



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2023
Deferred Examinations

Marking Scheme

Mathematics

Ordinary Level

Note to teachers and students on the marking schemes for the deferred examinations

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. However, it should be noted that the marking schemes for the deferred examinations may not necessarily be as detailed as the corresponding marking schemes for the main sitting of an examination, which serve to ensure consistency across a large team of examiners.

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 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 between the main sitting and the deferred sitting and from year to year. In the case of the deferred examinations, this means that the level of detail may vary by question, as the marking scheme will only have been finalised for the questions attempted by the candidates who sat these examinations.

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 a senior examiner when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes (whether for the main examinations or the deferred examinations) 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 concerned. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination will not necessarily be the same for the deferred sitting as for the main sitting or from one year to the next.

Leaving Certificate Examination

Deferred Exam 2023

Mathematics

**Ordinary Level
Paper 1**

Marking Scheme

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

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

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. Such cases are denoted with a * and 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 section (a), (b), (c) etc. A penalty for an omitted unit is applied only once in each section (a), (b), (c) etc. 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.

Unless otherwise specified, an answer without sufficient supporting work is generally awarded the lowest non-zero level of credit (typically *Partial Credit* or *Low Partial Credit*, as appropriate).

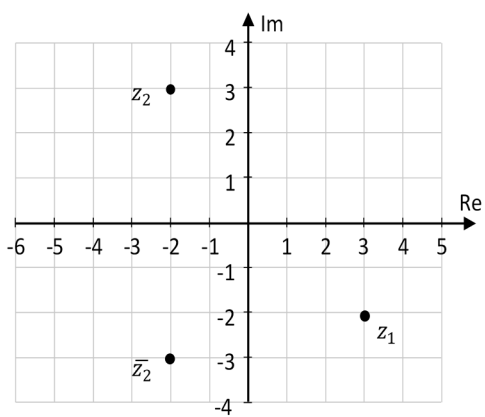
Summary of mark allocations and scales to be applied

Section A (150) Answer any five questions		Section B (150) Answer any three questions	
Question 1 (30)	Question 4 (30)	Question 7 (50)	Question 9 (50)
(a)(i) 15D	(a) 15C	(a) 15C	(a)(i) 5B
(a)(ii) 5C	(b) 5C	(b)(i) 10C	(a)(ii) 10C
(b) 5C	(c)(i)(ii)(iii) 10D	(b)(ii) 5B	(a)(iii) 5C
(c) 5C		(c) 10D	(a)(iv) 10C
		(d) 10C	(a)(v) 5C
Question 2 (30)	Question 5 (30)	Question 8 (50)	(b)(i) 10C
(a) 10C	(a)(i) 10C	(a)(i) 10C	(b)(ii) 5B
(b) 5C	(a)(ii) 5C	(a)(ii) 10B	Question 10 (50)
(c) 15D	(b)(i) 5B	(b) 10C	(a)(i) 10B
	(b)(ii) 10C	(c)(i)(ii)(iii) 10D	(a)(ii) 10C
Question 3 (30)	Question 6 (30)	(d) 10C	(a)(iii) 5D
(a) 15C	(a) 10C		(a)(iv) 5C
(b) 5C	(b) 5C		(b)(i) 10C
(c) 10D	(c)(i) 10C		(b)(ii) 10C
	(c)(ii) 5C		

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 – 30 Marks	Marking Notes
<p>(a) (i)</p>	$z_1 = 3 - 2i \quad \text{and} \quad z_2 = -2 + 3i$ $\bar{z}_2 = -2 - 3i$ 	<p>Scale 15D (0, 4, 8, 12, 15) 4 parts in the solution \bar{z}_2 and 3 plots</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, real or imaginary part of \bar{z}_2 correct, or real or imaginary part of z_1 or z_2 plotted correctly • 1 part correct <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • 2 parts correct <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • 3 parts correct <p>NOTE: Apply F* if labels omitted</p>
<p>(ii)</p>	$z_1 - z_2 = 3 - 2i - (-2 + 3i) = 5 - 5i$ $ 5 - 5i = \sqrt{25 + 25} = \sqrt{50}$ $= 5\sqrt{2}$	<p>Scale 5C (0, 2, 3, 5) 2 parts in the solution</p> <ol style="list-style-type: none"> 1. Find $z_1 - z_2 =$ in form $a + bi$ 2. Find $z_1 - z_2$ <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit in one part, for example, some correct work in substitution for $z_1 - z_2$, or formula for Modulus <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • One part correct and work of merit in the other part

(b)	$3(2 - i) + i(5 + 2i)$ $= 6 - 3i + 5i + 2i^2$ $= 4 + 2i$	<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 correct expansion of brackets <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Multiplication fully correct
(c)	$2 - 3pi - 9 - ki = 4k + 1 - i$ <p><i>Real:</i> $2 - 9 = 4k + 1$ $-2 = k$</p> <p><i>Imaginary:</i> $-3p - k = -1$ $-3p + 2 = -1$ $p = 1$</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 identifies reals or imaginaries <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Correctly finds k or p

Q3	Model Solution – 30 Marks	Marking Notes
(a)	$5x - 4y = 1$ $5(-7) - 4y = 1$ $-4y = 36$ $y = -9$	<p>Scale 15C (0, 5, 10, 15)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example substitutes -7 for y correctly <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Error in transposing but finishes correctly
(b)	$2^x = \sqrt{32}$ $2^x = (2^5)^{1/2}$ $2^x = 2^{5/2}$ $x = \frac{5}{2}$	<p>Scale 5C (0, 2, 3, 5)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • 1 step correct <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • 2 steps correct
(c)	$x - y = 2$ $x = y + 2$ $(y + 2)^2 + y^2 = 10$ $y^2 + 4y + 4 + y^2 - 10 = 0$ $2y^2 + 4y - 6 = 0$ $y^2 + 2y - 3 = 0$ $(y + 3)(y - 1) = 0$ $y = -3 \text{ and } y = 1$ $x = -1 \text{ and } x = 3$	<p>Scale 10D (0, 4, 6, 8, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example a correct substitution or transposing <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • Finds correct quadratic equation <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds values of y

