Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2022
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 2022

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	
10-mark scale		0, 3, 7, 10	0, 3, 5, 8, 10
15-mark scale		0, 5, 10, 15	0, 4, 8, 12, 15
20-mark scale			0, 5, 10, 15, 20

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

Marking scales – level descriptors

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.

Summary of mark allocations and scales to be applied

Section A (120) **Answer any four questions**		**Section B (100)** **Answer any two questions**	
Question 1 (30) (a) 10D (b) 10C (c) 10C **Question 2 (30)** (a)(i) 10C (a)(ii) 10C (b) 10C **Question 3 (30)** (a) 10D (b)(i) 5C (b)(ii) 10C (c) 5C	**Question 4 (30)** (a)(i)/(ii) 15D (b)(i) 10C (b)(ii) 5B **Question 5 (30)** (a)(i) 10C (a)(ii) 5C (a)(iii) 10C (b) 5C **Question 6 (30)** (a) 15C (b)(i) 5C (b)(ii) 10C	**Question 7 (50)** (a) 10C (b) 10D (c)(i) 5B (c)(ii) 5B (d) 10D (e)(i) 5B (e)(ii) 5B **Question 8 (50)** (a)(i)(ii) 15D (b)(i)(ii)(iii) 15D (c)(i) 10D (c)(ii) 5B (c)(iii) 5B	**Question 9 (50)** (a) 15D (b) 5B (c) 10C (d)(i) 10D (d)(ii) 10D **Question 10 (50)** (a) 5B (b) 10C (c)(i) 10C (c)(ii) 5B (d)(i) 5B (d)(ii) 5B (e) 5B (f) 5C

Palette of annotations available to examiners

Symbol	Name	Meaning in the body of the work	Meaning when used in the right margin
✓	Tick	Work of relevance	The work presented in the body of the script merits full credit
✗	Cross	Incorrect work (distinct from an error)	The work presented in the body of the script merits 0 credit
*	Star	Rounding / Unit / Arithmetic error Misreading	
~~	Horizontal wavy	Error	
✓l	Tick L		The work presented in the body of the script merits low partial credit
✓m	Tick M		The work presented in the body of the script merits mid partial credit (or partial credit)
✓h	Tick H		The work presented in the body of the script merits high partial credit
F*	F star		The work presented in the body of the script merits Full Credit (– 1)
[	Left Bracket		Another version of this solution is presented elsewhere and it merits equal or higher credit
≀	Vertical wavy	No work on this page (portion of the page)	
o	Oversimplify	The candidate has oversimplified the work	

Note: Where work of substance is presented in the body of the script, the annotation on the right margin should reflect a combination of annotations in the work

In a **C scale** where * and ~~~ and ~~~ appear in the body of the work, then ✓l should be placed in the right margin.

In the case of a **D scale** with the same annotations, ✓m should be placed in the right margin.

A ✓ in the body of the work may sometimes be used to indicate where a portion of the work presented has value and has merited one of the levels of credit described in the marking scheme. The level of credit is then indicated in the right margin.

Detailed marking notes

Model Solutions & Marking Notes

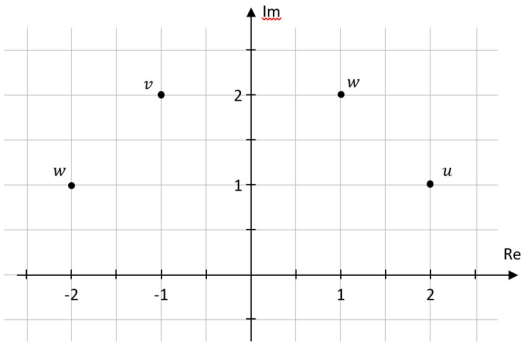
Note: The model solutions for each question are not intended to be exhaustive – there may be other correct solutions. Any Examiner unsure of the validity of the approach adopted by a particular candidate to a particular question should contact his / her Advising Examiner.

Q1	Model Solution – 30 Marks	Marking Notes
(a)	$5^{-3} = \frac{1}{5^3} = \frac{1}{125}$ **or** $0{\cdot}008$ $4^{\frac{3}{2}} = \left(4^{\frac{1}{2}}\right)^3 = (2)^3 = 8$	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* • Relevant work with indices in either part *Mid Partial Credit:* • One correct solution • Work of merit in each part *High Partial Credit:* • One correct solution together with relevant work with indices in the other part **Note**: Accept correct answers without work
(b)	$\frac{\left(\sqrt{8}\right)^6}{8^5} = \frac{\left(8^{\frac{1}{2}}\right)^6}{8^5} = \frac{8^3}{8^5} = 8^{-2}$	**Scale 10C (0, 3,7, 10)** *Low Partial Credit:* • Relevant work with indices *High Partial Credit:* • $Writes\ or\ 8^3\ or\ 8^6\ or\ \frac{8^3}{8^5}$

Q1	Model Solution – 30 Marks	Marking Notes
(c)	$\frac{2}{7x-5} - \frac{4}{3x+1}$ $\frac{2(3x+1)-4(7x-5)}{(7x-5)(3x+1)}$ $\frac{6x+2-28x+20}{(7x-5)(3x+1)}$ $\frac{22-22x}{(7x-5)(3x+1)}$	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit:* • Some work of merit, for example writes the LCM *High Partial Credit:* • Full 2nd Line of the solution

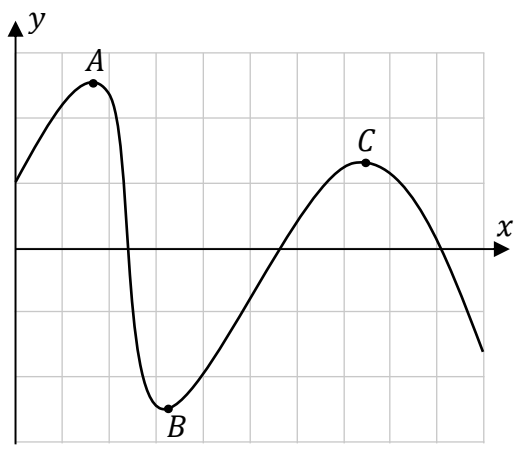
Q2	Model Solution – 30 Marks	Marking Notes
(a) (i)	$22\,000(0.8)^2 = €14\,080$ **Or** $22\,000 - 4400 = 17\,600$ $17\,600 - 3520 = €14\,080$	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit:* • Some work of merit, for example 0.2 or 0.8 • Correct relevant formula written • 4400 *High Partial Credit:* • 17600 • $(0.8)^2 = 0.64$
(a) (ii)	$P(0.8) = 10\,000$ $P = \frac{10\,000}{0.8} = €12\,500$	**Scale 10C (0, 3 ,7, 10)** *Low Partial Credit:* • Work of merit, for example 0.2 or 0.8 or the correct formula • P(0.8) = 10000 *High Partial Credit:* • $\frac{10\,000}{0.8}$

