



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Cycle 2022

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 on this examination paper 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, 4, 10	0, 4, 7, 10	0, 3, 5, 8, 10
15-mark scale			0, 5, 10, 15	0, 4, 8, 12, 15
20-mark scale			0, 7, 12, 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 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.

No marks may be awarded other than those on the appropriate scale, and *Full Credit –1*.

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 (25)

- (a) 10B
- (b)(i) 10C
- (b)(ii) 5C

Question 2 (40)

- (a),(b) 15D
- (c) 10C
- (d) 10B
- (e) 5C

Question 3 (20)

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

Question 4 (20)

- (a) 5B
- (b) 10D
- (c)(i),(ii) 5D

Question 5 (20)

- (a) 5B
- (b)(i),(ii) 10D
- (c) 5D

Question 6 (20)

20C

Question 7 (15)

- (a)(i),(ii) 10C
- (b) 5C

Question 8 (25)

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

Question 9 (25)

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

Question 10 (45)

- (a),(b) 10C
- (c) 10B
- (d) 20C
- (e) 5C

Question 11 (5)

5C

Question 12 (10)

10D

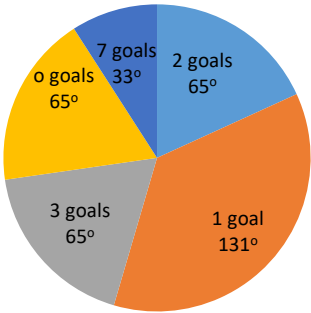
Model Solutions & Marking Notes

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.

Where “work of merit” is referred to in the marking notes, example(s) are given to demonstrate the standard of work to be considered work of merit in that particular question.

Q1	Model Solution – 25 Marks	Marking Notes
(a)	$(699 + 30) \times 0.9 = 729 \times 0.9$ $= [€]656.10$	<p>Scale 10B (0, 4, 10)</p> <p>Accept correct solution without € symbol Accept correct answer without work</p> <p><i>Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, 699×0.9, or $699 + 30$ <p><i>Full Credit – 1</i></p> <ul style="list-style-type: none"> • \$656.10
(b)(i)	<p>Tax at 20% = $0.2 \times 44300 = [€]8860$</p> <p>Tax at 40% = $0.4 \times (56000 - 44300)$ $= 0.4 \times 11700 = [€]4680$</p>	<p>Scale 10C (0, 4, 7, 10)</p> <p>Accept correct answers without work</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, 0.2, or $56000 - 44300$ <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Tax at 20% correct, and work of merit towards tax at 40% • Tax at 40% correct
(b)(ii)	$56000 - 8860 - 4680 + 3300$ $= [€]45760$	<p>Scale 5C (0, 2, 3, 5)</p> <p>Accept correct answer without work Accept correct solution without € symbol</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • One correct operation, for example, $56000 - 4680$, or $8860 - 3300$, $8860 + 4680$ <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Two correct operations, for example, $56000 - 8860 - 4680$, or $8860 + 4680 - 3300$

Q2	Model Solution – 40 Marks	Marking Notes
(a),(b)	(a) $\begin{array}{ccc} WW & WD & WL \\ DW & DD & DL \\ LW & LD & LL \end{array}$ (b) $\frac{5}{9}$	Scale 15D (0, 4, 8, 12, 15) There are 8 entries required in the table Accept answer in (b) without work <i>Low Partial Credit</i> <ul style="list-style-type: none"> One correct entry, including with letters reversed in (a) Numerator or denominator correct in (b) <i>Mid Partial Credit</i> <ul style="list-style-type: none"> Five correct entries in parts (a) or (b) correct <i>High Partial Credit</i> <ul style="list-style-type: none"> Table in (a) correct Five correct entries in part (a) and (b) correct
(c)	$3^5 = 243$	Scale 10C (0, 4, 7, 10) Accept correct answer without work <i>Low Partial Credit</i> <ul style="list-style-type: none"> Some indication of powers of 3 at least one other possible outcome listed <i>High Partial Credit</i> <ul style="list-style-type: none"> 3^5
(d)	$\frac{3+1+1+\dots+1+3}{11} = \frac{21}{11} = 1 \cdot 90$ $= 1 \cdot 9 \text{ [1 D.P.]}$ <p style="text-align: center;">OR</p> $\frac{0 \times 2 + 1 \times 4 + 2 \times 2 + 3 \times 2 + 7 \times 1}{11} = \frac{21}{11} = 1 \cdot 90$ $= 1 \cdot 9 \text{ [1 D.P.]}$	Scale 10B (0, 4, 10) Accept correct answer without work <i>Partial Credit</i> <ul style="list-style-type: none"> Work of merit for example, indicates sum of goals scored, or division by 11 <i>Full Credit –1</i> <ul style="list-style-type: none"> Indicates sum of top line, incorrect sum, and finishes correctly. No rounding or incorrect rounding.