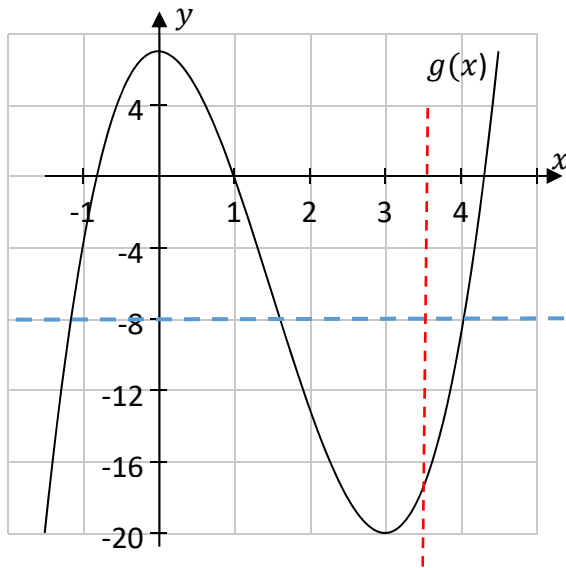
Q4	Model Solution – 30 Marks	Marking Notes
(a)	$x^2 - 6x + 3 = 0$ $\frac{6 \pm \sqrt{36 - 12}}{2}$ $\frac{6 \pm \sqrt{24}}{2}$ $\frac{6 \pm 4.898}{2}$ $= 5.4 \text{ and } 0.6$	<p>Scale 15C (0, 5, 10, 15) 3 steps involved</p> <ol style="list-style-type: none"> 1. Identifies a, b, and c 2. Fully substituted formula 3. Correctly evaluated <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example identifies a, b or c • -b formula, without or partially substituted <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Fully correct substitution
(b)	$h(x) = \frac{6x^2 - 23x + 20}{2x - 5}$ $h(x) = \frac{(3x - 4)(2x - 5)}{2x - 5}$ $h(x) = 3x - 4$	<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, attempt to factorise quadratic <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Correct factors of quadratic found

(c)
(i)
&
(c)
(ii)
&
(c)
(iii)

$$x = -0.8, 1 \text{ and } 4.2$$

$$g(3.5) = -18$$

$$g(x) = -8 \text{ at } x = -1.2, 1.6 \text{ and } 4$$



Scale 10D (0, 4, 6, 8, 10)

3 sections

Low Partial Credit

- Work of merit in any section

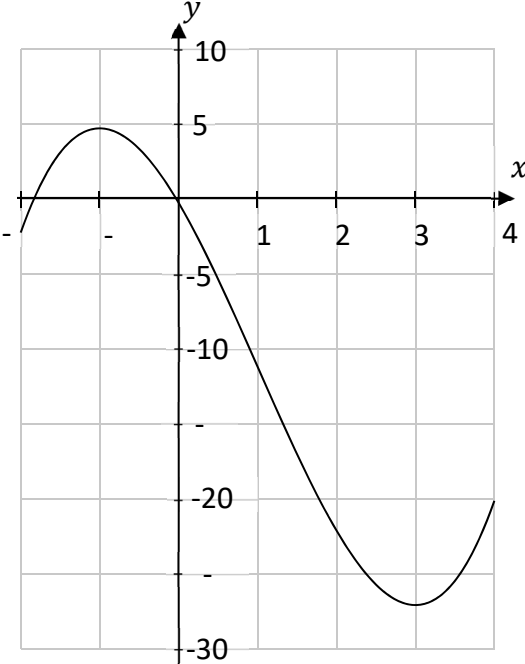
Mid Partial Credit

- Any 1 correct section
- Work of Merit in

High Partial Credit

- Any 2 correct sections
- Correct solutions but no work on graph

Q5	Model Solution – 30 Marks	Marking Notes
(a) (i)	$T_n = 4n + 1$ $T_1 = 4 + 1 = 5$ $T_2 = 8 + 1 = 9$ $T_3 = 12 + 1 = 13$	<p>Scale 10C (0, 3, 7, 10) NOTE: Accept correct answers without supporting work</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Any one term correct <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> Any two terms correct
(a) (ii)	$T_k = 4k + 1 = 101$ $4k = 100$ $k = 25$	<p>Scale 5C (0, 2, 3, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Work of merit, for example writes $T_k = 101$ Writes T_n formula or $a = 5$ or $d = 4$ <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> One error in transposing but finishes correctly.
(b) (i)	$S_n = \frac{n(n+1)}{2}$ $S_{12} = \frac{12(12+1)}{2} = 78$	<p>Scale 5B (0, 2, 5) <i>Partial Credit</i></p> <ul style="list-style-type: none"> Work of merit, for example substitutes 12 in for n
(b) (ii)	$\frac{n(n+1)}{2} = 325$ $n^2 + n - 650 = 0$ $(n + 26)(n - 25) = 0$ $n = 25$	<p>Scale 10C (0, 3, 7, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Work of merit, for example any correct multiplication <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> Finds correct quadratic <p>NOTE: Apply F* if fails to eliminate answer of $n = -26$</p>

Q6	Model Solution – 30 Marks	Marking Notes																
(a)	<table border="1" data-bbox="252 286 767 394"> <tr> <td>x</td> <td>-2</td> <td>-1</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> </tr> <tr> <td>$f(x)$</td> <td>-2</td> <td>5</td> <td>0</td> <td>-11</td> <td>-22</td> <td>-27</td> <td>-20</td> </tr> </table>	x	-2	-1	0	1	2	3	4	$f(x)$	-2	5	0	-11	-22	-27	-20	<p>Scale 10C (0, 3, 7, 10) Low Partial Credit</p> <ul style="list-style-type: none"> Any one correct value of $f(x)$ <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> 4 correct
x	-2	-1	0	1	2	3	4											
$f(x)$	-2	5	0	-11	-22	-27	-20											
(b)		<p>Scale 5C (0,2,3,5) Low Partial Credit</p> <ul style="list-style-type: none"> Any one of the candidates points plotted correctly <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> 4/5 points plotted correctly <p>Note: Apply F* if all 6 points plotted correctly but failure to join or joined incorrectly.</p>																

<p>(c) (i)</p>	$f'(x) = 3x^2 - 6x - 9$	<p>Scale 10C (0, 3, 7, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example writes dy/dx or any one part differentiated correctly <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Any two parts differentiated correctly
<p>(c) (ii)</p>	$3x^2 - 6x - 9 = 0$ $x^2 - 2x - 3 = 0$ $(x - 3)(x + 1) = 0$ $x = 3 \text{ and } x = -1$ $y = -27 \text{ and } y = 5$ <p>ANS: Max is (-1, 5) and Min is (3, -27)</p>	<p>Scale 5C (0, 2, 3, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Lets $f'(x) = 0$ or brings down answer from (c)(i) <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds x values <p>NOTE: Apply F* if finds both points correctly but fails to identify Max and Min</p>

