



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate 2019

Marking Scheme

Mathematics

Ordinary 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.

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Mathematics

Ordinary Level

Paper 1

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	
10-mark scale		0, 5, 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, 14, 20	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 be awarded. Thus, for example, in Scale 10C, 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) 5C
- (c) 10C

Question 2 (30)

- (a)(i), (ii) 15C
- (b) 5B
- (c) 10C

Question 3 (15)

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

Question 4 (10)

10C

Question 5 (5)

5C

Question 6 (30)

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

Question 7 (15)

- (a), (b) 15C

Question 8 (45)

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

Question 9 (25)

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

Question 10 (25)

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

Question 11 (40)

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

Question 12 (20)

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

Question 13 (15)

15D

Model Solutions & Marking Notes

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 the scheme refers to “work of merit”, examples are given of the standard acceptable as work of merit in that particular part.

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.

Q1	Model Solution – 25 Marks	Marking Notes
(a)	$[\text{€}]80$, $[\text{€}]80$ and $[\text{€}]80$ OR $[\text{€}]70$, $[\text{€}]70$ and $[\text{€}]100$	<p>Scale 10B (0, 5, 10)</p> <p>Accept correct answer without work Accept correct answer without units</p> <p><i>Partial Credit</i></p> <ul style="list-style-type: none"> Work of merit, for example: Relevant use of given ticket cost <p>Full Credit -1</p> <ul style="list-style-type: none"> Apply a * for $\frac{240}{3} = \text{€}80$
(b)	$240 \times 1.08 = [\text{€}]259.20$ OR $240 \times 8\% = 19.20$ $240 + 19.20 = [\text{€}]259.20$	<p>Scale 5C (0, 2, 3, 5)</p> <p>Accept correct answer without work Accept correct answer without units</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Work of merit, for example: Shows understanding of percentages, or some relevant operation <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> Booking fee found (19.20) <p>Full Credit --1</p> <ul style="list-style-type: none"> Apply a * for $240 + 19.20$ (not added)

Q1	Model Solution – 25 Marks	Marking Notes
(c)	$20\,000 \times 70 = 1\,400\,000$ $25\,000 \times 80 = 2\,000\,000$ $15\,000 \times 100 = 1\,500\,000$ $1\,400\,000 + 2\,000\,000 + 1\,500\,000$ $= [\text{€}]4\,900\,000$	<p>Scale 10C (0, 4, 7, 10)</p> <p>Accept correct answer without work Accept correct answer without units</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example: A relevant operation • One total found • 2×7 and 25×80 and 150×1 or similar (not a consistent error) <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Two totals found • One consistent decimal error, otherwise correct <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> • Apply a * if three totals found but not added

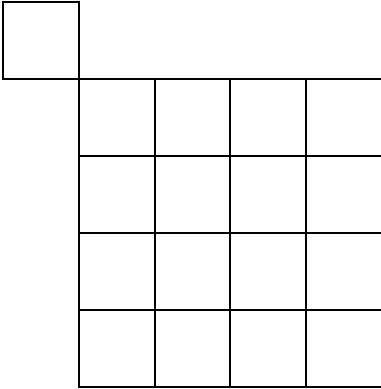
Q2	Model Solution – 30 Marks	Marking Notes
(a)	(i) $400 - 80 = [€]320$ (ii) $\frac{1000}{320} = 3 \cdot 125$ 4 lotteries OR $320 + 320 + 320 < 1000$ $320 + 320 + 320 + 320 > 1000$ 4 lotteries	Scale 15C (0, 5, 10, 15) Accept correct answer without work in (i) Accept correct answer without units <i>Low Partial Credit</i> <ul style="list-style-type: none"> Work of merit, for example: A relevant operation or evidence of trial and improvement in (ii). <i>High Partial Credit</i> <ul style="list-style-type: none"> Part (i) correct and work of merit in (ii) Part (ii) correct Full Credit –1 <ul style="list-style-type: none"> Apply a * if $320 + 320 + 320 + 320 > 1000$ is given but no conclusion
(b)	$5 : 9$	Scale 5B (0, 2, 5) Accept correct answer without work Accept 5/9 for full credit <i>Partial Credit</i> <ul style="list-style-type: none"> Work of merit, for example: 25:45, 5:n or n:9 Full Credit –1 <ul style="list-style-type: none"> Gives 9 : 5 as the answer
(c)	(i) $4 \cdot 8 \times 1 \cdot 15 = [\$]5 \cdot 52$ million [\\$5.52 million > \$5 \cdot 3 million] OR $5 \cdot 3 \div 1 \cdot 15 = [€]4 \cdot 61$ million [€4 \cdot 61 million < €4 \cdot 8 million] OR $\frac{5 \cdot 3}{4 \cdot 8} = 1 \cdot 10 \dots$ $[1 \cdot 1 < 1 \cdot 15]$ (ii) Accept any positive value less than \$1 \cdot 10416 for example \$1	Scale 10C (0, 4, 7, 10) <i>Low Partial Credit</i> <ul style="list-style-type: none"> Work of merit, for example: In (i), incorrect multiplication or division by exchange rate In (ii), trialling an exchange rate <i>High Partial Credit</i> <ul style="list-style-type: none"> (i) or (ii) correct Work of merit in (i) and (ii)