Q2	Model Solution – 40 Marks	Marking Notes										
(e)	<p>0, 2 or 3 goals: $\frac{2}{11} \times 360 = 65 \cdot 45 = 65^\circ$</p> <p>1 goal: $\frac{4}{11} \times 360 = 130 \cdot 90 = 131^\circ$</p> <p>7 goals: $\frac{1}{11} \times 360 = 32 \cdot 72 = 33^\circ$</p> <table border="1" data-bbox="284 450 912 548"> <thead> <tr> <th>0 goals</th> <th>1 goal</th> <th>2 goals</th> <th>3 goals</th> <th>7 goals</th> </tr> </thead> <tbody> <tr> <td>65°</td> <td>131°</td> <td>65°</td> <td>65°</td> <td>33°</td> </tr> </tbody> </table> 	0 goals	1 goal	2 goals	3 goals	7 goals	65°	131°	65°	65°	33°	<p>Scale 5C (0, 2, 3, 5)</p> <p>Allow a tolerance of $\pm 2^\circ$</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, $\frac{2}{11}$ or $\frac{4}{11}$ or $\frac{1}{11}$, use of 360, one angle correctly calculated or drawn <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Angles correct and two angles correct in pie chart • Fully correct pie chart but work not shown <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> • Sectors not labelled and/or angles not marked
0 goals	1 goal	2 goals	3 goals	7 goals								
65°	131°	65°	65°	33°								

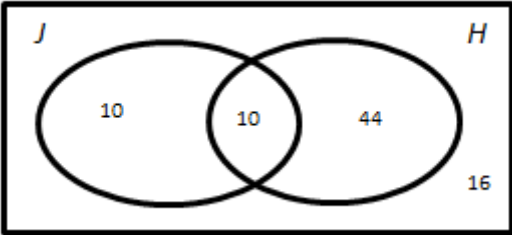
Q3	Model Solution – 20 Marks	Marking Notes
(a),(b)	<p>(a) $P = (-1, 3)$</p> <p>(b) $x = 0$ $0 + 7y = 20$ $y = \frac{20}{7}$</p> <p>Answer: $(0, \frac{20}{7})$</p> <p style="text-align: center;">OR</p> <p>Slope of $PQ = -\frac{1}{7}$</p> <p>Let $R(0, y)$ be the point where PQ crosses the y-axis</p> <p>Slope $PR = \frac{y-3}{0-(-1)} = -\frac{1}{7}$ $-7(y - 3) = 1$ $-7y + 21 = 1$ $y = \frac{20}{7}$</p> <p>Answer: $(0, \frac{20}{7})$</p>	<p>Scale 10C (0, 4, 7, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, in (a), one co-ordinate correct, or correct co-ordinates reversed, in (b) indicates $x = 0$, point read from diagram <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • (a) correct and work of merit in (b) • Finds $\frac{20}{7}$
(c)	<p>Slope of $PQ = -\frac{1}{7}$ Perpendicular slope = 7</p> <p>$y - 2 = 7(x - 6)$ $y - 2 = 7x - 42$ $-7x + y + 40 = 0$ or $7x - y - 40 = 0$</p> <p style="text-align: center;">OR</p> <p>Slope of $PQ = -\frac{1}{7}$ Perpendicular slope = 7</p> <p>$2 = 7(6) + c$ $c = 2 - 42 = -40$ $y = 7x - 40$ $-7x + y + 40 = 0$ or $7x - y - 40 = 0$</p>	<p>Scale 5D (0, 2, 3, 4, 5)</p> <p>Consider solution as involving 4 steps:</p> <p>Step 1: find slope of PQ</p> <p>Step 2: find perpendicular slope</p> <p>Step 3: Full substitution into 'Equation of line' formula</p> <p>Step 4: Rewrite equation of the line in the form $ax + by + c = 0$</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, some correct substitution into relevant formula <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • 2 steps correct <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • 3 steps correct <p><i>Full Credit – 1</i></p> <ul style="list-style-type: none"> • Answer given as $-7x + y + 40$ or $7x - y - 40$