Q7	Model Solution – 50 Marks	Marking Notes
(a)	<p>34 min and 30 sec = 2070 sec</p> <p>= 414 sec for 1 km</p> <p>= 6 minutes and 54 seconds</p>	<p>Scale 15C (0, 5, 10, 15) Low Partial Credit</p> <ul style="list-style-type: none"> • Work of merit, for example writes 1 minute = 60 second <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds total number of seconds <p>NOTE: Apply F* for correct answer but not given in required form</p>
(b) (i)	<p>17 Minutes and 20 seconds for 3 km Finished at 10:05 so 35 minutes in total 17 minutes and 40 seconds for last 2 km 8 minutes and 50 seconds for last km</p>	<p>Scale 10C (0, 3, 7, 10) Low Partial Credit</p> <ul style="list-style-type: none"> • Any work of merit, for example finds correct time for first three kilometres run <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds how long final two kilometres take
(b) (ii)	<p>5km in 35 minutes</p> $\frac{5}{35} \times 60 = 8.57$ <p>Ans: 8.6 km/hr</p>	<p>Scale 5B (0, 2, 5) <i>Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit
(c)	<p>Brian: 15 km in 60 minutes 5 km in 20 minutes Finishes at 9:53am</p> <p>Shane: 12.5 km in 60 minutes 5 km in 24 minutes Finishes at 9:54am</p> <p>Brian finishes first by 1 minute</p>	<p>Scale 10D (0, 4, 6, 8, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • Finds finish time of Brian or Shane <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds finish time of both

(d)	$10 + 9 + 10n + 60(n - 1) = 32 \text{ mins}$ $10n + 60(n - 1) = 13 \times 60$ $70n = 840$ $n = 12$	Scale 10C (0, 3, 7, 10) <i>Low Partial Credit</i> <ul style="list-style-type: none">• Any work of merit, for example writes 32 – 19 or just 13 <i>High Partial Credit</i> <ul style="list-style-type: none">• Fully correct equation set up
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Q8	Model Solution – 50 Marks	Marking Notes
(a) (i)	$10360 - 9160 = 1200$ $1200 \times 0.6168 = \text{€}740.16$	<p>Scale 10C (0, 3, 7, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example, number of litres 1200 <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Error in finding litres but finishes correctly
(a) (ii)	$740.16 \times 0.135 = 99.9216$ <p>Total Cost = €840.08</p>	<p>Scale 10B (0, 7, 10) NOTE: Accept correct answer without supporting work</p> <p><i>Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example identifies 13.5% as .135 or 1.135
(b)	$\frac{\text{€}1157.70}{1200} = 0.96475$ $\text{€}0.96475 = 1.135$ <p>€0.85 = price excluding VAT</p> <p>Or</p> $\frac{\text{€}1157.70}{1.135} = 1020$ $\frac{1020}{1200} = 0.85$	<p>Scale 10C (0, 3, 7, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds 0.96475 or 1020

<p>(c) (i) & (c) (ii) & (c) (iii)</p>	<p>Comp A: $100 + 5 \times 60 = 400$ Comp B: $80 + 5 \times 70 = 430$</p> <p>Comp A = $60n + 100$ Comp B = $70n + 80$</p> $70n + 80 = 60n + 100$ $10n = 20$ $n = 2$	<p>Scale 10D (0, 4, 6, 8, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Some work of merit <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> Any one section correct <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> Any 2 sections correct
<p>(d)</p>	$VOL = \pi r^2 h$ $1\,500\,000 = \pi r^2 200$ $2387.1324146 = r^2$ $48.86 = r$ $r = 49 \text{ cm}$	<p>Scale 10C (0, 3, 7, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Work of merit, for example writes correct formula for cylinder or some correct substitution in formula <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> Finds r^2 correctly and fails to finish

Q9	Model Solution – 50 Marks	Marking Notes
(a) (i)	$t = 0 \Rightarrow h = 40$	<p>Scale 5B (0, 2, 5) <i>Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example substitutes 0 in for t and stops <p>NOTE: Accept correct answer without work</p>
(a) (ii)	$h(1.5) = 40 + 10(1.5) - 5(1.5)^2$ $= 43.75 \text{ m}$	<p>Scale 10C (0, 3, 7, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Substitutes 1.5 for t and stops <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Fully correct substitution
(a) (iii)	$10 - 10t = 0$ $t = 1$ $h(1) = 40 + 10(1) - 5(1)^2$ <p>Max Height = 45 m</p>	<p>Scale 5C (0, 2, 3, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Mentions differentiation or dy/dx <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds $t = 1$
(a) (iv)	$40 + 10t - 5t^2 = 0$ $t^2 - 2t - 8 = 0$ $(t - 4)(t + 2) = 0$ $t = 4 \text{ and } t = -2$ <p>Ans: After 4 seconds</p>	<p>Scale 10C (0, 3, 7, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example writes – b formula <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Substitutes – b formula correctly <p>NOTE: Apply F* if fails to eliminate $t = -2$ as an answer</p>

<p>(a) (v)</p>	$x^2 = 40^2 + 240^2$ $x = 243.31$	<p>Scale 5C (0, 2, 3, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example writes Pythagoras or sets up equation correctly <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • One error in calculation but finishes correctly
<p>(b) (i)</p>	$\frac{138.75}{0.8338} = \text{€}166.41$	<p>Scale 10C (0, 3, 7, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Sets up division correctly but fails to finish
<p>(b) (ii)</p>	$\text{€}125 - 15\% = \text{€}106.25$ $\text{€}106.25 = 123\%$ $\text{€}86.38 = \text{price without VAT}$ $\text{€}106.25 - \text{€}86.38 = \text{€}19.87 \text{ VAT}$	<p>Scale 5B (0, 2, 5) <i>Partial Credit</i></p> <ul style="list-style-type: none"> • Any work of merit, for example writes 0.15

Q10	Model Solution – 50 Marks	Marking Notes
(a) (i)	$950 \times 0.4 = \text{€}380$	<p>Scale 10B (0, 7, 10) <i>Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example recognises $0.4 = 40\%$ <p>NOTE: Accept correct answer without work</p>
(a) (ii)	$678.85 @ 20\% = 135.77$ $271.15 @ 40\% = 108.46$ <p>Gross Tax = 244.23</p> <p>Tax Credits 65.38</p> <p>Nett Tax = €178.85</p>	<p>Scale 10C (0, 3, 7, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Finds 271.15 <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds Gross Tax
(a) (iii)	$6 \times 380 = 2280 \text{ emergency tax paid}$ <p>what she should have paid</p> $6 \times 178.85 = 1073.10$ $2280 - 1073.10 = 1206.9$ <p>1206.90 Overpayment</p>	<p>Scale 5C (0, 2, 3, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example finds 2280 or 1073.10 <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds 2280 and 1073.10
(a) (iv)	$218.85 + 65.38 = 284.23$ $284.23 - 135.77 = 148.46$ <p>(tax @40%)</p> $\frac{148.46 \times 100}{40} =$ <p>371.15 taxable income @ 40%</p> <p>Ans: Pay Increase of €100</p>	<p>Scale 5D (0, 2, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example any correct % calculation <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • Finds new tax @ 40% after pay increase <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds new taxable income after pay increase