Q3	Model Solution – 15 Marks	Marking Notes
(a) (i)(ii)	(i) $29\,000 \times 0.2 = [\text{€}]5800$ (ii) $29\,000 - 5800 + 3400$ $= [\text{€}]26\,600$	Scale 10C (0, 4, 7, 10) Accept correct answer without work Accept correct answer without units Accept $5800 - 3400 = 2400$, $29000 - 2400 =$ $[\text{€}]26,600$ <i>Low Partial Credit</i> <ul style="list-style-type: none"> • Work of merit, for example: A relevant operation, or shows understanding of percentages in (i) <i>High Partial Credit</i> <ul style="list-style-type: none"> • (i) or (ii) correct • Work of merit in both parts
(b)	$\frac{12\,600}{14\,000} \times 100 = 90\%$	Scale 5C (0, 2, 3, 5) Accept correct answer without work Accept correct answer without units <i>Low Partial Credit</i> <ul style="list-style-type: none"> • Work of merit, for example: A relevant operation • 1400 found <i>High Partial Credit</i> <ul style="list-style-type: none"> • 10%

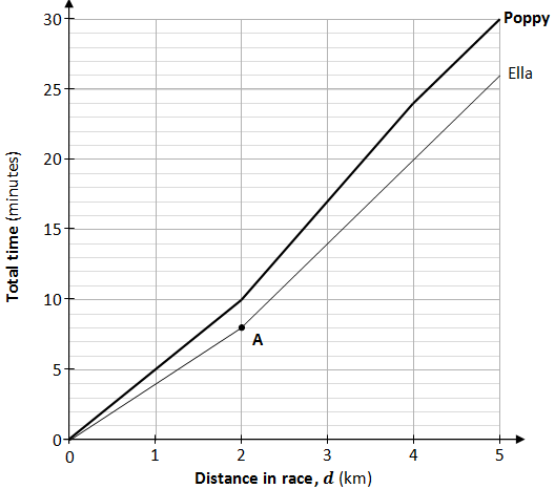
Q4	Model Solution – 10 Marks	Marking Notes
	$\frac{330 - 100}{2} = 115\text{cm}$	Scale 10C (0, 4, 7, 10) Accept correct answer without work <i>Low Partial Credit</i> <ul style="list-style-type: none"> • Work of merit, for example: A relevant operation <i>High Partial Credit</i> <ul style="list-style-type: none"> • Finds the value of 2L [230] Full Credit –1 <ul style="list-style-type: none"> • No units or incorrect units given in answer

Q5	Model Solution – 5 Marks	Marking Notes
	$2x + 3 = 35$ $2x = 32$ $x = 16$	<p>Scale 5C (0, 2,3,5)</p> <p>Note: Consider solution requiring 6 operations: Multiply both sides by 5;(2 operations) Subtract 3 from both sides;(2 operations) Divide by 2(2operations)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • 1 correct relevant operation • Substitutes a value in for x <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • 3 correct relevant operations • Correct answer with no supporting work <p><i>Full credit</i></p> <ul style="list-style-type: none"> • Trial and improvement with correct substitution <p>Note: Correct answer must be indicated if more than one x value is trialled</p>

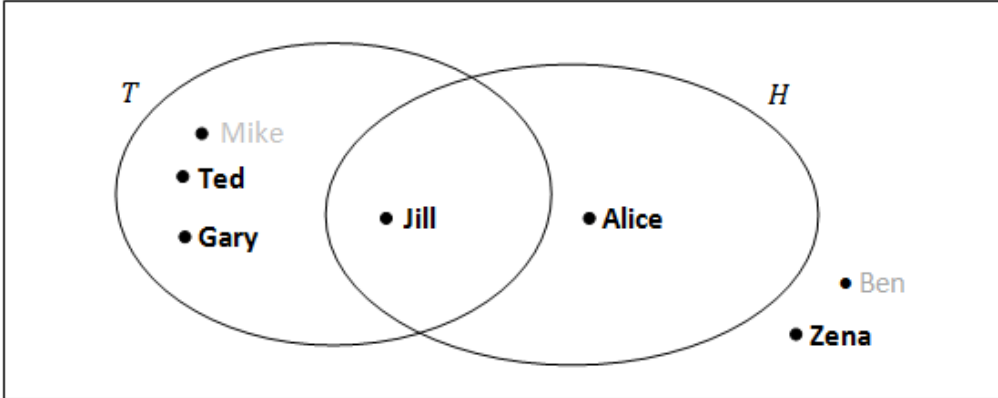
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Q6	Model Solution – 30 Marks	Marking Notes										
(a)		<p>Scale 10B (0, 5, 10)</p> <p><i>Partial Credit</i></p> <ul style="list-style-type: none"> • Effort at diagram for example $4n$ • Writes 4×4 • One isolated box drawn <p>Full Credit –1 Draws 4×4 diagram</p>										
(b)	<table border="1" data-bbox="376 725 815 1126"> <thead> <tr> <th>Pattern</th> <th>Number of small squares</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2</td> </tr> <tr> <td>2</td> <td>5</td> </tr> <tr> <td>3</td> <td>10</td> </tr> <tr> <td>4</td> <td>17</td> </tr> </tbody> </table>	Pattern	Number of small squares	1	2	2	5	3	10	4	17	<p>Scale 10C (0, 4, 7, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • One correct entry <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Two correct entries
Pattern	Number of small squares											
1	2											
2	5											
3	10											
4	17											
(c), (d)	<p>(c) $(20)^2 + 1 = 401$</p> <p>(d) Quadratic</p> <p>The second difference is a constant</p> <p style="text-align: center;">OR</p> <p>n^2 is in the formula</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 (c) or (d) for example: Effort at substitution in (c) Quadratic identified in (d) Effort at finding the difference between two terms in (d) <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • (c) or (d) correct • Work of merit in both (c) and (d) <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • (c) or (d) correct and work of merit in the other part <p>Full Credit –1</p> <ul style="list-style-type: none"> • Writes out all twenty terms to get the correct answer but does not use the given formula 										