Q2	Model Solution – 30 Marks	Marking Notes
(b)	$\frac{9{\cdot}5\times10^{12}\times10^{3}}{365\times24\times60\times60} = 3{\cdot}01\times10^{8}$ km/s $\approx 3\times10^{8}$ m/s They are roughly the same **Or** $\frac{3\times10^{8}\times60\times60\times24\times365}{10^{3}}$ $= 9{\cdot}46\times10^{12} \approx 9{\cdot}5\times10^{12}$ km/year They are roughly the same	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit:* • Effort at converting km to m (m to km) • Effort at converting year to seconds (s to year) • 10^{12} *High Partial Credit:* • Either expression fully formulated

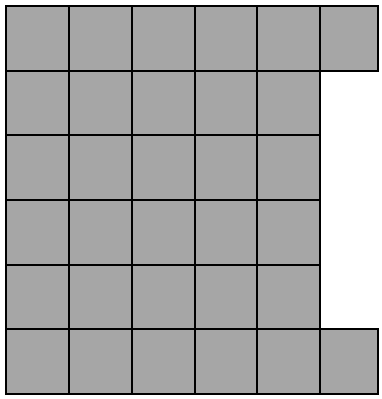
Q3	Model Solution – 30 Marks	Marking Notes
(a)	$u = 2 + 1i$ $v = -1 + 2i$	**Scale10D (0, 3, 5, 8, 10)** **Note**: 4 items $[2, -1, 1i, 2i]$ *Low Partial Credit:* • One correct item *Mid Partial credit:* • 2 correct items *High Partial credit:* • One correct answer
(b) (i)	$\lvert u\rvert = \sqrt{(2)^2 + (1)^2} = \sqrt{5}$ $\lvert v\rvert = \sqrt{(-1)^2 + (2)^2} = \sqrt{5}$	**Scale 5C (0, 2,3,5)** *Low Partial Credit:* • Modulus formula written with or without some substitution *High Partial Credit:* • Either modulus found
(b) (ii)	 $w = 1 + 2i$ or $w = -2 + i$	**Scale 10C (0,3,7,10)** Low Partial Credit • Work of merit High Partial Credit • One of the items correct ie correct complex number **OR** a correct plot

Q3	Model Solution – 30 Marks	Marking Notes
(c)	$(2+i)z = -1+2i$ $z = \frac{(-1+2i)}{(2+i)}$ $z = \frac{(-1+2i)(2-i)}{(2+i)(2-i)}$ $= \frac{5i}{5} = i$ **Or** $(2+i)(x+yi) = -1+2i$ $\Rightarrow 2x - y = -1$ $x + 2y = 2$ $\Rightarrow x = 0, \quad y = 1$	**Scale 5C (0,2,3,5)** *Low Partial Credit:* • Some correct substitution of a complex number • Conjugate identified • Some multiplication above and below by same number, even if incorrect conjugate *High Partial Credit:* $\frac{(-1+2i)(2-1i)}{(2+1i)(2-1i)}$ **Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* $(2+1i)(x+yi) = -1+2i$ and stops *High Partial Credit:* • 2 relevant equations found

Q4	Model Solution – 30 Marks	Marking Notes
(a)	**(i)** $5 - 2x \leq 11$ $-2x \leq 6$ $2x \geq -6$ $x \geq -3$ **(ii)** 	**Scale 15D (0, 4, 8, 12, 15)** *Low Partial Credit:* • Any relevant step towards solving inequality Mid Partial Credit • Treats as equation, *x = -3* with or without plot *High Partial Credit:* • If $x \geq -3$ but not shown on the line
(b) (i)	$x = -3$ and $x = 1$	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit:* • Work of merit, for example indicates value(s) on the diagram *High Partial Credit:* • One correct value found
(b) (ii)	$d(x) = k(x+3)(x-1)$ $= k(x^2 + 2x - 3)$ $\therefore k = 4$ since $(0, -12)$ is y intercept $d(x) = 4x^2 + 8x - 12$	**Scale 5B (0,2,5)** Partial Credit • Any work of merit, for example, an answer from part (i) written

Q5	Model Solution – 30 Marks	Marking Notes
(a) (i)	$f'(x) = 6x^2 - 6x + 7$	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit:* • 1 term correctly differentiated *High Partial Credit:* • 2 terms correctly differentiated
(a) (ii)	$f'(1) = 6(1)^2 - 6(1) + 7 = 7$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Any substitution into candidates $f'(x)$ $f'(1)$ or equivalent written *High Partial Credit:* $f'(1)$ fully substituted
(a) (iii)	$m = 7 \quad (1,6)$ $y - 6 = 7(x - 1)$ $7x - y - 1 = 0$	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit:* • Work of merit, for example relevant formula written OR *m=7* OR *(1,6)* *High Partial Credit:* • *m=7* **AND** *(1,6)*
(b)		**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • one correct point plotted *High Partial Credit:* • 2 correct points plotted NOTE: Apply * if no labels

Q6	Model Solution – 30 Marks	Marking Notes
(a)	$p(5) = (5)^2 - 1 = 24$	**Scale 15C (0, 5, 10, 15)** *Low Partial Credit:* $p(5) = 2(5) - 3$ and continues *High Partial Credit:* $(5)^2 - 1$ Note: Accept correct answer without work
(b) (i)	$p\big(h(x)\big) = p(2x - 3)$ $= (2x - 3)^2 - 1$ $= 4x^2 - 12x + 9 - 1$ $= 4x^2 - 12x + 8$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit, for example writes $2x - 3$ and/or $x^2 - 1$ *High Partial Credit:* $(2x - 3)^2 - 1$ • Finds *h(p(x))*, $2x^2 - 5$
(b) (ii)	$4x^2 - 12x + 8 = 4$ $4x^2 - 12x + 4 = 0$ $x = \frac{12 \pm \sqrt{144 - 4(4)(4)}}{2(4)}$ $x = \frac{12 \pm \sqrt{80}}{8}$ $x = 2.62 \quad x = 0.38$	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit:* • Work of merit for example, answer from (b)(i) written • *-b* formula written or identifies a or b or c *High Partial Credit:* • Fully substituted *-b* formula

<table>
<tr><th>Q7</th><th>Model Solution – 50 Marks</th><th>Marking Notes</th></tr>
<tr><td>(a)</td><td>  </td><td>Scale 10C (0,3,7,10)
Low Partial Credit:
• Work of merit, for example box(es) drawn

High Partial Credit:
• One line or column missing</td></tr>
<tr><td>(b)</td><td><table><tr><td>Day</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>Total number of square tiles used</td><td>8</td><td>14</td><td>22</td><td>32</td><td>44</td><td>58</td><td>74</td></tr></table></td><td>Scale 10D (0,3,5,8,10)
Low Partial Credit:
• One correct entry

Mid Partial Credit:
• 3 correct entries

High Partial Credit:
• 4 correct entries</td></tr>
<tr><td>(c)
(i)</td><td>$T_2 = (2+2)^2 - 2$
$= 4^2 - 2$
$= 14$</td><td>Scale 5B (0,2,5)