<p>(b) (i)</p>	$15000 \left(1 + \frac{r}{100}\right)^3 = 16153.36$ $\left(1 + \frac{r}{100}\right)^3 = 1.07689066$ $\left(1 + \frac{r}{100}\right) = 1.025$ $\frac{r}{100} = 0.025$ $r = 2.5\%$	<p>Scale 10C (0, 3, 7, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Correct formula written or formula with some correct substitution <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Formula fully substituted correctly
<p>(b) (ii)</p>	<p>Yr 1: $5000 \times 1.042 = 5210$</p> <p>Yr 2: $10210 \times 1.042 = 10638.82$</p> <p>Yr 3: 15638.82×1.042 $= 16295.65$</p>	<p>Scale 10C (0,3, 7, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, for example finds 0.042 of 5000 <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds 10210

Leaving Certificate

Deferred Exam 2023

Mathematics

Ordinary Level

Paper 2

Marking Scheme

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, 3, 5	0, 3, 4, 5	0, 2, 3, 4, 5
10-mark scale			0, 4, 6, 10	0, 4, 6, 8, 10
15-mark scale			0, 5, 10, 15	0, 4, 8, 12, 15
20-mark scale				

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-Scale (two categories)

- response of no substantial merit (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. Such cases are denoted with a * and 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 section (a), (b), (c) etc. A penalty for an omitted unit is applied only once in each section (a), (b), (c) etc. 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.

Throughout the scheme a correct relevant formula written is regarded as Work of merit, award the lowest non-zero level of credit (typically *Partial Credit* or *Low Partial Credit*, as appropriate).

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.

Unless otherwise specified, an answer without sufficient supporting work is generally awarded the lowest non-zero level of credit (typically *Partial Credit* or *Low Partial Credit*, as appropriate).

Summary of mark allocations and scales to be applied

Section A (150) Answer any five questions		Section B (150) Answer any three questions	
Question 1 (30)	Question 4 (30)	Question 7 (50)	Question 9 (50)
(a)(i) 10D	(a)(i) 10C	(a) 10C	(a) 5C
(a)(ii) 5B	(a)(ii),(iii) 5C	(b) 15D	(b) 5C
(a)(iii) 5C	(b)(i) 10C	(c) 5C	(c) 5B
(b) 10C	(b)(ii) 5C	(d) 5B	(d) 5C
		(e)(i) 5C	(e) 5B
Question 2 (30)	Question 5 (30)	(e)(ii) 5C	(f) 5C
(a)(i) 5B	(a) 10C	(e)(iii) 5C	(g)(i) 5C
(a)(ii) 10C	(b) 5B	Question 8 (50)	(g)(ii) 5C
(b)(i) 10C	(c) 5B	(a)(i) 10C	(h) 10C
(b)(ii) 5C	(d) 5B	(a)(ii) 5C	
	(e) 5B	(a)(iii) 10C	Question 10 (50)
Question 3 (30)	Question 6 (30)	(b)(i) 10D	(a)(i) 15C
(a)(i) 5B	(a)(i) 5B	(b)(ii) 10D	(a)(ii) 10C
(a)(ii) 5C	(a)(ii) 5C	(b)(iii) 5C	(a)(iii) 5C
(a)(iii) 10C	(b) 15C		(a)(iv) 5D
(b) 10C	(c) 5D		(b)(i) 5C
			(b)(ii) 5D
			(b)(iii) 5A

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 – 30 Marks	Marking Notes																																																	
(a) (i)	<table border="1"> <thead> <tr> <th>×</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> </tr> <tr> <td>2</td> <td>2</td> <td>4</td> <td>6</td> <td>8</td> <td>10</td> <td>12</td> </tr> <tr> <td>3</td> <td>3</td> <td>6</td> <td>9</td> <td>12</td> <td>15</td> <td>18</td> </tr> <tr> <td>4</td> <td>4</td> <td>8</td> <td>12</td> <td>16</td> <td>20</td> <td>24</td> </tr> <tr> <td>5</td> <td>5</td> <td>10</td> <td>15</td> <td>20</td> <td>25</td> <td>30</td> </tr> <tr> <td>6</td> <td>6</td> <td>12</td> <td>18</td> <td>24</td> <td>30</td> <td>36</td> </tr> </tbody> </table>	×	1	2	3	4	5	6	1	1	2	3	4	5	6	2	2	4	6	8	10	12	3	3	6	9	12	15	18	4	4	8	12	16	20	24	5	5	10	15	20	25	30	6	6	12	18	24	30	36	<p>Scale 10D (0, 4, 6, 8, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Any 1 correct entry Any correct couple identified <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> Up to 10 correct entries <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> 5 rows or column's correct <p><i>Full Credit (-1):</i></p> <ul style="list-style-type: none"> All couples identified but multiplication ignored
×	1	2	3	4	5	6																																													
1	1	2	3	4	5	6																																													
2	2	4	6	8	10	12																																													
3	3	6	9	12	15	18																																													
4	4	8	12	16	20	24																																													
5	5	10	15	20	25	30																																													
6	6	12	18	24	30	36																																													
(a) (ii)	$P(\text{multiple of 3}) = \frac{20}{36} \text{ or } \frac{5}{9}$	<p>Scale 5B (0, 3, 5) <i>Partial Credit</i></p> <ul style="list-style-type: none"> Correct numerator or denominator 																																																	
(a) (iii)	<p>Probability of winning is $= \frac{1}{36}$</p> <p>Possible values of n are: 1, 4, 9, 16, 25, 36</p>	<p>Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> One correct value of n <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> 3 or 4 correct values of n 																																																	

(b)		Male	Female	total	<p>Scale 10C (0, 4, 6, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Finds 4 or 10 or has 25 as denominator <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Numerator correct
	Glasses	3	4	7	
	No Glasses	12	6	18	
	Total	15	10	25	
	<p>P (girl not wearing glasses) = $\frac{6}{25}$</p>				