Q3	Model Solution – 20 Marks	Marking Notes
(d)	<p>5 mm represents 100 m 1 cm represents $2 \times 100 = 200$ m 7.1 cm represents 7.1×200 $= 1420$ 1420 m = 1.42 [km]</p> <p style="text-align: center;">OR</p> <p>5 mm represents 100 m 1 mm represents 20 m 7.1 cm = 71 mm $71 \times 20 = 1420$ 1420 m = 1.42 [km]</p> <p style="text-align: center;">OR</p> <p>5 mm represents 100 m 7.1 cm = 71 mm $\frac{71}{5} = 14.2$ $14.2 \times 100 = 1420$ 1420 m = 1.42 [km]</p>	<p>Scale 5C (0, 2, 3, 5)</p> <p>Treat solution as requiring 3 steps (which may be presented implicitly, and not in this order):</p> <ol style="list-style-type: none"> 1. Use 5 mm to find what 1 cm represents, in m 2. Use 1 cm to find what 7.1 cm represents, in m 3. Convert m to km. <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, one relevant conversion ($5 \text{ mm} = \frac{1}{2} \text{ cm}$, etc.) <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • 2 of the steps above correct, for example, finds 0.2 (the number of km represented by 1 cm) • Correct answer without work

Q4	Model Solution – 20 Marks	Marking Notes
(a)	$8 - (2 + 3 \cdot 5) = 8 - 5 \cdot 5 = 2 \cdot 5$ [cm]	<p>Scale 5B (0, 2, 5)</p> <p>Accept correct answer without work</p> <p><i>Partial Credit</i></p> <ul style="list-style-type: none"> • One correct operation, for example, $8 - 2$, or $2 + 3 \cdot 5$ • Correct formula with some substitution
(b)	<p>(i) $3 + 2x + 2x + 1$ [cm] or $4x + 4$</p> <p>(ii) $3 + 2x + 2x + 1 = 24$ $4x + 4 = 24$ $4x = 20$ $x = 5$ [cm]</p>	<p>Scale 10D (0, 3, 5, 8, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, in (i), correct formula with some substitution, or one correct operation, in (ii), sets expression from (i) equal to 24 <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • One part correct • Work of merit in both parts <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • One part correct and work of merit in the other part
(c)	<p>(i) $24 - 8 = 16$ $24 + 16 = 40$ [cm]</p> <p>(ii) $5 + y^2 + y^2 + 3 = 40$ $2y^2 = 32$ $y^2 = 16$ $y = 4$ [cm]</p>	<p>Scale 5D (0, 2, 3, 4, 5)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, in (i), correct formula with some substitution, or 16 found, $T_2 - T_1$ is a constant in (ii), correct formula with some substitution, or sets expression involving values from Triangle C equal to answer from (i) <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • One part correct • Work of merit in both parts <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • One part correct and work of merit in the other part <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> • $y = \pm 4$

Q5	Model Solution – 20 Marks	Marking Notes
(a)	$V = \pi r^2 h = \pi \left(\frac{6}{2}\right)^2 (20) = 180\pi \text{ [cm}^3\text{]}$	<p>Scale 5B (0, 2, 5)</p> <p><i>Partial Credit</i></p> <ul style="list-style-type: none"> • Correct formula with some correct substitution • Finds radius • $\pi \left(\frac{6}{2}\right)^2 (20)$ or similar, but no conclusion (that is, does not indicate that this is the correct answer).
(b)	<p>(i) $V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi(15^3)$ $= 4500\pi \text{ [cm}^3\text{]}$</p> <p>(ii) $\frac{4500\pi}{180\pi} = 25 \text{ [seconds]}$</p>	<p>Scale 10D (0, 3, 5, 8, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit in one part, for example, in (i), correct formula with some substitution, in (ii), some attempt to count up in increments of 180π, or similar <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • One part correct • Work of merit in both parts <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Part (i) correct and work of merit in part (ii) • Incorrect formula - $k\pi r^3$ and finishes correctly