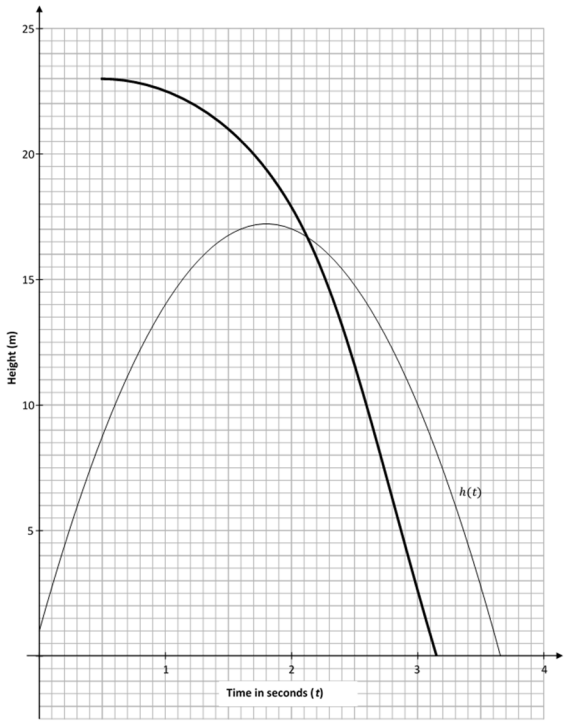
Partial Credit
• Work of merit, for example n=2 or substitutes 2 for n</td></tr>
<tr><td>(c)
(ii)</td><td>$(n+2)^2 - n$
$= n^2 + 4n + 4 - n$
$= n^2 + 3n + 4$</td><td>Scale 5B (0,2,5)

Partial Credit
• Work of merit, brings down the T_n formula from the question</td></tr>
</table>

Q7	Model Solution – 50 Marks	Marking Notes
(d)	$T_{14} = 14^2 + 3(14) + 4 = 242$ $T_{15} = 15^2 + 3(15) + 4 = 274$ $\therefore$ tiles laid on $15th$ day$= 274 - 242 = 32$	**Scale 10D (0,3,5,8,10)** Low Partial Credit • Work of merit, for example in finding T_{14} or T_{15} Mid Partial Credit • T_{14} **OR** T_{15} found correctly • Work of merit presented in finding both T_{14} **AND** T_{15} High Partial Credit • Finds **BOTH** T_{14} **AND** T_{15}
(e) (i)	$0.6 \times 0.6 = 0.36\ m^2\ \times 554 = 199.44\ m^2$	**Scale 5B (0,2,5)** Partial Credit • Work of merit, for example 0.6 or area formula
(e) (ii)	$\frac{199.44}{20} \times 700 = €6980.40$ $€6980.40 \times 1.23 = €8585.89$ $= €8586$	**Scale 5B (0,2,5)** Partial Credit • Work of merit, for example answer from (e)(i) written

Q8	Model Solution – 50 Marks	Marking Notes
(a) **(i)** **(ii)**		**Scale 15D (0, 4, 8, 12, 15)** Solution requires 10 elements , 4 values in the table, and 6 points plotted, joined by an appropriate curve *Low Partial Credit:* • One correct element *Mid Partial Credit:* • 4 correct elements *High Partial Credit:* • 8 correct elements Note: * if 9 elements correct with an appropriate curve

t	1	1·5	2	2·5	3	3·1
$g(t)$	23	21·75	18	11.75	3	0·95



Q8	Model Solution – 50 Marks	Marking Notes
(b) **(i)** **(ii)** **(iii)**	Approx 4.9 m Approx 1.75 secs Approx 16.8 m	**Scale 15D (0, 4, 8, 12, 15)** *Low Partial Credit:* • Work of relevance in any part *Mid Partial Credit:* • One part correct • Work of relevance in 2 or 3 parts *High Partial Credit:* • 2 parts correct **Note**: In part (i) accept answer in the range $4.6 \leq d \leq 5.4$ **Note**: In part (ii) accept answer in the range $1.5 \leq d \leq 2$ **Note**: In part (iii) accept answer in the range $16 \leq h \leq 17.5$ Note: * if incomplete graph work
(c) **(i)**	$h(1.5) = 1 + 18(1.5) - 5(1.5)^2 = 16.75$ m $g(1.5) = 18 + 10 - 5(1.5)^2 = 21.75$ m $\therefore 21.75 - 16.75 = 5$ m higher	**Scale 10D (0,3,5,8,10)** Low Partial Credit • Work of merit, for example writes *h(1.5) and/or g(1.5) or* substitutes *t = 1.5* Mid Partial Credit • Finds one correct answer either *h(1.5) = 16.75 or g(1.5) =21.75* • Work of merit in both parts High Partial Credit • Finds **BOTH** *h(1.5)* **AND** *g(1.5)*
(c) **(ii)**	$h'(t) = 18 - 10t = 0$ $t = 1.8$ secs	**Scale 5B (0,2,5)** Partial Credit • Some correct differentiation • Equates h'(t) = 0

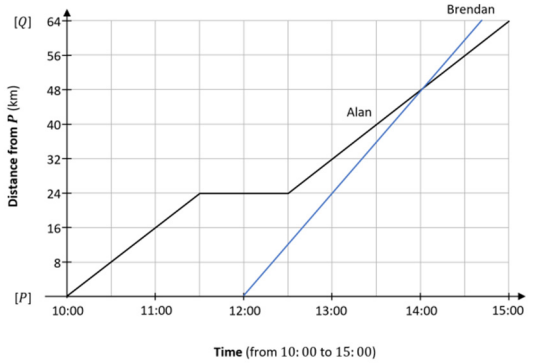
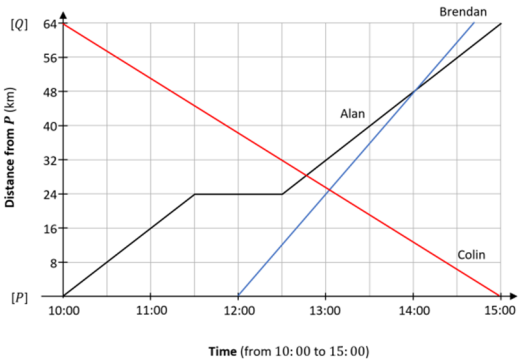
Q8	Model Solution – 50 Marks	Marking Notes
(c) (iii)	$18 + 10t - 5t^2 = 1 + 18t - 5t^2$ $18 + 10t = 1 + 18t$ $17 = 8t$ $t = 2.125$ secs $h(2.125) = 1 + 18(2.125) - 5(2.125)^2$ $= 16.7$ m	**Scale 5B (0,2,5)** Partial Credit • Work of merit, either expression for *h(t)* or *g(t)* written