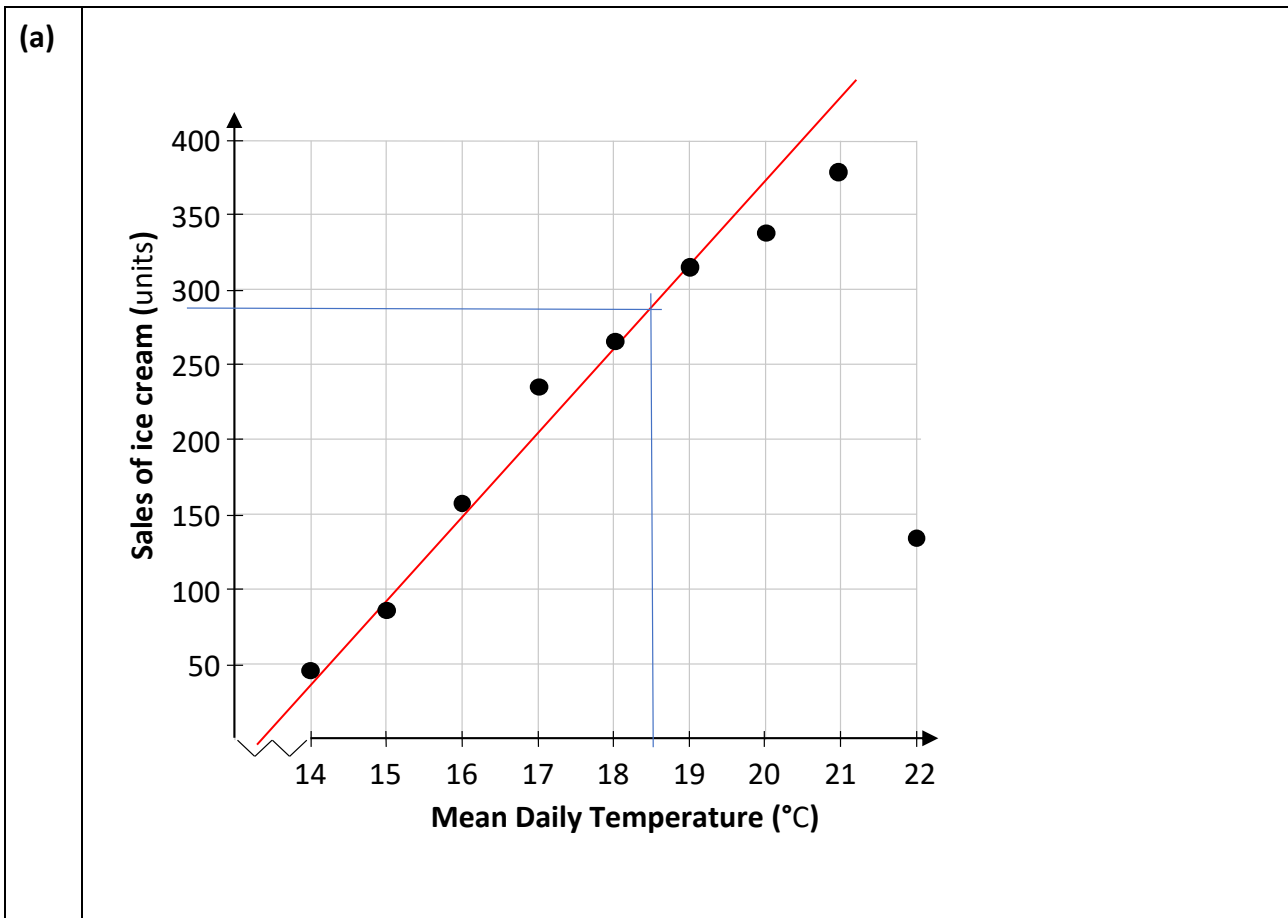
Q2	Model Solution – 30 Marks	Marking Notes
(a) (i)	$6 \times 5 \times 4 \times 3 \times 2 \times 1 = 720$ <p style="text-align: center;">or</p> $6! = 720$	<p>Scale 5B (0, 3, 5) <i>Partial Credit</i></p> <ul style="list-style-type: none"> Writes any correct arrangement Work of merit. e.g. indicates multiplication of two relevant numbers <p><i>Full Credit :</i></p> <ul style="list-style-type: none"> Correct answer without supporting work
(a) (ii)	$4 \times 3 \times 2 \times 1 \times 3! = 144$	<p>Scale 10C (0, 4, 6, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Work of merit. e.g. indicates multiplication of two relevant numbers or 3! <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> Finds 24 or (24 x 3!) but doesn't finish
(b) (i)	$597 + 410 = 1007$ $P(\text{most popular}) = \frac{1007}{55959}$ $= 0.0179$ $= 1.79$ $= 1.8\%$	<p>Scale 10C (0, 4, 6, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Work of merit e.g. finds 1007 Identifies 597, 410 or 28,902 <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> Both numerator and denominator correct Finds correct % for most popular boy or most popular girls name
(b) (ii)	$410 + 366 + 329 + 328 + 297 = 1730$ $P(\text{1 of 5 female names}) = \frac{1730}{55959}$ $= 0.030915 \dots$ $= 3.0915$ $= 3.1\%$	<p>Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> Work of merit e.g. Identifies the number of any one female name Finds 1730 <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> Correct numerator and denominator

Q3	Model Solution – 30 Marks	Marking Notes
(a) (i)	$2x - 3y + 7 = 0$ $3y = 2x + 7$ $y = \frac{2}{3}(x) + \frac{7}{3}$ $m = \frac{2}{3}$ <p>or</p> $\text{Slope of } t = -\frac{a}{b} = -\left(\frac{2}{-3}\right) = \frac{2}{3}$	<p>Scale 5B (0, 3, 5) <i>Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. correct formula identified • Attempts to isolate y <p><i>Full Credit :</i></p> <ul style="list-style-type: none"> • Correct answer without supporting work
(a) (ii)	<p>Slope of v is $\frac{a}{6}$ which is $= \frac{2}{3}$</p> $\frac{a}{6} = \frac{2}{3}$ $3a = 12$ $a = 4$	<p>Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Correct formula written • Identifies $\frac{a}{6}$ or $\frac{2}{3}$ <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Equates both fractions but fails to finish
(a) (iii)	$3x + 2y = 9$ $\underline{2x - 3y = -7}$ $9x + 6y = 27$ $\underline{4x - 6y = -14}$ $13x = 13$ $x = 1$ <p>Thus:</p> $2(1) - 3y + 7 = 0$ $3y = 9$ $y = 3$ <p>Point of intersection is (1, 3)</p>	<p>Scale 10C (0, 4, 6, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. any correct transposition or attempt to equate variables <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds x or y correctly <p><i>Full Credit(-1):</i></p> <ul style="list-style-type: none"> • Answers not given as a pair of coordinates