Q7	Model Solution – 15 Marks	Marking Notes
(a), (b)	(a) $x^2 - 2x + 3x - 6$ $x^2 + x - 6$ (b) $(x + 8)(x - 8)$	<p>Scale 15 C (0, 5, 10, 15)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit in (a) or (b) for example: In (a), indicates distribution or one correct multiplication (ignoring signs) In (b), correct factorising of x^2 or 64 (ignoring signs) <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • (a) or (b) correct • Work of merit in (a) and (b) <p>Full Credit –1</p> <ul style="list-style-type: none"> • Apply a * if $x^2 - 2x + 3x - 6$ is given but does not finish or finishes incorrectly

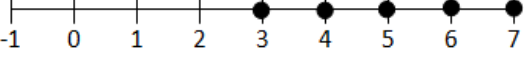
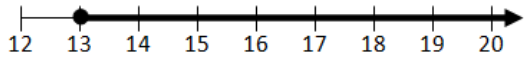
Q8	Model Solution – 45 Marks	Marking Notes																		
(a)	<table border="1" data-bbox="268 291 826 703"> <thead> <tr> <th>Distance</th> <th>Ella Time</th> <th>Poppy Time</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>4</td> <td>5</td> </tr> <tr> <td>2</td> <td>8</td> <td>10</td> </tr> <tr> <td>3</td> <td>14</td> <td>17</td> </tr> <tr> <td>4</td> <td>20</td> <td>24</td> </tr> <tr> <td>5</td> <td>26</td> <td>30</td> </tr> </tbody> </table>	Distance	Ella Time	Poppy Time	1	4	5	2	8	10	3	14	17	4	20	24	5	26	30	<p>Scale 10C (0, 4, 7, 10)</p> <p>Accept correct points marked and labelled on the graph for full marks</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • One correct entry • Relevant work on the graph <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Two correct entries
Distance	Ella Time	Poppy Time																		
1	4	5																		
2	8	10																		
3	14	17																		
4	20	24																		
5	26	30																		
(b)		<p>Scale 10C (0, 4, 7, 10)</p> <p>Note: 6 points are required: The 5 in the table plus (0,0). They must be joined appropriately, though not necessarily by line segments.</p> <p>Allow a tolerance of +/- 0.5 in the Y axis</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • One point plotted correctly <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Three or four points plotted correctly <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> • 6 points plotted correctly but not joined or joined incorrectly 																		
(c), (d)	<p>(c) Ella 26 minutes < 30 minutes</p> <p>(d) Ella's speed decreased</p> <p>It took her longer to run the next kilometre</p> <p>Her pace [slope] changed from 4 minute/km to 6 minute/km</p>	<p>Scale 15D (0,4,8,12 15)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit in (c) or (d) for example: Correct answer identified, or shows relevant understanding. <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • (c) or (d) correct • Work of merit in both (c) and (d) <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • (c) or (d) correct and work of merit in the other part 																		

Q8	Model Solution – 45 Marks	Marking Notes
(e)	$\frac{5}{0.5} = 10[\text{km/hr}]$ <p style="text-align: center;">OR</p> <p>30 minutes — 5 km 60 minutes — 10 km</p> <p style="text-align: center;">Answer 10 [km/hr]</p>	<p>Scale 10C (0, 4, 7, 10)</p> <p>Accept correct answer without work Accept correct answer without units Low Partial Credit</p> <ul style="list-style-type: none"> • Work of merit, for example: Formula identified (with or without substitution), or 1 hour = 60 minutes, or finds pace (6 min/km), or $\frac{5}{30}$ <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Formula fully substituted • Finds speed in km/minute $(\frac{5}{30} = 0.1\dot{6}, 0.17)$

Q9	Model Solution – 25 Marks	Marking Notes								
(a)										
	<p>Scale 10C (0, 4, 7, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • One correct entry <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Three or four correct entries <p>Full Credit -1</p> <ul style="list-style-type: none"> • Apply a* if Jill appears in $T \cap H$ and also in one or both of $T \setminus H$ or $H \setminus T$ 									
(b), (c)	<p>(b) 7</p> <p>(c)</p> <table border="1" data-bbox="386 1189 718 1480"> <thead> <tr> <th></th> <th>Set notation</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>$T \cap Z$</td> </tr> <tr> <td>2</td> <td>$Z \setminus T$</td> </tr> <tr> <td>3</td> <td>Z'</td> </tr> </tbody> </table>		Set notation	1	$T \cap Z$	2	$Z \setminus T$	3	Z'	<p>Scale 15D (0, 4, 8, 12, 15)</p> <p>Note: 4 answers are required: one in (b) and three in (c)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • One correct answer <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • Two correct answers <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Three correct answers
	Set notation									
1	$T \cap Z$									
2	$Z \setminus T$									
3	Z'									