Q9	Model Solution – 50 Marks	Marking Notes
(a)		**Scale 15D (0,4,8,12,15)** Low Partial Credit • One correct entry Mid Partial Credit • 5 correct entries High Partial Credit • 8 correct entries
(b)	No; not equal initially and coins increasing by 8 but total increasing by 3 etc **Or** $136 + 8n = 51 + 3n$ $5n = -85$ No, since $n \notin \mathbb{N}$	**Scale 5B (0,2,5)** Partial Credit • Work of merit, for example either of their expressions from (a) written
(c)		**Scale 10C (0,3,7,10)** Low Partial Credit • One correct value High Partial Credit • 2 correct values

	Total number of coins	Total amount of money (€)
Start	136	51
After 1 week	144	54
After 2 weeks	152	57
After 3 weeks	160	60
After 4 weeks	168	63
After n weeks ($n \in \mathbb{N}$)	$136 + 8n$	$51 + 3n$

Money box	Box 1	Box 2	Box 3
Number of coins in this money box	17	34	85

Q9	Model Solution – 50 Marks	Marking Notes
(d) (i)	$12\,012 \times 0.5\% = €60.06$ $(20\,484 - 12\,012) \times 2\% = €169.44$	**Scale 10D (0,3,5,8,10)** Low Partial Credit • Work of merit, for example 0.02 0.005 written Mid Partial Credit • Finds 60.06 **OR** 8472 High Partial Credit • Finds 60.06 **AND** 8472
(d) (ii)	$60.06 + 169.44 = €229.50$ $822.72 - 229.50 = €593.22$ $\therefore €593.22 = 4.5\%$ of income above $€20\,484$ $593.22 \div 4.5 \times 100 = €13\,182.67$ $13\,182.67 + 20\,484 = €33\,666.67$	**Scale 10D (0,3,5,8,10)** Low Partial Credit • Work of merit, for example 60.06 or 169.44 or 229.50 Mid Partial Credit • Finds 593.22 High Partial Credit • Finds 13182.67

Q10	Model Solution – 50 Marks	Marking Notes
(a)	$11:30$	**Scale 5B (0,2,5)** Partial Credit • Indication on the graph
(b)	Before the break: $S = \frac{D}{T} = \frac{24}{1.5} = 16$ km/hr	**Scale 10C (0,3,7,10)** Low Partial Credit • Work of merit, for example Formula written High Partial Credit • Formula fully substituted
(c) **(i)**		**Scale 10C (0,3,7,10)** Low Partial Credit • Any use of 12:00 or any straight line drawn High Partial Credit • Indicates point of intersection
(c) **(ii)**	$S = \frac{D}{T} = \frac{48}{2} = 24$ km/hr	**Scale 5B (0,2,5)** Partial Credit • Work of merit, for example, formula written
(d) **(i)**		**Scale 5B (0,2,5)** Partial Credit • One correct point plotted
(d) **(ii)**	Approx $13:05$	**Scale 5B (0,2,5)** Partial Credit • Some indication on the graph (tolerance: 13:00 – 13:20)
(e)	$S = \frac{D}{T} = \frac{64}{5} = 12.8$ km/hr $\therefore$ distance from $P = 64 - 12.8t$	**Scale 5B (0,2,5)** Partial Credit • Correct formula written • 12.8

Q10	Model Solution – 50 Marks	Marking Notes
(f)	$d'(t) = 18t^2 - 24t + 40$ $d'(0.5) = 18(0.5)^2 - 24(0.5) + 40$ $= 32.5$ km/hr	**Scale 5C (0,2,3,5)** Low Partial Credit • Work of merit, for example one correct term differentiated High Partial Credit • Fully correct differentiation

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Paper 2

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- 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.

Palette of annotations available to examiners

Symbol	Name	Meaning in the body of the work	Meaning when used in the right margin
✓	Tick	Work of relevance	The work presented in the body of the script merits full credit
✗	Cross	Incorrect work (distinct from an error)	The work presented in the body of the script merits 0 credit
*	Star	Rounding / Unit / Arithmetic error Misreading	
~~	Horizontal wavy	Error	
✓l	Tick L		The work presented in the body of the script merits low partial credit
✓m	Tick M		The work presented in the body of the script merits mid partial credit (or partial credit)
✓h	Tick H		The work presented in the body of the script merits high partial credit
F*	F star		The work presented in the body of the script merits Full Credit (– 1)
[	Left Bracket		Another version of this solution is presented elsewhere and it merits equal or higher credit
≀	Vertical wavy	No work on this page (portion of the page)	
o	Oversimplify	The candidate has oversimplified the work	

Note: Where work of substance is presented in the body of the script, the annotation on the right margin should reflect a combination of annotations in the work

In a **C scale** where * and ~~~ and ~~~ appear in the body of the work, then ✓l should be placed in the right margin.

In the case of a **D scale** with the same annotations, ✓m should be placed in the right margin.

A ✓ in the body of the work may sometimes be used to indicate where a portion of the work presented has value and has merited one of the levels of credit described in the marking scheme. The level of credit is then indicated in the right margin.

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)	A: $(12,0)$ B: $(0,5)$	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit:* • Work of Merit e.g. Writes $x = 0$ or $y = 0$ • One correct coordinate in wrong bracket *High Partial Credit:* • One correct set of coordinates • Both written as (y, x) *Full Credit:* • Correct answers without supporting work
(b)	$\text{Area} = \frac{1}{2}(12)(5) = 30$ [square units] Or (0,5) → (0,0) (12,5) → (12,0) (12,0) → (12,-5) $\text{Area} = \frac{1}{2}\lvert x_1y_2 - x_2y_1\rvert$ $= \frac{1}{2}\lvert 12(-5) - 12(0)\rvert$ $= \frac{1}{2}\lvert 60\rvert$ $= 30$[square units]	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of Merit e.g. Correct relevant formula written or correct translation *High Partial Credit:* • Fully correct substitution into a correct relevant formula • No translation and finishes correctly • Works area of rectangle OAPB • Correct answer without supporting work. *Full Credit (-1)* Finds area of $\lvert\Delta AOB\rvert$

Q1	Model Solution – 30 Marks	Marking Notes
(c)	$Length = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ $\|AB\| = \sqrt{(0-12)^2 + (5-0)^2}$ $= \sqrt{169}$ $= 13$ Or $a^2 + b^2 = c^2$ $5^5 + 12^2 = 169$ $\|AB\| = 13$	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit:* • Work of Merit e.g. Distance formula or Pythagoras Theorem with no substitution *High Partial Credit:* • Relevant formula correctly substituted • Answer in surd form • Correct answer without supporting work
(d)	Area $= \frac{1}{2}\|AB\| \times h$ $30 = \frac{1}{2}(13) \times h$ $30 = 6{\cdot}5\,h$ $h = 4{\cdot}615384$ $h = 4 \cdot 62$ [units]	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of Merit e.g. Line drawn joining P to the line AB. • Relevant formula written *High Partial Credit:* • Equation correctly substituted • One incorrect substitution followed by a consistent solution. • Correct answer without supporting work *Full Credit (-1)* • Correct answer, incorrect rounding