Q5	Model Solution – 20 Marks	Marking Notes
(c)	$V = 50 \times 180\pi = 9000\pi \text{ [cm}^3\text{]}$ <p style="text-align: center;">OR</p> $V = 4500\pi \times \frac{50}{25} = 9000\pi \text{ [cm}^3\text{]}$ $\frac{4}{3}\pi r^3 = 9000\pi$ $r^3 = \frac{3 \times 9000}{4} = 6750$ $r = \sqrt[3]{6750} = 18.89 \dots = 18.9 \text{ cm [1 D.P.]}$	<p>Scale 5D (0, 2, 3, 4, 5)</p> <p>Consider solution as requiring 4 steps:</p> <ol style="list-style-type: none"> 1. Finds volume of balloon 2. Sets up equation 3. Finds $r^3 = 6750$ 4. Finds r <p>Accept candidate's volume formula from part(b) as long as it involves a power of r which is greater than 1</p> <p>If the power of r is 1, award <i>High Partial Credit</i>, at most</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, 50/25 <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • Two steps correct <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Three steps correct <p><i>Full Credit – 1</i></p> <ul style="list-style-type: none"> • No rounding or incorrect rounding • No units or incorrect units

Q6	Model Solution – 20 Marks	Marking Notes
	$\frac{1}{5} \times 80 = 16 \text{ did neither} = \#(J \cup H)'$ $0.25 \times 80 = 20 \text{ got a job}$ $20 \div 2 = 10 \text{ also went on holidays}$ $80 - (20 + 16) = 44 \text{ holidays only}$ <div style="text-align: center;">  </div> $10 + 44 = 54 \text{ went on holidays}$	<p>Scale 20C (0, 7, 12, 20)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, one relevant number of students found, or one additional relevant fraction found <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds number of students (or fraction of students) in two regions of Venn diagram (that is, 2 of $J \setminus H$, $J \cap H$, $H \setminus J$, and $(J \cup H)'$) • Correct answer without work

Q7	Model Solution – 15 Marks	Marking Notes
(a)	<p>(i) $p = q = r = \frac{12}{3} = 4$</p> <p>(ii) Any triple of real numbers that adds to 12, and where all 3 are different. For example: $p = 0, q = -1.5, r = 13.5$</p>	<p>Scale 10C (0, 4, 7, 10)</p> <p>Accept correct answers without work</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit in one part, for example, $p + q + r = 12$ <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • One part correct • Work of merit in both parts
(b)	<p>$b^{m-2-1} = b^{10}$ $m - 3 = 10$ $m = 13$</p> <p style="text-align: center;">OR</p> <p>$b^m \times b^{-2} = b^{10} \times b^1$</p> $b^m = \frac{b^{11}}{b^{-2}} = b^{13}$ <p>$m = 13$</p> <p style="text-align: center;">OR</p> $\frac{b^m \times \frac{1}{b^2}}{b} = b^{10}$ $b^m \times \frac{1}{b^2} = b^{11}$ $b^m = b^{11} b^2$ $b^m = b^{13}$ <p>$m = 13$</p>	<p>Scale 5C (0, 2, 3, 5)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, b^{m-2} or $\frac{1}{b} = b^{-1}$ or similar <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds b^{m-2-1} or similar • $b^{m-2} = b^{11}$ • One error in handling powers and finishes correctly • Correct answer without work <p><i>Full Credit-1</i></p> <ul style="list-style-type: none"> • Finds $b^m = b^{13}$

Q8	Model Solution – 25 Marks	Marking Notes
(a)	$C = 180 - (90 + 35) = 55[^\circ]$ <p style="text-align: center;">OR</p> $C = 90 - 35 = 55[^\circ]$ <p style="text-align: center;">OR</p> $\tan C = \frac{220}{154}$ $C = \tan^{-1} \frac{220}{154}$ $= 55 \cdot 008$ $= 55[^\circ]$	<p>Scale 10B (0, 4, 10)</p> <p>Accept correct answer without work</p> <p><i>Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, mention of 180, or 90 + 35 • $\tan C = \frac{220}{154}$ <p><i>Full Credit -1</i></p> <ul style="list-style-type: none"> • Calculator in incorrect mode
(b)	$y^2 = 154^2 + 220^2$ $y^2 = 23716 + 48400 = 72116$ $y = \sqrt{72116} = 268.54 \dots$ $= 269 \text{ [m] [nearest metre]}$	<p>Scale 10C (0, 4, 7, 10)</p> <p>Accept correct answer without units</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, some substitution into relevant formula, or indicates squaring of a side • Correct trigonometric equation fully set up <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Fully substituted formula and some other relevant work (for example, correctly squares a term, or squares incorrectly but correct square root found) • Finds 23716 and 48400 • Correct answer without work • Uses trigonometry to find y correctly <p><i>Full Credit -1</i></p> <ul style="list-style-type: none"> • No rounding or incorrect rounding