Q10	Model Solution – 25 Marks	Marking Notes												
(a) (i),(ii)	(i) 5 400 000 grams (ii) $5\,400\,000 \div 19 = 284\,210 \cdot \dots$ $\approx 300\,000$	Scale 10C (0, 4, 7, 10) Accept correct answer without work in (i) Accept correct answer without units <i>Low Partial Credit</i> <ul style="list-style-type: none"> • Work of merit in (i) or (ii) for example: In (i), 1000 identified, 540,5400,etc (i.e. 5400×10^n where $n \in \mathbb{Z} \setminus \{0,3\}$) In (ii), correct answer or a relevant operation <i>High Partial Credit</i> <ul style="list-style-type: none"> • (i) or (ii) correct • <i>Work of merit in (i) and (ii)</i> 												
(b)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Number</th> <th style="width: 50%;">Number in the form 10^n</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">100</td> <td style="text-align: center;">10^2</td> </tr> <tr> <td style="text-align: center;">10 000</td> <td style="text-align: center;">10^4</td> </tr> <tr> <td style="text-align: center;">$10^3 \times 10^9$</td> <td style="text-align: center;">10^{12}</td> </tr> <tr> <td style="text-align: center;">10</td> <td style="text-align: center;">10^1</td> </tr> <tr> <td> </td> <td> </td> </tr> </tbody> </table>	Number	Number in the form 10^n	100	10^2	10 000	10^4	$10^3 \times 10^9$	10^{12}	10	10^1			Scale 10C (0, 4, 7, 10) <i>Low Partial Credit</i> <ul style="list-style-type: none"> • One correct <i>High Partial Credit</i> <ul style="list-style-type: none"> • Two correct <i>Full Credit –1</i> <ul style="list-style-type: none"> • Answer given as index without the base
Number	Number in the form 10^n													
100	10^2													
10 000	10^4													
$10^3 \times 10^9$	10^{12}													
10	10^1													
(c)	$5 \cdot 4 \times 10^3$	Scale 5B (0,2,5) Accept correct answer without work Accept correct answer without units <i>Partial Credit</i> <ul style="list-style-type: none"> • Work of merit in (c), for example: a or n correct, or for example 54×10^2 												

Q11	Model Solution – 40 Marks	Marking Notes
(a), (b)(i), (ii)	(a) [€]80 (b)(i) [€]130 (b)(ii) [€]50	Scale 15D (0, 4, 8, 12, 15) <i>Low Partial Credit</i> <ul style="list-style-type: none"> • Work of merit, for example: <i>Relevant work on the graph</i> <i>Mid Partial Credit</i> <ul style="list-style-type: none"> • 1 correct <i>High Partial Credit</i> <ul style="list-style-type: none"> • 2 correct
(c)	Ruairí gets paid €105 when the customer spend is €250	Scale 5C (0,2,3,5) <i>Low Partial Credit</i> <ul style="list-style-type: none"> • Shows some relevant understanding • €105 or €250 <i>High Partial Credit</i> <ul style="list-style-type: none"> • €105 – Ruairí or €250 – customer spend
(d)	$P = 80 + 10S$ Y intercept = €80 Slope = 10 Or Gives one integer point on the graph Other than (0,80)	Scale 10C (0, 4, 7, 10) <i>Low Partial Credit</i> <ul style="list-style-type: none"> • Incorrect box ticked and some relevant justification <i>High Partial Credit</i> <ul style="list-style-type: none"> • Correct box ticked
(e)		Scale 10C (0, 4, 7, 10) <i>Low Partial Credit</i> <ul style="list-style-type: none"> • Work of merit, for example: Subbing a value into the equation • One point plotted correctly • Draws a line with correct starting point or correct slope <i>High Partial Credit</i> <ul style="list-style-type: none"> • Two points correctly plotted Full Credit –1 <ul style="list-style-type: none"> • (0,60) and (5,160) correctly plotted but no line drawn

Q12	Model Solution – 20 Marks	Marking Notes
(a)	<p>2. $x > 2$</p>  <p>3. $x > 5 \cdot 1$ OR $x \geq 6$ <i>Or any other valid inequality</i></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: Any solution point plotted <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • 1 correct <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> • Apply a * if 2 is included in A • Apply a * if 6 is excluded in B (Apply once only)
(b)(i)	<p>1. $A \geq 13$</p>  <p>2. $A < 18$</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: Any solution point plotted <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • 1 part correct <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> • Apply a * if 13 is not included in (1) • Apply a * if 18 is included in (2) (Apply once only in question – do not apply if already applied in (a))
(b)(ii)	Intersection	Scale 5A (0,5)

Q13	Model Solution – 15 Marks	Marking Notes
	<p style="text-align: center;"> $(-2, 4), (-1, 0), (0, -2)$ $(1, -2), (2, 0), (3, 4)$ </p>	<p>Scale 15D (0,4,8,12,15)</p> <p>Accept correct graph without supporting work</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example: Work towards finding a point Coordinates of a point written <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • 2 points with integer coordinates plotted • 4 points found but not plotted <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • 4 or 5 points found and plotted correctly <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> • All points plotted correctly but not joined or joined incorrectly

