</i> - Work of merit, for example: $y = 0$ in (a); identifies $m_k = 2$ or reference to flip and change sign in (b); some correct substitution into equation of line formula in (b) <i>Mid Partial Credit:</i> - Work of merit in (a) and (b) (a) or (b) correct <i>High Partial Credit:</i> - One part correct and work of merit in the other part <i>Full Credit – 1:</i> - Answer in (b) not in required form. - In (a) x-value found but answer not given as a couple and (b) correct

Q11	Model Solution - 25 marks	Marking Notes
(a) & (b)	(a) $12 - 3(-2)^2$ $= 12 - 3(4)$ $= 0$ (b) $pm + 3p - m - 3$ $p(m + 3) - 1(m + 3)$ $(m + 3)(p - 1)$ OR $pm - m + 3p - 3$ $m(p - 1) + 3(p - 1)$ $(p - 1)(m + 3)$	Scale 10D (0, 4, 6, 8, 10) Accept correct answer in (a) without work <i>Low Partial Credit:</i> - Work of merit in (a) or (b) for example: -2^2 in (a), $p(m + 3)$ in (b) <i>Mid Partial Credit:</i> (a) or (b) correct - Work of merit in (a) and (b), for example: $12 - 3(-2)^2$ in (a); $p(m + 3)$ in (b) <i>High Partial Credit:</i> - One part correct and work of merit in the other part

Q11	Model Solution - 25 marks	Marking Notes
(c) & (d)	(c)  (d) $\frac{5x-2}{3} + \frac{2}{5x+2}$ $= \frac{(5x+2)(5x-2) + (3)(2)}{(3)(5x+2)}$ $= \frac{25x^2 - 4 + 6}{(3)(5x+2)}$ $= \frac{25x^2 + 2}{(3)(5x+2)}$	Scale 15D (0, 4, 8, 12, 15) Note: Accept 0 graphed for second inequality <i>Low Partial Credit:</i> - Work of merit in (c) or (d), for example: work of merit on one graph; one or two graphs correct in (c); $(3)(5x + 2)$; numerator indicated in (d) <i>Mid Partial Credit:</i> - Work of merit in both (c) and (d) - Works out $\frac{25x^2 - 4 + 6}{(3)(5x+2)}$ in (d) with no solution in (c) (c) correct and no work of merit in (d) <i>High Partial Credit:</i> (c) correct and work of merit in (d) (d) correct <i>Full Credit –1</i> - Strictness not treated correctly in (c), once only - Correct denominator in (d) shown but dropped later, assuming (c) correct

Q12	Model Solution – 25 marks	Marking Notes																					
(a) & (b)	(a)  (b) <table border="1"> <thead> <tr> <th>Pattern</th><th>Number of coloured squares</th><th>Total number of squares</th></tr> </thead> <tbody> <tr> <td>1</td><td>4</td><td>9</td></tr> <tr> <td>2</td><td>5</td><td>16</td></tr> <tr> <td>3</td><td>6</td><td>25</td></tr> <tr> <td>4</td><td>7</td><td>36</td></tr> <tr> <td>5</td><td>8</td><td>49</td></tr> <tr> <td>n</td><td>$n + 3$</td><td>$(n + 2)^2$</td></tr> </tbody> </table>	Pattern	Number of coloured squares	Total number of squares	1	4	9	2	5	16	3	6	25	4	7	36	5	8	49	n	$n + 3$	$(n + 2)^2$	Scale 5D (0, 2, 3, 4, 5) <i>Low Partial Credit:</i> - Any relevant attempt at (a), for example a 6 by 6 square drawn 1 correct entry in the table in (b) <i>Mid Partial Credit:</i> (a) correct 8 correct entries in table in (b) - Work of merit in (a) and (b) <i>High Partial Credit:</i> (a) correct and work of merit in the table in (b) (b) correct
Pattern	Number of coloured squares	Total number of squares																					
1	4	9																					
2	5	16																					
3	6	25																					
4	7	36																					
5	8	49																					
n	$n + 3$	$(n + 2)^2$																					

Q12	Model Solution – 25 marks	Marking Notes
(c)	(i) $(k + 2)^2 - (k + 3) = 271$ $k^2 + 4k + 4 - k - 3 = 271$ $k^2 + 3k + 1 = 271$ (ii) $k^2 + 3k - 270 = 0$ $(k - 15)(k + 18) = 0$ $k - 15 = 0 \text{ or } k + 18 = 0$ $k = 15 \quad k \neq -18$	Scale 20D (0, 5, 10, 15, 20) <i>Low Partial Credit:</i> - Work of merit in (i) or (ii), for example: writes $(k + 2)^2$ in (i); any set of factors of 270 in (ii); some correct substitution into $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ in (ii) <i>Mid Partial Credit:</i> - Work of merit in (i) and (ii) - Significant work in (ii), for example, quadratic formula fully substituted or quadratic equation factorised in (ii) (i) correct $k = 15$ without work and not verified and (i) incorrect <i>High Partial Credit:</i> (i) correct and second line or formula correctly substituted in (ii) (i) correct and correct answer without work in (ii) (ii) correct <i>Full Credit –1:</i> - Negative answer not excluded in (ii)