Q8	Model Solution – 25 Marks	Marking Notes
(c)	<p>Let $z = h + 220$.</p> $\tan 20^\circ = \frac{h}{154}$ $h = 154 \tan 20^\circ = 56.05 \dots$ $z = 220 + 56.05$ $= 276.05$ $= 276 \text{ [m] [nearest metre]}$	<p>Scale 5D (0, 2, 3, 4, 5)</p> <p>Consider solution as requiring 3 steps:</p> <ol style="list-style-type: none"> 1. Set up equation correctly 2. Evaluate h 3. Evaluate z <p>If incorrect trig equation is set up, Step 1 is not correct, but other 2 steps can be</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, some substitution into relevant formula <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • One step correct <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Two steps correct <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> • No rounding or incorrect rounding • Calculator in incorrect mode

Q9	Model Solution – 25 Marks	Marking Notes
(a)	$m - 7 = 4$ $m = 11$ $9(7) - 6(11) = 63 - 66$ $= -3$	<p>Scale 5C (0, 2, 3, 5)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, $m - 7 = 4$ <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Values of m and k subbed into $9k - 6m$ • Transposition error when finding m, but continues correctly • Correct answer without work
(b)	$2x(4a - 7b) + y(4a - 7b)$ $= (2x + y)(4a - 7b)$ <p style="text-align: center;">OR</p> $4a(2x + y) - 7b(2x + y)$ $= (4a - 7b)(2x + y)$	<p>Scale 5C (0, 2, 3, 5)</p> <p>Accept correct answer without work</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, one highest common factor factorised out of one pair <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • $2x(4a - 7b) + y(4a - 7b)$ • $4a(2x + y) - 7b(2x + y)$
(c)	$= \frac{2(3x+5)-3(2x+1)}{(2x+1)(3x+5)}$ $= \frac{6x+10-6x-3}{(2x+1)(3x+5)}$ $= \frac{7}{(2x+1)(3x+5)}$	<p>Scale 10D (0, 3, 5, 8, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, correct common denominator, $2(3x + 5) - 3(2x + 1)$ and no denominator • $-6x - 10 + 6x + 3$ and no denominator • $\frac{2(2x+1)-3(3x+5)}{(2x+1)(3x+5)}$ and continues <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • Two terms correct out of $6x + 10 - 6x - 3$ in numerator and finishes correctly, assuming that the first line in the solution is not shown • No or incorrect denominator but numerator correct as per solution <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • $\frac{2(3x+5)-3(2x+1)}{(2x+1)(3x+5)}$ • 3 terms correct in numerator and finishes correctly, assuming that the first line in the solution is not shown <p><i>Full Credit -1</i></p> <ul style="list-style-type: none"> • Shows correct common denominator in calculations but drops it subsequently

Q9	Model Solution – 25 Marks	Marking Notes
(d)	$x = \frac{7 \pm \sqrt{7^2 - 4(2)(-3)}}{2(2)}$ $= \frac{7 \pm \sqrt{73}}{4} = 3.886 \dots \text{ or } -0.386 \dots$ $= 3.89 \text{ or } -0.39 \text{ [2 D.P.]}$	<p>Scale 5C (0, 2, 3, 5)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, some substitution into correct formula • Identifies <i>a</i> or <i>b</i> or <i>c</i> • One correct answer without work <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Formula fully substituted correctly • One error in filling in formula, but evaluates correctly • $7 \pm \frac{\sqrt{73}}{4}$ and finishes correctly • Correct answers without work <p><i>Full Credit -1</i></p> <ul style="list-style-type: none"> • No rounding or incorrect rounding