Q2	Model Solution – 30 Marks	Marking Notes
(a)	$3^2 + h^2 = 5^2$ $9 + h^2 = 25$ $h^2 = 25$ $h = 4\text{cm}$ $\therefore \text{Area} = 9 \times 4 = 36\ \text{cm}^2$	**Scale 15D (0, 4, 8, 12, 15)** *Low Partial Credit:* • Work of merit Correct relevant formula e.g. Writes Pythagoras's Theorem *Mid Partial Credit:* • Pythagoras's formula fully substituted • Correctly modifies diagram to equivalent rectangle *High Partial Credit:* • $\text{h} = 4$ *Full Credit (-1)* • Correct answer, no units *Full Credit:* • Correct answers without supporting work
(b)	$\text{Area} = \frac{h}{2}\{y_1 + y_n + 2(y_2 + y_3 \ldots + y_{n-1}\}$ $= \frac{1}{2}[0 + 6 + 2(2 + 4 + 6 + 6 + 6 + 6)]$ $= \frac{1}{2}[6 + 2(30)]$ $= \frac{1}{2}[66]$ $= 33\ \text{cm}^2$	**Scale 15D (0, 4, 8, 12, 15)** *Low Partial Credit:* • Work of merit e.g. Writes Trapezoidal Rule, or identifies a correct height • Identifies $h = 1$ *Mid Partial Credit:* • Some correct substitution into the Trapezoidal Rule Formula • Correct answer found using area of triangle and rectangle *High Partial Credit:* • Fully correct substitution into the Trapezoidal Rule Formula • One incorrect substitution followed by a consistent solution.

Q3	Model Solution – 30 Marks	Marking Notes
(a) (i)	$(3)^2 + (-1)^2 = 10$ $9 + 1 = 10$ $10 = 10$ [$\therefore$ $(3, -1)$ is on the circle] **Or** Line joining $(0, 0)$ to $(3, -1)$ equals Radius Lenght $= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ $= \sqrt{(3-0)^2 + (-1-0)^2}$ $= \sqrt{(3)^2 + (-1)^2}$ $= \sqrt{9+1}$ $= \sqrt{10}$ $=$ Radius	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit:* • Relevant formula written • Centre and/or radius written *High Partial Credit* • Fully correct substitution into a correct relevant formula • Incorrect or no conclusion given
(a) (ii)	Slope of radius $= \frac{-1-0}{3-0}$ $= -\frac{1}{3}$ $\therefore$ slope of the tangent $= 3$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit. e.g. Relevant formula written • $m_1 \times m_2 = -1$ written • Relevant diagram drawn with tangent • Centre written *High Partial Credit:* • Calculates slope of radius

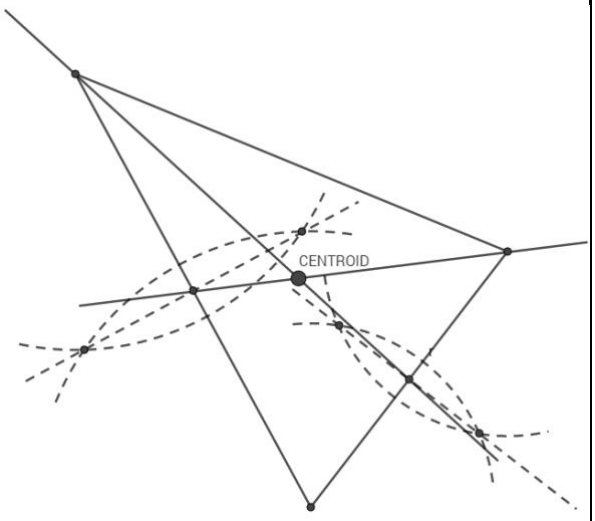
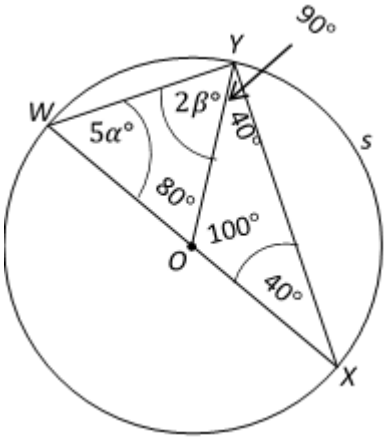
Q3	Model Solution – 30 Marks	Marking Notes
(b) (i)	Centre : $(-2, 2)$ Radius $= 2$ $\big(x-(-2)\big)^2 + (y-2)^2 = 2^2$ $(x+2)^2 + (y-2)^2 = 4$	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit:* • Identifies centre and/or radius • Formula substituted with either centre or radius • Relevant formula written. *High Partial Credit:* • Formula substituted with both centre and radius • One error in substitution and finished correctly *Full Credit:* • Correct answer without work
(b) (ii)	Radius $= \sqrt{(0+2)^2 + (0-2)^2}$ $= \sqrt{8}$ Centre: $(-2, 2)$ $\big(x-(-2)\big)^2 + (y-2)^2 = \big(\sqrt{8}\big)^2$ $(x+2)^2 + (y-2)^2 = 8$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Relevant circle drawn on diagram • Calculates length of radius • Relevant formula written • Identifies Centre *High Partial Credit:* • Circle formula substituted with both centre and radius • One error in substitution and finished correctly

Q4	Model Solution – 30 Marks	Marking Notes
(a)	20	**Scale 10B (0, 5, 10)** *Partial Credit:* • Work of merit e.g. Attempt at counting entries *Full Credit:* • Correct answer without supporting work
(b)	Range $= 161 - 135$ $= 26$ cm	**Scale 5B (0, 3, 5)** *Partial Credit:* • Maximum or Minimum values identified *Full Credit (-1)* • Correct answer, no units *Full Credit:* • Correct answer without supporting work
(c)	$Q_1 = 144{\cdot}5$ $Q_3 = 155{\cdot}5$ $\therefore IQR = 11$ **Or** $Q_1 = 143$ $Q_3 = 155$ $\therefore IQR = 12$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit e.g. Calculates Median • Identifies Q_1 *or* Q_3 *High Partial Credit:* • Identifies Q_1 *and* Q_3 *Full Credit* • Correct answer without supporting work

Q4	Model Solution – 30 Marks	Marking Notes
(d)	$\frac{\sum x}{n} = \text{mean}$ $\frac{\text{Sum}}{20} = 149{\cdot}5$ $\text{Sum} = 149{\cdot}5 \times 20$ $\text{Sum} = 2990 \text{ cm}$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit: e.g. Relevant formula written *High Partial Credit:* • Formula fully substituted *Full Credit (-1)* • Correct answer, no units evaluated *Full Credit:* • Correct answer without supporting work
(e)	149.5 ± 7.3 $142.2 \leftrightarrow 156.8$ $\frac{13}{20} = 65\%$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • Work of merit e.g. $\bar{x}=149{\cdot}5$, $\sigma=7{\cdot}3$ • One correct boundary indicated e.g. $142 \cdot 2$ or $156 \cdot 8$ *High Partial Credit* • Both boundaries indicated e.g. $142 \cdot 2$ and $156 \cdot 8$ *Full Credit:* • Correct answer without supporting work