Q13	Model Solution – 30 marks	Marking Notes
(a) & (b)	(a) $6 \cdot 1^2 + 2 \cdot 84^2 = x^2$ $37 \cdot 21 + 8 \cdot 0656 \dots = x^2$ $45 \cdot 2756 = x^2$ $x = 6 \cdot 7287 = 6 \cdot 73 \text{ [2 DP]}$ (b) $\tan \theta = \frac{3 \cdot 12}{6 \cdot 1}$ $\theta = \tan^{-1} \frac{3 \cdot 12}{6 \cdot 1}$ $\theta = 27 \cdot 088 = 27[^\circ] \text{ [} \in \mathbb{N} \text{]}$	Scale 10D (0, 4, 6, 8, 10) Accept correct answers without units Accept correct answers without work <i>Low Partial Credit:</i> - Work of merit in (a) or (b), for example: some correct substitution into $a^2 + b^2 = c^2$; hypotenuse identified on diagram; finds one of the other two angles, with work in (a); $\tan \theta = \frac{\text{opp}}{\text{adj}}$; both opposite and adjacent identified on diagram; finds 6.85 with work in (b) <i>Mid Partial Credit:</i> (a) or (b) correct - Work of merit in (a) and (b) <i>High Partial Credit:</i> - One part correct and work of merit in the other part <i>Full Credit –1:</i> - Incorrect rounding or early rounding, only the first time it occurs in (a) or (b) - Calculator in the incorrect mode in (b)

Q13	Model Solution – 30 marks	Marking Notes
(c)	(i) $\frac{x}{3} = \frac{y}{7}$ $\Rightarrow x = \frac{3y}{7}$ OR $\tan \theta = \frac{x}{3} \text{ and } \tan \theta = \frac{y}{7}$ $\Rightarrow \frac{x}{3} = \frac{y}{7}$ $\Rightarrow x = \frac{3y}{7}$ (ii) Method 1: (using half the shape) $\frac{1}{2}(7)(y) - \frac{1}{2}(3)(x) = 6$ $\frac{1}{2}(7)(y) - \frac{1}{2}(3)\left(\frac{3y}{7}\right) = 6 \quad (\times 14)$ $49y - 9y = 84$ $40y = 84$ $y = \frac{84}{40} = 2.1 \text{ [m]}$ OR Method 2: (area of rectangle $ABCD$ + area triangle ADE = 12) $8x + \frac{1}{2}(8)(y - x) = 12$ $8\left(\frac{3y}{7}\right) + \frac{1}{2}(8)\left(y - \frac{3y}{7}\right) = 12$ $\frac{24y}{7} + 4y - \frac{12y}{7} = 12 \quad (\times 7)$ $24y + 28y - 12y = 84$ $40y = 84$ $y = \frac{84}{40} = 2.1 \text{ [m]}$	Scale 20D (0, 5, 10, 15, 20) <i>Low Partial Credit:</i> - Work of merit in (i) or (ii), for example: shows understanding of similar triangles; relevant fraction set up; identifies 3 or 7; 3 or 7 calculated; $\tan \theta = \frac{x}{3}$ or $\tan \theta = \frac{y}{7}$ in (i); some correct substitution into area of a triangle formula; area of a rectangle formula written in (ii) <i>Mid Partial Credit:</i> - work of merit in (i) and (ii) (i) correct - Significant work in (ii), for example, gets an equation in y <i>High Partial Credit:</i> (i) correct and work of merit in (ii) (ii) correct

Q13	Model Solution – 30 marks	Marking Notes
	OR Method 3: (area of large triangle – area of 2 small triangles = 12) $\frac{1}{2}(14)(y) - 2\left(\frac{1}{2}\right)(3)(x) = 12$ $\frac{1}{2}(14)(y) - 2\left(\frac{1}{2}\right)(3)\left(\frac{3y}{7}\right) = 12$ $7y - \frac{9y}{7} = 12 \quad (\times 7)$ $49y - 9y = 84$ $40y = 84$ $y = \frac{84}{40} = 2.1 \text{ [m]}$ OR Method 4: (area of 2 small triangles + 12 = area of large triangle) $2\left(\frac{1}{2}\right)(3)(x) + 12 = \frac{1}{2}(14)(y)$ $3\left(\frac{3y}{7}\right) + 12 = 7y$ $12 = 7y - \frac{9y}{7} \quad (\times 7)$ $84 = 49y - 9y$ $84 = 40y$ $y = \frac{84}{40} = 2.1 \text{ [m]}$ OR Method 5: (using area of trapezium, $\left(\frac{a+b}{2}\right)h$) $\left(\frac{x+y}{2}\right)(4) = 6$ $\frac{\frac{3y}{7} + y}{2}(4) = 6$ $2\left(\frac{3y}{7} + y\right) = 6$ $\frac{6y}{7} + 2y = 6 \quad (\times 7)$ $6y + 14y = 42$ $20y = 42$ $y = \frac{42}{20} = 2.1 \text{ [m]}$	