Q10	Model Solution – 45 Marks	Marking Notes
(a),(b)	(a) behind Jon (b) Distance: 25 [km] Length of time: 1.5 [mins]	Scale 10C (0, 4, 7, 10) <i>Low Partial Credit</i> <ul style="list-style-type: none"> Work of merit, for example, mentions “two minutes” in (a) (a) correct <i>High Partial Credit</i> <ul style="list-style-type: none"> (a) correct and work of merit in (b) (b) correct
(c)	Any valid description, for example: Ali was passing Jon out, or similar	Scale 10B (0, 4, 10) <i>Partial Credit</i> <ul style="list-style-type: none"> Work of merit, for example, mention of “same”, “equal”, “together”
(d)	32 38 36 106 34 35 36 105	Scale 20C (0, 7, 12, 20) Note: the total time is considered correct if it is the sum of the 3 constituent times, or if it is 105 <i>Low Partial Credit</i> <ul style="list-style-type: none"> Work of merit, for example, one correct entry, “it takes Ali 2 minutes more than Jon to do the kayaking” <i>High Partial Credit</i> <ul style="list-style-type: none"> Three correct entries
(e)	$T_{Jon} = \frac{400}{7.8} = 51.282 \dots \text{secs}$ $T_{Ali} = 51.282 + 2 = 53.282 \dots \text{secs}$ $S_{Ali} = \frac{400}{53.282\dots} = 7.50 \dots$ $= 7.5 \text{ [m/s, 1 D.P.]}$	Scale 5C (0, 2, 3, 5) Consider solution requiring 3 steps: <ol style="list-style-type: none"> Find Jon’s time Find Ali’s time Find Ali’s speed <i>Low Partial Credit</i> <ul style="list-style-type: none"> Work of merit, for example, one correct operation <i>High Partial Credit</i> <ul style="list-style-type: none"> 2 steps correct Correct answer without work <i>Full Credit –1</i> <ul style="list-style-type: none"> No rounding or incorrect rounding

Q11	Model Solution – 5 Marks	Marking Notes
	<p>Slope = $\frac{\text{rise}}{\text{run}} = \frac{4}{1}$</p> <p>$(20 + 1, 12 + 4) = (21, 16)$</p> <p style="text-align: center;">OR</p> <p>$(20 - 1, 12 - 4) = (19, 8)$</p> <p style="text-align: center;">OR</p> <p>$h: y - 12 = 4(x - 20)$</p> <p>$4x - y - 68 = 0$</p> <p>$x = 0 \rightarrow y = -68$</p> <p style="text-align: center;">$(0, -68)$</p> <p>or any substitution for x or y</p> <p style="text-align: center;">OR</p> <p style="text-align: center;">$y = mx + c$</p> <p style="text-align: center;">$12 = 4(20) + c$</p> <p style="text-align: center;">$c = -68$</p> <p style="text-align: center;">$y = 4x - 68$</p> <p>$x = 0 \rightarrow y = -68$</p> <p style="text-align: center;">$(0, -68)$</p> <p>or any substitution for x or y</p> <p style="text-align: center;">OR</p> <p>$\frac{y_2 - 12}{x_2 - 20} = \frac{4}{1}$ (or any equivalent fraction)</p> <p>$y_2 - 12 = 4 \rightarrow y_2 = 16$</p> <p>$x_2 - 20 = 1 \rightarrow x_2 = 21$</p> <p style="text-align: center;">$(21, 16)$</p>	<p>Scale 5C (0, 2, 3, 5)</p> <p>Some indication of understanding of slope is required</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Work of merit, for example, slope = $\frac{\text{rise}}{\text{run}}$, some indication of understanding of slope, finds the equation of h <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> Substitution of x or y into equation of h Correct answer without work

Q12	Model Solution – 10 Marks	Marking Notes
	<p>$\pi r^2 = 25\pi$</p> <p>$r^2 = 25$</p> <p>$r = 5$</p> <p>Diameter = 10</p> <p>$\cos \angle CAB = \frac{8}{10}$</p> <p>$\angle CAB = \cos^{-1} \frac{8}{10} = 36.87^\circ$</p> <p style="text-align: center;">OR</p> <p>$\sin \angle CBA = \frac{8}{10}$</p> <p>$\angle CBA = \sin^{-1} \frac{8}{10} = 53.13^\circ$</p> <p>$\angle CAB = 90^\circ - 53.13^\circ$</p> <p style="text-align: center;">$= 36.87^\circ$</p>	<p>Scale 10D (0, 3, 5, 8, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Work of merit, for example, identifies the right angle, identifies the required angle <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> Finds $d = 10$ Finds incorrect $d (> 8)$ and finishes correctly <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> Correct trigonometric ratio set up $\angle CBA = 53.13^\circ$ <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> No degree symbol Calculator in incorrect mode