(b)	$\begin{aligned} \text{Area} &= \frac{1}{2} x_1y_2 - x_2y_1 \\ &= \frac{1}{2} (-2 \times 4) - (2 \times 3) \\ &= \frac{1}{2} -8 - 6 \\ &= 7 \text{ [sq units]} \end{aligned}$	Scale 10C (0, 4, 6, 10) <i>Low Partial Credit</i> <ul style="list-style-type: none">• Work of merit e.g. area formula <i>High Partial Credit</i> <ul style="list-style-type: none">• Formula fully substituted correctly.
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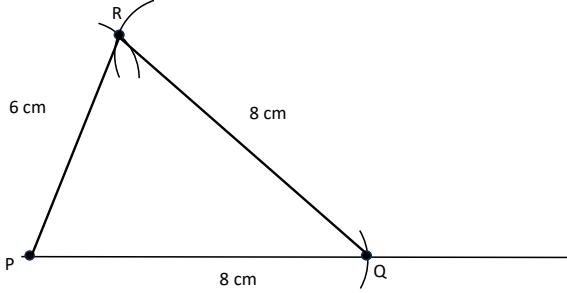
Q4	Model Solution – 30 Marks	Marking Notes
(a) (i)	Centre $\left(\frac{-4+4}{2}, \frac{3-3}{2}\right) = (0, 0)$ Radius $(-4, 3)$ to $(0, 0)$ $= \sqrt{[0 - (-4)]^2 + [0 - (3)]^2}$ $= \sqrt{(-4)^2 + 3^2}$ $= \sqrt{16 + 9}$ $= \sqrt{25}$ $= 5$	Scale 10C (0, 4, 6, 10) <i>Low Partial Credit</i> <ul style="list-style-type: none"> • Work of merit e.g. Correctly labels the coordinates of a given point • Correct graphical solution <i>High Partial Credit</i> <ul style="list-style-type: none"> • Centre or Radius correct <i>Full Credit :</i> <ul style="list-style-type: none"> • Correct answer without supporting work
(a) (ii) & (a) (iii)	$x^2 + y^2 = 5^2$ $x^2 + y^2 = 25$ $(-1)^2 + (-3)^2 = 1 + 9 = 10$ $10 < 25$ so inside the circle	Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i> <ul style="list-style-type: none"> • Work of merit e.g. writes $(-3)^2 = 9$ <i>High Partial Credit</i> <ul style="list-style-type: none"> • Equation of circle found • Calculates correctly the distance from centre to $p(-1, -3)$ <i>Full Credit (-1):</i> <ul style="list-style-type: none"> • No conclusion in (iii)

<p>(b) (i)</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">k</th> <th style="text-align: center;">p</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Radius (k) = 7</td> <td style="text-align: center;">Radius (p) = 3</td> </tr> <tr> <td style="text-align: center;">Centre(k) = (0, 0)</td> <td style="text-align: center;">Centre(p) = (8, -6)</td> </tr> </tbody> </table>	k	p	Radius (k) = 7	Radius (p) = 3	Centre(k) = (0, 0)	Centre(p) = (8, -6)	<p>Scale 10C (0, 4, 6, 10) 4 parts to solution</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • One part correct <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Any 3 parts correct
k	p							
Radius (k) = 7	Radius (p) = 3							
Centre(k) = (0, 0)	Centre(p) = (8, -6)							
<p>(b) (ii)</p>	<p>Circle k: (7, 0) and (0, 7) (or similar)</p> <p>Circle p: (8, -3) and (11, -6) (or similar)</p>	<p>Scale 5C (0, 3, 4, 5) 4 points to solution</p> <p><i>Low Partial Credit:</i></p> <ul style="list-style-type: none"> • Work of merit e.g. Some substitution into equation of k or p <p><i>High Partial Credit:</i></p> <ul style="list-style-type: none"> • One correct point given <p><i>Full Credit :</i></p> <ul style="list-style-type: none"> • Correct answer without supporting work <p><i>Full Credit(-1):</i></p> <ul style="list-style-type: none"> • Answers not given as a pair of coordinates 						



		<p>Scale 10C (0, 4, 6, 10) Note: 7 correct plots required Note: Tolerance – within correct box</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Any one plot correct <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Up to 6 correct plots
(b)	<p>Name: Outlier</p> <p>Reason: Supply issue with shop or shop closed at midday.</p>	<p>Scale 5B (0, 3, 5) <i>Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. correct name but no reason given or vice versa

(c)	Work on graph	Scale 5B (0, 3, 5) <i>Partial Credit</i> <ul style="list-style-type: none"> • Work of merit e.g. Joins the data points
(d)	From the diagram, sales of 290 (or similar from candidates line)	Scale 5B (0, 3, 5) <i>Partial Credit</i> <ul style="list-style-type: none"> • Work of merit e.g. 18.5 highlighted on the diagram
(e)	Answer: 0.95 Reason: All data close to line of best fit and near perfect correlation of 1	Scale 5B (0, 3, 5) <i>Partial Credit</i> <ul style="list-style-type: none"> • Work of merit e.g. correct answer but no reason given • Selects a positive value from the given list • Incorrect answer with a plausible reason e.g. 0.7 positive correlation

Q6	Model Solution – 30 Marks	Marking Notes
(a) (i)	$ \angle BOC = \frac{360}{4} = 90^\circ$	<p>Scale 5B (0, 3, 5) <i>Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. writes 360° <p><i>Full Credit :</i></p> <ul style="list-style-type: none"> • Correct answer without supporting work
(a) (ii)	$FE^2 = 5^2 + 5^2$ $FE^2 = 25 + 25$ $FE^2 = 50$ $FE = \sqrt{50}$ <p>or</p> $FE = 5\sqrt{2}$	<p>Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of Merit e.g. writes 5^2 • Theorem of Pythagoras written <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds $FE^2 = 50$
(b)		<p>Scale 15C (0, 5, 10, 15) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Any one line drawn correctly to scale • Draws a pilot diagram <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Two correct lengths drawn. • Construction correct without arcs (having checked length of sides). <p>Note: Tolerance of ± 0.25 cm</p>