Q5	Model Solution – 30 Marks	Marking Notes
(a)	$$P(win) = \frac{1}{3}$$	**Scale 10B (0, 5, 10)** *Partial Credit:* • Work of merit • Correct numerator or denominator • Identifies Sample space as $\mathrm{L}, \mathrm{L}, \mathrm{S},$ *Full Credit:* • Correct answer without supporting work
(b) (i) + (ii)	(i) No win $\rightarrow$ $L\ L\ L$ $$P(loses\ all\ three) = \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3}$$ $$= \frac{8}{27}$$ (ii) Wins first two and loses third $\rightarrow$ $W\ W\ L$ $$P(W, W, L) = \frac{1}{3} \times \frac{1}{3} \times \frac{2}{3}$$ $$= \frac{2}{27}$$	**Scale 10D (0, 3, 5, 8, 10))** *Low Partial Credit:* • $P(W) = \frac{1}{3}$ or $P(L) = \frac{2}{3}$ • L L L written in (i) • L L L $= \frac{1}{8}$ or consistent in (i) • Correct numerator or denominator • Possible outcome(s) listed in (ii) *Mid Partial Credit:* • Work of merit in Part (i) and (ii) • $P(W, W, W) = \frac{1}{3} \times \frac{1}{3} \times \frac{1}{3} = \frac{1}{27}$ in (i) *High Partial Credit:* • Part(i) or (ii) correct • Correct solutions indicated but not calculated • Part (i) correct and work of merit in (ii) or visa versa *Full Credit (-1):* • Incorrect order in (ii) *Full Credit:* • Correct answers without supporting work

Q5	Model Solution – 30 Marks	Marking Notes
(c)	Wins first time on fifth game $\rightarrow$ $L\ L\ L\ L\ W$ $= L\ L\ L\ L\ W$ $= \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} \times \frac{1}{3}$ $= \frac{16}{243}$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* Work of merit. • $\mathrm{P(W)} = \frac{1}{3}$ or $\mathrm{P(L)} = \frac{2}{3}$ *High Partial Credit:* Further work • $\frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} \times \frac{1}{3}$ and stops • Incorrect operation *Full Credit (–1):* Answer as $\frac{1}{3} \times \frac{1}{3} \times \frac{1}{3} \times \frac{1}{3} \times \frac{2}{3}$ and continues correctly *Full Credit:* • Correct answer without supporting work.
(d)	3 possible outcomes with same result $W\ \ L\ \ L \rightarrow €6$ $L\ \ W\ \ L \rightarrow €6$ $L\ \ L\ \ W \rightarrow €6$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* Work of merit • $e.g.\ W, L, L,$ arranged in any way *High Partial Credit:* • W, L, L, and L, W, L and L, L, W with further work *Full Credit:* • Correct answer without supporting work.

Q6	Model Solution – 30 Marks	Marking Notes
(a)		**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* • Effort at bisecting a side • Line drawn from vertex to opposite side • Midpoint indicated *Mid Partial Credit:* • One midpoint constructed correctly • One median line drawn *High Partial Credit:* • Two midpoints correctly found • One median line constructed correctly • Circumcentre identified **Note:** No construction lines award Mid Partial Credit at most
(b) (i)	[WX] is a diameter of the circle (*s*). $\lvert< WYX\rvert = 90°$ since each angle standing on a diameter (or in a semi-circle) is $90°$.	**Scale 5B (0, 3, 5)** *Partial Credit:* Mentions [WX] is a diameter or equivalent
(b) (ii)	 $5\alpha = 50^{\circ}$ $2\beta = 50^{\circ}$ giving $\alpha = 10^{\circ}$ $\beta = 25^{\circ}$	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* • Identifies any one correct geometrical property *Mid-Partial Credit:* • Writes a correct relationship for either α *or* β *High Partial Credit:* • α or β calculated • $5\alpha = 50^{\circ}$and $2\beta = 50^{\circ}$
(b) (iii)	Point O	**Scale 5A (0, 5)** • Hit or Miss

<table>
<tr><th>Q7</th><th>Model Solution – 50 Marks</th><th>Marking Notes</th></tr>
<tr><td>(a)
(i)</td><td>$\mathrm{P}(\mathrm{B_{T1}}\text{will not win a prize}) = 1{\cdot}0\text{-}0{\cdot}2$
$= 0{\cdot}8$</td><td>Scale 5B (0, 3, 5)
Partial Credit:
• Mentions total probability = 1
• Works with $1 -$ relevant decimal/fraction

Full Credit (–1):
$\mathrm{P}(\mathrm{B_{T2}}$ will not win a prize)
$=1{\cdot}0\text{-}0{\cdot}25$
$=0{\cdot}75$
(Accept without work)

Full Credit:
• Correct answer without supporting work.</td></tr>
<tr><td>(a)
(ii)</td><td>
<table>
<tr><th></th><th>Ann</th><th>Billy</th><th>Neither</th></tr>
<tr><td>Task 1</td><td>0·5</td><td>0·2</td><td>0·3</td></tr>
<tr><td>Task 2</td><td>0·1</td><td>0·25</td><td>0·65</td></tr>
</table>
$\mathrm{P_{Task\,1}}(\mathrm{A\ or\ B}) = 0{\cdot}5 + 0{\cdot}2 = 0{\cdot}7$
$\Longrightarrow \mathrm{P_{Task\,1}}(\overline{\mathrm{A\ or\ B}}) = 1{\cdot}0\text{-}0{\cdot}7 = 0{\cdot}3$

$\mathrm{P_{Task\,2}}(\mathrm{A\ or\ B}) = 0{\cdot}1 + 0{\cdot}25 = 0{\cdot}35$
$\Longrightarrow \mathrm{P_{Task\,2}}(\overline{\mathrm{A\ or\ B}}) = 1{\cdot}0\text{-}0{\cdot}35 = 0{\cdot}65$</td><td>Scale 5C (0, 2, 3, 5)

Zero Credit:
• Probability greater than 1
Low partial Credit:
• Relevant decimals with addition indicated
• Mention of $\mathrm{P(not\ event)} = 1\text{-}\mathrm{P(event)}$
• $0{\cdot}7$ or $0{\cdot}35$

High Partial Credit:
• One correct answer written
• Two correct answers indicated but not calculated
• $0{\cdot}7$ and $0{\cdot}35$