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate 2019

Marking Scheme

Mathematics

Ordinary Level

Paper 2

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, 2, 5	0, 2, 3, 5	
10-mark scale		0, 5, 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, 14, 20	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 be awarded. Thus, for example, in Scale 10C, 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 (15)

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

Question 2 (25)

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

Question 3 (20)

- (a) 10C
(b) 10C

Question 4 (20)

- (a),(b) 15D
(c) 5C

Question 5 (30)

- (a),(b) 20D
(c)(I), (ii) 10C

Question 6 (30)

- (a)(I),(ii),(iii) 10C
(b) (I), (ii) 5B
(c) 5C
(d) 5B
(e) 5B

Question 7 (20)

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

Question 8 (50)

- (a) 5B
(b)(i), (ii) 15C
(c) 5B
(d)(i), (ii) 10D
(d)(iii) 15D

Question 9 (15)

15C

Question 10 (30)

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

Question 11 (45)

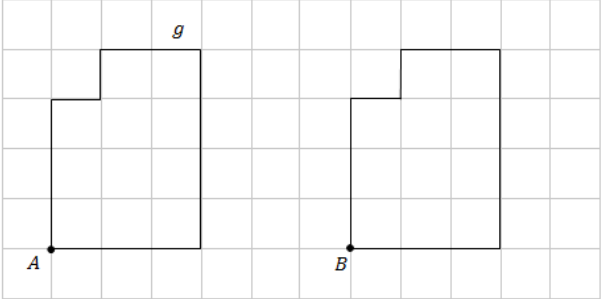
- (a) 10C
(b) 5B
(c)(i),(ii),(iii) 10D
(d) 10C
(e) 10C

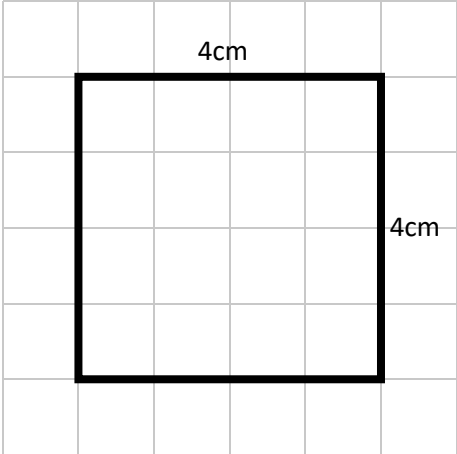
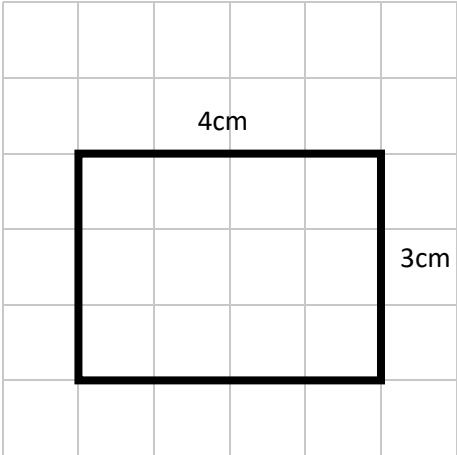
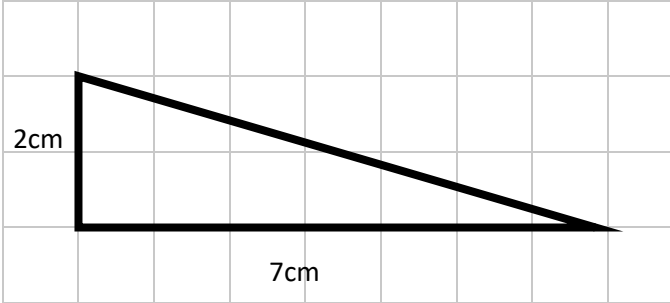
Model Solutions & Marking Notes

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)	$40 \times 18 = 720 \text{ m}^2$	<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"> Finds perimeter or semi-perimeter <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> 40×18 <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> Apply a * for incorrect or no units
(b),(c)	<p>(b)</p> $40 \times 18 \times 14 = 10\,080 \text{ m}^3$ <p>(c)</p> <p>Reduce it</p> <p>Or</p> <p>Get the area of the front and multiply by 40</p>	<p>Scale 10C (0, 4, 7, 10)</p> <p>Accept correct answer without work</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Work of merit in (b), for example: Product of 2 relevant numbers or correct formula (c) correct or work of merit in (c) Finds area of one or more surfaces <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> (b) correct Work of merit in both parts <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> Apply a * for incorrect or no units, if a * has not been applied in (a) <p>Note: Accept “it’s too big” or similar as correct answer in (c)</p>