<p>(c)</p>	$(x + 1)^2 = (x - 7)^2 + x^2$ $x^2 + 2x + 1 = x^2 - 14x + 49 + x^2$ $x^2 - 16x + 48 = 0$ $(x - 12)(x - 4) = 0$ $x = 12 \text{ and } x = 4,$ <p>but can't be 4 as would give side of -3</p> <p>Ans: $x = 12$</p>	<p>Scale 5D (0, 2, 3, 4, 5)</p> <p>Low Partial Credit</p> <ul style="list-style-type: none"> • Work of Merit e.g. writes $(x + 1)^2$ • Theorem of Pythagoras written • Correct relevant formula <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • Fully expands brackets correctly <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Factorises correctly or fully substitutes correctly into $-b$ formula <p><i>Full Credit (-1):</i></p> <ul style="list-style-type: none"> • Fails to eliminate 4 as a solution
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Q7	Model Solution – 50 Marks	Marking Notes
(a)	$120 \times 80 \times 70 = 672\,000 \text{ [cm}^3\text{]}$	<p>Scale 10C (0, 4, 6, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. writes $l \times b \times h$ • Writes 120 cm <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Multiplies any two lengths correctly <p><i>Full Credit :</i></p> <ul style="list-style-type: none"> • Correct answer without supporting work
(b)	$\begin{aligned} \text{Area} &= \frac{20}{2} [0 + 40 + 2(235)] \\ &= 10[0 + 40 + 470] \\ &= 5100 \text{ [m}^2\text{]} \end{aligned}$	<p>Scale 15D (0, 5, 8, 12, 15) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. $h = 20$ identified <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • 235 found • Trapezoidal Rule Formula with some substitution <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Trapezoidal Rule formula with full substitution • One error in substitution and finishes correctly
(c)	$\begin{aligned} \text{Length of semi-circular ends} &= 2\pi r \\ &= 2\pi(9) \\ &= 56.548 \\ &= 56.55 \text{ [m]} \end{aligned}$ $\begin{aligned} \text{Total distance walked} &= 56.55 + 200 \\ &= 256.55 \text{ [m]} \end{aligned}$	<p>Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. writes formula relevant formula • Finds 200 m <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds length of curved path <p><i>Full Credit (-1):</i></p> <ul style="list-style-type: none"> • Answer as 56.55 and 200

(d)	$\frac{5000}{256.55} = 19.48 = 20 \text{ laps}$	<p>Scale 5B (0, 3, 5) <i>Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. Writes 5 km as 5000 m <p><i>Full Credit (-1):</i></p> <ul style="list-style-type: none"> • Answer as 19 laps from correct work
(e) (i)	$V_{\text{toy}} = V_{\text{cone}} + V_{\text{hemisphere}}$ $\text{Volume of cone} = \frac{1}{3} \pi r^2 h$ $= \frac{1}{3} \pi (3)^2 4$ $= 12\pi \text{ [cm}^3\text{]}$ $\text{Volume of hemisphere} = \frac{2}{3} \pi r^3$ $= \frac{2}{3} \pi (3)^3$ $= 18 \pi \text{ cm}^3$ $\text{Total volume} = 30\pi \text{ [cm}^3\text{]}$	<p>Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Correct relevant formula <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds V_{cone} or $V_{\text{hemisphere}}$ • One error in substitution and finishes correctly <p><i>Full Credit (-1):</i></p> <ul style="list-style-type: none"> • Answer as 12π and 18π
(e) (ii)	$\text{Volume of sphere} = \frac{4}{3} \pi (0.2)^3$ $= \frac{4}{375} \pi \text{ cm}^3$ $= [0.0106] \pi \text{ cm}^3$	<p>Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. Writes 2 mm = 0.2 cm <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Formula for sphere fully substituted • One error in substitution and finishes correctly

<p>(e) (iii)</p>	$V_{\text{beads}} = 1500 \times \left(\frac{4}{375} \pi \right)$ $V_{\text{beads}} = 16\pi$ $V_{\text{empty space}} = 30\pi - 16\pi$ $V_{\text{empty space}} = 14\pi$ $\text{Percentage}_{\text{empty space}} = \frac{14 \times 100}{30}$ $\text{Percentage}_{\text{empty space}} = 46.7\%$	<p>Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Finds volume of 1500 beads <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds volume of empty space
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Q8	Model Solution – 50 Marks	Marking Notes
(a) (i)	$31.7^2 + 500^2 = x^2$ $251004.89 = x^2$ $x = 501 \text{ [m]}$	<p>Scale 10C (0, 4, 6, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. writes Pythagoras theorem <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • One error in substitution but finishes correctly
(a) (ii)	$\tan A = \frac{31.7}{500}$ $\tan A = 0.0634$ $\angle A = \tan^{-1}(0.0634)$ $\angle A = 3.62769^\circ$ $\angle A = 3.63^\circ$	<p>Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Correct Trig Ratio Formula written <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds 0.0634
(a) (iii)	$2A = 7.26$ $\tan 7.26^\circ = \frac{31.7}{x}$ $x = \frac{31.7}{\tan 7.26^\circ}$ $x = 249 \text{ m}$ <p>The boat moves 251 m closer to the lighthouse.</p>	<p>Scale 10C (0, 4, 6, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. Finds angle 2A ($7 \cdot 26^\circ$) <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Sets up equation correctly <p><i>Full Credit (-1):</i> Answer as. 249 m</p>

<p>(b) (i)</p>	$ \angle BPL = 90^\circ + 45^\circ = 135^\circ$ $\text{Area} = \frac{1}{2}(21 \times 16) \times \sin 135^\circ$ $= \frac{1}{2}(237.5878)$ $= 118.79 \text{ km}^2$	<p>Scale 10D (0, 4, 6, 8, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Some work of merit • Finds 135° <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • Finds $\angle BPL$ and some extra work for Area <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds $\angle BPL$ and area formula fully substituted • One error in substitution and finishes correctly
<p>(b) (ii)</p>	$ LB ^2 = 21^2 + 16^2 - 2(21 \times 16)\cos 135^\circ$ $ LB ^2 = 1172.1757$ $ LB = 34.2 \text{ km}$	<p>Scale 10D (0, 4, 6, 8, 10) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. 21^2 or 16^2 written • Cosine Rule formula written <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • Cosine Rule Formula correctly substituted <p><i>High Partial Credit:</i></p> <ul style="list-style-type: none"> • Cosine Rule Formula correctly substituted and finds $LB ^2$ • One error in substitution and finishes correctly <p><i>Zero Credit:</i></p> <ul style="list-style-type: none"> • Treats triangle as right angled