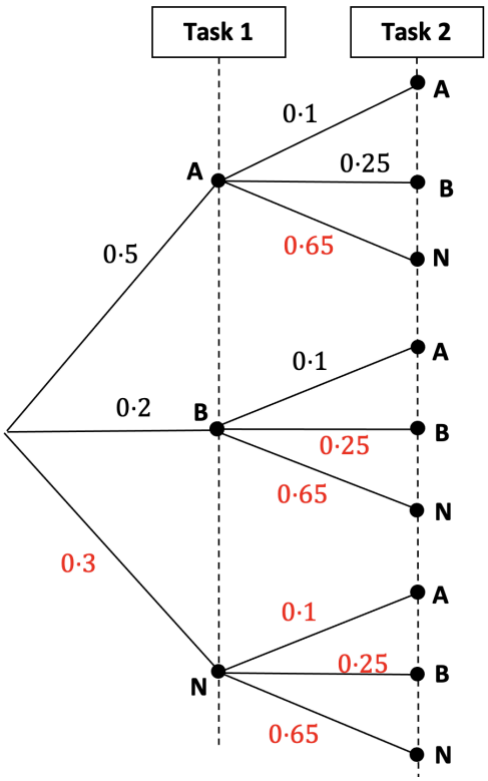
Full Credit:
• Correct answers without work</td></tr>
</table>

Q7	Model Solution – 50 Marks	Marking Notes
(a) (iii) + (iv)	(iii) Outcome (iv) Probability	**Scale 15D (0, 4, 8, 12, 15)**

(A, A)	0·05
(A, B)	0·125
(A, N)	0·325

(B, A)	0·02
(B, B)	0·05
(B, N)	0·13

(N, A)	0·03
(N, B)	0·075
(N, N)	0·195



Low Partial Credit:
- Any one correct outcome.
- Indication of multiplication
- Any correct entry in the Tree Diagram

Mid Partial Credit:
- 6 correct values

High Partial Credit:
- Greater than 6 correct values

Full Credit (–1)
- 11 correct values

<table>
<tr><th>Q7</th><th>Model Solution – 50 Marks</th><th>Marking Notes</th></tr>
<tr><td>(a)
(v)</td><td>$$P(AB \text{ or } BA) = 0{\cdot}125+0{\cdot}02$$
$$= \frac{29}{200}$$
$$= 0{\cdot}145$$</td><td>Scale 5C (0, 2, 3, 5)
Low Partial Credit:
• Relevant outcome(s) written
• One relevant probability written

High Partial Credit:
• Correct answer indicated but not calculated
• Both relevant probabilities identified</td></tr>
<tr><td>(b)
(i)</td><td>
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><th>1</th><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><th>2</th><td>2</td><td>4</td><td>6</td><td>8</td></tr>
<tr><th>3</th><td>3</td><td>6</td><td>9</td><td>12</td></tr>
<tr><th>4</th><td>4</td><td>8</td><td>12</td><td>16</td></tr>
</table>
</td><td>Scale 10D (0, 3, 5, 8, 10)

Low Partial Credit
• 1 correct value

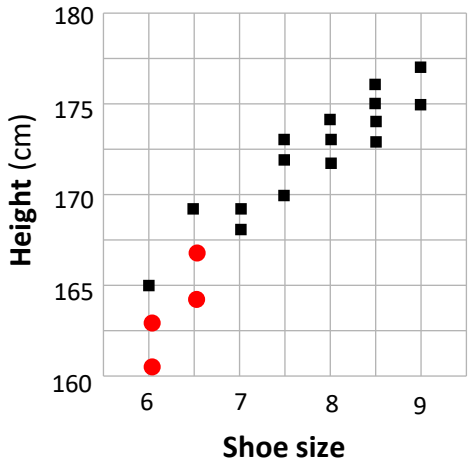
Mid Partial Credit
• 4 correct values

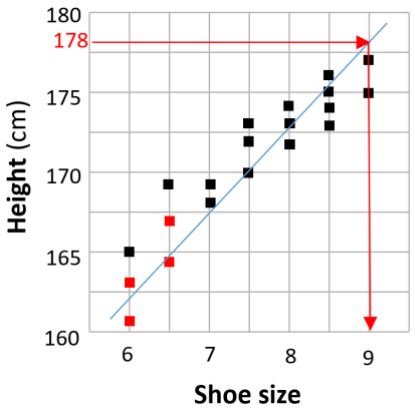
High Partial Credit
• 12 correct values</td></tr>
<tr><td>(b)
(ii)</td><td>Answer: Game is not fair
Justification:
P(Eric wins)$= \frac{10}{16} = \frac{5}{8}$
P(Chidalu wins)$= \frac{6}{16} = \frac{3}{8}$
P(Eric) $>$ P(Chidalu), therefore the game is not fair.</td><td>Scale 5C (0, 2, 3, 5)
Low Partial Credit:
• Any relevant outcome written
• Any relevant probability written
• Correct answer without a reason or with an incorrect reason

High Partial Credit:
• Correct answer indicated but not calculated
• Relevant probabilities identified but no conclusion</td></tr>
</table>

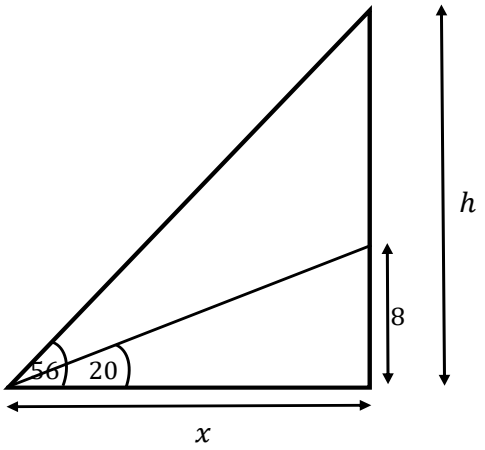
Q7	Model Solution – 50 Marks	Marking Notes
(b) (iii)	$$P(Result) = P(4)\ and\ P(3)\ and\ P(16)$$ $$= \frac{3}{16} \times \frac{2}{16} \times \frac{1}{16}$$ $$= 0{\cdot}0015$$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Any relevant probability written • One correct numerator or denominator *High Partial Credit:* • Correct answer indicated but not calculated • Incorrect or no operator used *Full Credit(–1)* • Incorrect rounding • Incorrect order