Q2	Model Solution – 25 Marks	Marking Notes
(a) (i),(ii)	(i) Any correct points plotted and labelled (ii) Coordinates of the points given	<p>Scale 15D (0, 4, 8, 12, 15)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Any point plotted and labelled in the correct position One point plotted and coordinates given or reversed One or two coordinates correct <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> Two or three points plotted and labelled in the correct position Two points plotted and coordinates correct or reversed (i) or (ii) correct One point fully correct in parts (i) and (ii) <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> Two points fully correct with respect to (i) and (ii) <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> All points plotted correctly and coordinates given but not labelled All points plotted correctly and labelled but coordinates reversed
(b),(c)	<p>(b) $r = 3[cm]$</p> <p>(c) $A = \pi r^2$ $= \pi(3)^2$ $= 28 \cdot 3[cm^2]$ 1 D.P.</p>	<p>Scale 10C (0, 4, 7, 10)</p> <p>Accept correct answer without work Accept correct answer without units</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> (b) correct Work of merit in (c) for example: Correct formula or correct operation Work of merit in (b) i.e. $2r = 6$ or r clearly indicated in diagram <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> (b) correct and work of merit in (c) (c) correct <p><i>Full Credit (-1)</i></p> <ul style="list-style-type: none"> Incorrect or no rounding Uses $\pi = 3.1$

Q3	Model Solution – 20 Marks	Marking Notes
(a)	$3 + 1 + 1 + 2 + 4 + 3 = 14cm$	<p>Scale 10C (0, 4, 7, 10)</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: Relevant addition or two relevant lengths indicated <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • 4 or 5 sides added • 3+1+1+2+4+3 but not added <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> • Apply a * for incorrect or no units
(b)		<p>Scale 10C (0, 4, 7, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • One vertex translated other than P • Image of given shape produced under symmetry or rotation <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • One line translated • Image of given shape produced under incorrect translation

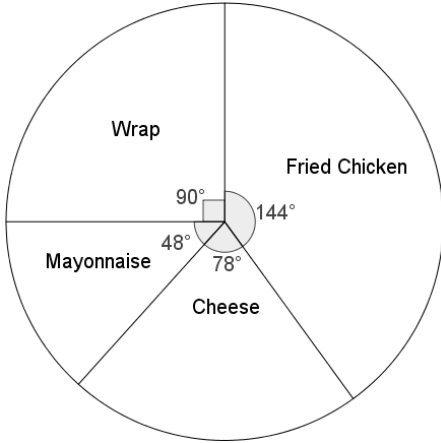
Q4	Model Solution – 20 Marks	Marking Notes
(a), (b)	<p>(a)</p>  <p>(b)</p>  <p><i>Or any other valid solution</i></p>	<p>Scale 15D (0, 4, 8, 12, 15)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit in (a) or (b) for example: In (a), draws an incorrect square or mention of 4 or draws a side of length 4 cm or draws a rectangle of area 16 cm^2 In (b), draws an incorrect rectangle or any pair of factors of 12 written or draws a square <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • (a) or (b) correct • Work of merit in (a) and (b) <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • (a) or (b) correct and work of merit in the other part
(c)	 <p><i>Or any other valid solution</i></p>	<p>Scale 5C (0, 2, 3,5)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Area of triangle formula • Draws any triangle • Draws a $7 \text{ cm} \times 2 \text{ cm}$. rectangle • 7×2 or 14×1 <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Draws a triangle with an area of 3.5 cm^2

Q5	Model Solution – 30 Marks	Marking Notes						
(a),(b)	<p>(a)</p> <table border="1" data-bbox="399 280 821 392"> <tr> <td>Acute</td> <td>Reflex</td> <td>Obtuse</td> </tr> <tr> <td><i>P</i></td> <td><i>S</i></td> <td><i>Q</i></td> </tr> </table> <p>(b)</p> $ \angle P = 60^\circ$ $ \angle Q = 120^\circ$ $ \angle S = 240^\circ$	Acute	Reflex	Obtuse	<i>P</i>	<i>S</i>	<i>Q</i>	<p>Scale 20D (0, 5, 10, 15, 20)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Work of merit, for example: In (a), one type of angle correct In (b), one angle correct, or mentions 180° or 360° <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> (a) correct In (b) 2 angles correct Work of merit in both parts <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> (a) correct, and one angle correct in (b) (b) correct
Acute	Reflex	Obtuse						
<i>P</i>	<i>S</i>	<i>Q</i>						
(c) (i),(ii)	<p>(i) Both triangles are equilateral so they have the same angles</p> <p>(ii) The sides of the triangles are different lengths</p>	<p>Scale 10C (0, 4, 7, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Some relevant work <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> (i) or (ii) correct Work of merit in both parts 						

Q6	Model Solution – 30 Marks	Marking Notes
(a) (i),(ii),(iii)	(i) 60,000 (ii) 110,000 (iii) $90,000 + 80,000 = 170,000$	Scale 10C (0, 4, 7, 10) <i>Low Partial Credit</i> <ul style="list-style-type: none"> Some relevant values in (iii) 1 correct Total for any other job for (iii) <i>High Partial Credit</i> <ul style="list-style-type: none"> 2 correct <i>Full Credit -1</i> <ul style="list-style-type: none"> Writes $90,000 + 80,000$ as answer in (iii) <i>Misreading (-1)</i> Gives no. of women in A (10000) and gives number of men in B (40000) Note : A tolerance of ± 2000 applies to parts (ii) and (iii)
(b)(i),(ii)	(i) B (ii) A	Scale 5B (0, 2, 5) <i>Partial Credit</i> <ul style="list-style-type: none"> 1 correct
(c)	<p style="text-align: center;">Type of job</p>	Scale 5C (0, 2, 3, 5) <i>Low Partial Credit</i> <ul style="list-style-type: none"> Number of women with job E calculated (80 000) <i>High Partial Credit</i> <ul style="list-style-type: none"> One correct column <i>Full Credit -1</i> <ul style="list-style-type: none"> No shading
(d)	0.5 Job C is close to 50:50	Scale 5B (0, 2, 5) <i>Partial Credit</i> <ul style="list-style-type: none"> Correct box ticked 0.9 selected with reason that there are more women than men with job C
(e)	$\frac{3}{10}$	Scale 5B (0, 2, 5) <i>Partial Credit</i> <ul style="list-style-type: none"> Correct numerator or denominator Works out 10