<p>(b) (iii)</p>	$\frac{\sin \angle PLB }{16} = \frac{\sin 135^\circ}{34.2}$ $= \frac{16 \times \sin 135^\circ}{34.2}$ $\sin \angle PLB = 0.3308$ $= \sin^{-1}(0.3308)$ $ \angle PLB = 19.3^\circ$	<p>Scale 5C (0, 3, 4, 5)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Correct Sine Rule Formula with some correct substitution <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Sine Rule Formula correctly substituted • One error in substituting Sine Rule formula but finishes correctly
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Q9	Model Solution – 50 Marks	Marking Notes
(a)	Brian, B (2 , 1) Ciara, C (4 , 4) Dave, D (2 , 7)	Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i> <ul style="list-style-type: none"> Any one coordinate/point correct <i>High Partial Credit</i> <ul style="list-style-type: none"> Any two points correct
(b)	$ CB = \sqrt{(4 - 2)^2 + (4 - 1)^2}$ $= \sqrt{2^2 + 3^2} = \sqrt{13}$ $ CD = \sqrt{(7 - 4)^2 + (2 - 4)^2}$ $= \sqrt{3^2 + (-2)^2} = \sqrt{13}$ $ CB = CD $	Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i> <ul style="list-style-type: none"> Correct relevant formula Any correct reading from the grid <i>High Partial Credit</i> <ul style="list-style-type: none"> Finds CB or CD
(c)	From the diagram, DB is parallel to the y -axis AC is parallel to the x – axis x -axis and y axis are perpendicular so DB is perpendicular to AC	Scale 5B (0, 3, 5) <i>Partial Credit</i> <ul style="list-style-type: none"> Work of merit Any correct reading from the grid
(d)	$\text{Slope of BC} = \frac{4 - 1}{4 - 2} = \frac{3}{2}$ $\text{Slope of DC} = \frac{7 - 4}{2 - 4} = -\frac{3}{2}$ Answer: NO $\frac{3}{2} \times -\frac{3}{2} \neq -1 \text{ so not perpendicular}$	Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i> <ul style="list-style-type: none"> Slope Formula or relevant work on one slope Correct answer with no or incorrect justification <i>High Partial Credit</i> <ul style="list-style-type: none"> Finds both slopes correctly but no or incorrect conclusion.

(e)	<p>Alice and Ciara meet after 2 km Brian will be at (2, 3) at this time Dave will be at (2, 5) at this time</p>	<p>Scale 5B (0, 3, 5) <i>Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. mentions 2 km • Any correct reading from the grid • Finds one point correctly
(f)	<p>Answer: NO Reason: Using slopes, BC not perpendicular to DC Using distances, $BD \neq AC$, $6 \neq 4$</p>	<p>Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Correct answer but no reason • Correct relevant formula written • Any correct reading from the grid <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Correct answer and some relevant work towards distance or slope
(g) (i)	$ OC = \sqrt{4^2 + 4^2} = \sqrt{32}$ or $4\sqrt{2}$	<p>Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Some substitution into distance formula • Writes Pythagoras theorem • Any correct reading from the grid <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Relevant formula correctly substituted
(g) (ii)	<p>Drop perpendicular from D to x-axis to point K $\tan \angle DOK = \frac{7}{2}$ so $\angle DOK = 74.0546^\circ$</p> <p>Drop perpendicular from C to x-axis to point L $\tan \angle COL = 1$, so $\angle COL = 45^\circ$</p> <p>Subtracting gives $\angle DOC = 29.05^\circ$ $= 29^\circ$</p>	<p>Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. Correct relevant formula <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds either $\angle DOK$ or $\angle COL$

<p>(h)</p>	$\begin{aligned} \text{Area of } \triangle ABD &= \frac{1}{2}(a)(h) \\ &= \frac{1}{2}(6)(2) \\ &= 6 \end{aligned}$ <p>Area of $\triangle ABD =$ Area of $\triangle BCD$ (symmetry) Area of $ABCD = 12 \text{ [km}^2\text{]}$</p>	<p>Scale 10C (0, 4, 6, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. correct relevant formula • Correct substitution of co-ordinates if using $\frac{1}{2} x_1y_2 - x_2y_1$ <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Area of half shape found correctly <p><i>Full Credit :</i></p> <ul style="list-style-type: none"> • Correct answer without supporting work
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Q10	Model Solution – 50 Marks	Marking Notes
(a) (i)	Petrol 156 to 213 Diesel 145 to 205	<p>Scale 15C (0, 5, 10, 15)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • One limit of any range correct • Answer of 57 or 60 <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Any 3 limits of the ranges correct • Answer as 57 and 60
(a) (ii)	Mean D: $177.9166 = 178$ cent Standard Deviation D: $18.9976 = 19$ cent	<p>Scale 10C (0, 4, 6, 10)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Any work of merit, including adding any two terms in an attempt to find the mean <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds Mean or Standard Deviation correctly <p><i>Full Credit :</i></p> <ul style="list-style-type: none"> • Correct answer without supporting work
(iii)	$178 + 19 = 197$ $178 - 19 = 159$ November, December, January, February, March, April, May, August	<p>Scale 5C (0, 3, 4, 5)</p> <p><i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. adds or subtracts standard deviation to mean price of diesel • Any one correct month written <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Writes 7 of the 8 required months

<p>(a) (iv)</p>	<p>Sean: $3.4 \times 5.4 = 18.36$ litres $18.36 \times 1.91 = 35.07$</p> <p>Jenny: $3.4 \times 6.2 = 21.08$ $21.08 \times 1.81 = 38.15$</p> <p>Sean's car is cheaper by €3.08</p>	<p>Scale 5D (0, 2, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit e.g. finds number of litres for Sean or Jenny <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • Finds correct number of litres for both Sean and Jenny • Finds total cost of fuel for either Sean or Jenny <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Finds total cost of fuel for both Sean and Jenny
<p>(b) (i)</p>	$\frac{1}{\sqrt{1276}} = 0.027994 = 2.799\%$	<p>Scale 5C (0, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Writes correct formula <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • Formula substituted correctly
<p>(b) (ii)</p>	$\frac{740}{1276} \times 100 = 57.99$ $57.99 + 2.799 = 60.789$ $57.99 - 2.799 = 55.191$ <p>[55.191%, 60.789%]</p>	<p>Scale 5D (0, 2, 3, 4, 5) <i>Low Partial Credit</i></p> <ul style="list-style-type: none"> • Work of merit, including bringing answer from (i) forward <p><i>Mid Partial Credit</i></p> <ul style="list-style-type: none"> • Finds 57.99 <p><i>High Partial Credit</i></p> <ul style="list-style-type: none"> • One boundary found, 60.789 or 55.191
<p>(b) (iii)</p>	<p>Increase number of people</p>	<p>Scale 5A (0, 5)</p> <ul style="list-style-type: none"> • Hit or Miss