Q7	Model Solution – 20 Marks	Marking Notes
(a)	$177 - 166 = 11 [cm]$	<p>Scale 5B (0, 2, 5) Accept correct answer without work Accept correct answer without units</p> <p><i>Partial Credit</i></p> <ul style="list-style-type: none"> • Max/min value identified <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> • Range given as “166 to 177” or similar
(b), (c)	<p>(b) 168 [cm]</p> <p>(c) 169 [cm]</p>	<p>Scale 10B (0, 5, 10) Accept correct answer without work Accept correct answer without units</p> <p><i>Partial Credit</i></p> <ul style="list-style-type: none"> • (b) or (c) correct • Confuses mode and median • Shows understanding of median as middle value • Shows understanding of mode
(d)	$\frac{166 + 168 + 168 + 169 + 172 + 173 + 177}{7}$ $= \frac{1193}{7} = 170 \cdot 4 [cm] \text{ 1 D.P.}$	<p>Scale 5C (0, 2, 3, 5) Accept correct answer without work Accept correct answer without units</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Any relevant addition • Division by 7 indicated <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Correct sum found • Omits one number <p><i>Full Credit -1</i></p> <ul style="list-style-type: none"> • Apply a* for incorrect or no rounding

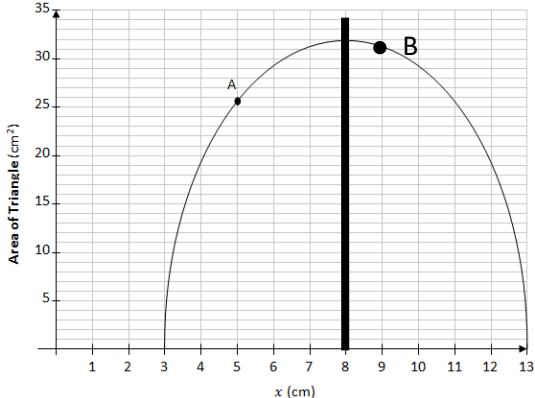
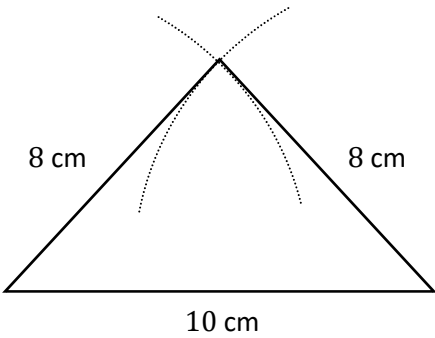
Q8	Model Solution – 50 Marks	Marking Notes
(a)	$\frac{1}{4}$	<p>Scale 5B (0, 2, 5)</p> <p><i>Partial Credit</i></p> <ul style="list-style-type: none"> • numerator or denominator correct
(b)(i)&(ii)	<p>(i) Any new combination e.g. BBQ Sauce and Plain Chicken</p> <p>(ii) $4 \times 3 = 12$</p>	<p>Scale 15C (0, 5, 10, 15)</p> <p>Accept correct answer without work</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • work of merit in (i) or (ii) for example: In (i) any new combination In (ii), at least one other combination listed, or some understanding of the fundamental principle of counting or use of 4 and / or 3 <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • (i) or (ii) correct • Work of merit in both parts <p><i>Full Credit (-1)</i> (i) correct and all outcomes listed but not totalled in (ii)</p>
(c)	$150 + 240 + 130 = 520$ $600 - 520 = 80$	<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"> • Any relevant addition or subtraction
(d)(i),(ii)	<p>(i) 360°</p> <p>(ii)</p> $\frac{130}{600} \times 360 = 78^\circ$ $\frac{80}{600} \times 360 = 48^\circ$	<p>Scale 10D (0, 3, 5, 8, 10)</p> <p>Accept correct answer without work</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • (i) correct • Work of merit in (ii) for example: one correct operation <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • (i) correct and work of merit in (ii) • 1 angle correct in (ii) <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • (i) correct and 1 correct angle in (ii) • (ii) correct

(d)(iii)		<p>Scale 15D (0, 4, 8, 12, 15)</p> <p>Tolerance $\pm 3^\circ$</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • One ray <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • 1 angle drawn correctly • Pie chart drawn with 4 areas but angles not measured <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • 2 angles drawn correctly <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> • Pie chart correct but labels or size of angles omitted
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Q9	Model Solution – 15 Marks	Marking Notes
	$180^\circ - (90^\circ + 35^\circ) = 55^\circ$	<p>Scale 15C (0, 5, 10, 15)</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: right angle identified in diagram, indicates 180° <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • One correct operation, for example: $90^\circ + 35^\circ$, $180^\circ - 35^\circ$

Q10	Model Solution – 30 Marks	Marking Notes
(a)	The point $(-1,3)$ plotted and labelled B	<p>Scale 5B (0, 2, 5)</p> <p><i>Partial Credit</i></p> <ul style="list-style-type: none"> Some work towards getting the midpoint <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> Point not labelled <p><i>Misreading (-1)</i></p> <p>Finds midpoint of School to Home or of Home to Shop</p>
(b)	$\sqrt{(3 - (-3))^2 + (3 - 1)^2}$ $= 6.3 \text{ [cm]}$	<p>Scale 10C (0, 4, 7, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Correct answer without work Coordinates of Home or Shop written Some use of Pythagoras Correct answer through measurement Home to Shop joined on diagram <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> Formula fully substituted $\sqrt{40}$ <p><i>Full Credit –1</i></p> <ul style="list-style-type: none"> Apply a* for incorrect or no rounding <p><i>Misreading (-1)</i></p> <p>Finds distance from Home to School or from School to Shop</p>
(c)	$5 \cdot 7 \times 2500$ $= 14\,250 \text{ cm}$ $= 142 \cdot 5 \text{ [m]}$	<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"> Use of $5 \cdot 7$ and 2500 <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> Correct answer given in cm

Q10	Model Solution – 30 Marks	Marking Notes
(d), (e)	<p>(d)</p> $\frac{\text{rise}}{\text{run}} = \frac{2}{6} = \frac{1}{3}$ <p style="text-align: center;">OR</p> $m = \frac{3 - 1}{3 - (-3)} = \frac{1}{3}$ <p>(e)</p> $\tan^{-1}\left(\frac{1}{3}\right) = 18.43 \dots^\circ$ $= 18^\circ \text{ nearest degree}$	<p>Scale 10C (0, 4, 7, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit in (d) or (e), for example: In (d), rise or run indicated, In (e), finds $\tan\left(\frac{1}{3}\right)$ <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • (d) or (e) correct • Work of merit in (d) and (e) <p><i>Full Credit (-1)</i></p> <ul style="list-style-type: none"> • Calculator in incorrect mode • Apply a * if answer not rounded or rounded incorrectly

Q11	Model Solution – 45 Marks	Marking Notes
(a)	Diagram A $26 - (10 + 5)$ $= 11$ Diagram B $26 - (10 + 9)$ $= 7$	Scale 10C (0, 4, 7, 10) Accept correct answer without work <i>Low Partial Credit</i> <ul style="list-style-type: none"> Some relevant addition or subtraction <i>High Partial Credit</i> <ul style="list-style-type: none"> A or B correct
(b)	Scalene All sides are different lengths	Scale 5B (0, 2, 5) <i>Partial Credit</i> <ul style="list-style-type: none"> Work of merit, for example: Correct box ticked, or work of merit in reason
(c) (i)(ii)(iii)	(i)  (ii) 25cm^2 (iii) Point B plotted and labelled	Scale 10D (0, 3, 5, 8, 10) <i>Low Partial Credit</i> <ul style="list-style-type: none"> Work of merit in one part <i>Mid Partial Credit</i> <ul style="list-style-type: none"> One part correct or work of merit in two parts <i>High Partial Credit</i> <ul style="list-style-type: none"> Two parts correct or work of merit in three parts <i>Full Credit (-1)</i> B not labelled
(d)		Scale 10C (0, 4, 7, 10) <i>Low Partial Credit:</i> <ul style="list-style-type: none"> Pilot diagram drawn. One correct length drawn. <i>High Partial Credit:</i> <ul style="list-style-type: none"> Two correct lengths drawn. Construction correct without arcs having checked length of sides. Note: Tolerance $\pm 0.3\text{cm}$.

Q11	Model Solution – 45 Marks	Marking Notes
(e)	$8^2 = h^2 + 5^2$ $64 = h^2 + 25$ $h^2 = 39$ $h = 6.2[\text{cm}] \text{ 1 D.P.}$	<p>Scale 10 C (0, 4, 7, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Some substitution in Pythagoras • Pythagoras Theorem stated <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Pythagoras fully substituted • Error in substitution but finishes correctly <p><i>Full Credit -1</i></p> <p>No rounding or incorrect rounding</p>

Marcanna Breise as ucht freagairt trí Ghaeilge

Léiríonn an tábla thíos an méid marcanna breise ba chóir a bhronnadh ar iarrthóirí a ghnóthaíonn níos mó ná 75% d'iomlán na marcanna.

N.B. Ba chóir marcanna de réir an ghnáthráta a bhronnadh ar iarrthóirí nach ghnóthaíonn níos mó ná 75% d'iomlán na marcanna don scrúdú. Ba chóir freisin an marc bóonais sin a **shlánú síos**.

Tábla 300 @ 5%

Bain úsáid as an tábla seo i gcás na n-ábhar a bhfuil 300 marc san iomlán ag gabháil leo agus inarb é 5% gnáthráta an bhónais.

Bain úsáid as an ngnáthráta i gcás 225 marc agus faoina bhun sin. Os cionn an mharc sin, féach an tábla thíos.

Bunmharc	Marc Bónais
226	11
227 - 233	10
234 - 240	9
241 - 246	8
247 - 253	7
254 - 260	6

Bunmharc	Marc Bónais
261 - 266	5
267 - 273	4
274 - 280	3
281 - 286	2
287 - 293	1
294 - 300	0