Q8	Model Solution – 50 Marks	Marking Notes
(a) (i)	$\frac{1}{\sqrt{n}} = \frac{1}{\sqrt{625}} = 0{\cdot}04 = 4\%$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Identifies $n=625$ *High Partial Credit:* • Answer as $\frac{1}{\sqrt{625}}$ or $0{\cdot}04$ *Full Credit:* • Correct answer without supporting work.
(a) (ii)	$\hat{\boldsymbol{p}} = \frac{\mathbf{230}}{\mathbf{625}} = \mathbf{36{\cdot}8}\%$ 95% confidence interval $= \left[\hat{p} - \frac{1}{\sqrt{n}} \ , \quad \hat{p} + \frac{1}{\sqrt{n}}\right]$ $= [36{\cdot}8\% - 4\% \ , 36{\cdot}8\% + 4\% \ ]$ $= [32{\cdot}8\% \ , \ 40{\cdot}8\%]$ Or $= \left(\frac{230}{625} - \frac{1}{25}\right), \left(\frac{230}{625} + \frac{1}{25}\right)$ $= \frac{41}{125}, \frac{51}{125}$ $(95\%$ C. I.$)\ 32{\cdot}8\% \leq \mu \leq 40{\cdot}8\%$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit • Works correctly with margin of error from (a)(i) • $\hat{p} = \frac{230}{625}$. • $\hat{p} \ \pm \frac{1}{\sqrt{n}}$. *High Partial Credit:* • One boundary formed: $(36{\cdot}8\% - 4\% \ \ or \ \ 36{\cdot}8\% + 4\%)$ • Correct answer without supporting work. *Full Credit(–1)* • Answers in decimal or fraction form **Note:** Accept use of version of formula from HL. $(33{\cdot}0 \ < \ \mu \ < \ 40{\cdot}6)$

Q8	Model Solution – 50 Marks	Marking Notes
(a) (iii)	$[\mathrm{H}_0 = 34\%]$ $[H_A \neq 34\%]$ **Conclusion:** Fail to reject the claim. Conclude that the figure of 34% has not changed. **Reason**: The figure 34% falls within the 95% C.I.	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • Work of merit • Either lower **or** upper boundary as $32{\cdot}8$ **or** $40{\cdot}8$ used from (ii) above • Conclusion without reason correct. • Reason without interpretation *High Partial Credit* • Either part correct **and** partial work in the remaining part. **Note:** Part (iii) cannot be fully correct unless some interval in part (ii) is given
(b) (i)		**Scale 10C (0, 3, 7, 10)** *Low Partial Credit:* One point plotted correctly *High Partial Credit:* More than one point plotted correctly **Tolerance:** Point plotted in the correct row on the vertical line
(b) (ii)	There is a strong positive correlation between shoe size and height indicating that as the boys' heights increase their shoe sizes tend to increase.	**Scale 5B (0, 3, 5)** *Partial Credit:* • Mentions points are increasing • Mentions height or shoe size increases • Mentions positive slope

Q8	Model Solution – 50 Marks	Marking Notes
(b) (iii)	1 ✓	**Scale 5B (0, 3, 5)** *Partial Credit:* • 0·5 ticked *Full Credit:* • Correct box ticked *Zero Credit:* • All other Answers
(b) (iv)	$\text{Mean} = \frac{\sum_1^{20} \text{Height Data}}{20}$ $= \frac{3410}{20}$ $= 170{\cdot}5 \text{ cm}$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Effort at adding data. • Division by 20. • Correct relevant formula *High Partial Credit:* • Formula fully substituted without calculation. • Correct Addition (Ans = 3410) *Full Credit (-1)* • Correct answer, no units *Full Credit:* • Correct answer without work.
(b) (v)	Approx size $9\text{-}9\frac{1}{2}$  	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit • Identifies 178 on the scatter plot. *High Partial Credit:* • Draws a best fit line on the scatter plot. *Full Credit (-1):* • Correct answer without work.

Q8	Model Solution – 50 Marks	Marking Notes
(b) (vi)	Answer as **Mean**. Justification: The Median doesn't change at all (172 cm) Arranging the heights in order with 21 elements still retains (172 cm) at the centre. Whereas: The mean will increase since the sum of 21 elements is greater and dividing by 21 will still produce a larger value than previously so.	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Correct answer with incorrect or no justification • Work of merit in Justification e.g. One relevant statement, or calculation considering the added value *High Partial Credit:* • **Mean** given as correct answer **and** work of merit in the justification • Justification that would fully support correct answer, but answer incorrect or not given

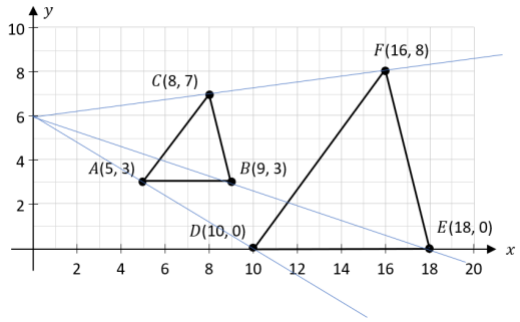
Q9	Model Solution – 50 Marks	Marking Notes
(a)	 Find:x $$\tan 20° = \frac{8}{x}$$ $$x = \frac{8}{\tan 20°}$$ $$x = 21{\cdot}9798$$ $$x = 22{\cdot}0 \text{ [m]}$$ Find:h $$\tan 56° = \frac{h}{22}$$ $$h = 22 \tan 56°$$ $$h = 32{\cdot}6 \text{ [m]}$$	**Scale 15D (0, 4, 8, 12, 15)** *Low Partial Credit:* • Work of merit • Relevant triangle drawn with values added • Relevant formula *Mid Partial Credit:* • Establishes correct equation for x *or* h *High Partial Credit:* • Calculates the length of the base (x) • Formula to find height (h)substituted correctly. *Full Credit (-1):* • Incorrect rounding. **Note:** Incorrect calculator mode (apply once in entire paper). For x : **Rad: 3·6** **Grad: 24·6** For h : **Rad: (-) 2·2** **Grad: 29·7**

Q9	Model Solution – 50 Marks	Marking Notes
(b)	$\text{P.E.} = \frac{\text{Error}}{\text{True Value}} \times 100$ $P.E. = \frac{34 - 32{\cdot}6}{34} \times 100$ $P.E. = \frac{1{\cdot}4}{34} \times 100$ $P.E. = 4{\cdot}1176$ $P.E. = 4[\%]$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Relevant subtraction indicated or calculated • Indicates $\times 100$ • Relevant formula written • Correct answer without work *High Partial Credit:* • % error formula substituted correctly • Incorrect denominator used and finished correctly
(c) (i)	**Height**: $\text{Scale Model} = 1{\cdot}7 \text{ m}$ $\text{Actual Height} = 34 \text{ m}$ $\text{Scale factor} = \frac{34}{1{\cdot}7}$ $= 20$ **Diameter**: $\text{Scale Model Diameter} = 0{\cdot}28 \text{ m}$ $\text{Actual Diameter} = 0{\cdot}28 \times 20$ $= 5{\cdot}6 \text{ [m]}$ **Or** $1{\cdot}7 \equiv 34$ $0{\cdot}28 \equiv ?$ $? \text{ (Actual Diameter)} = \frac{(34)(0{\cdot}28)}{1{\cdot}7}$ $\text{Actual Diameter} = 5{\cdot}6[\text{m}]$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit. • Correct ratio identified • Indicates $\frac{34}{1{\cdot}7}$ or similar *High Partial Credit:* • Finds Scale factor • Answer as 28×20

Q9	Model Solution – 50 Marks	Marking Notes
(c) (ii)	$C.S.A. = 2\pi rh$ $= 2\pi(14)(170)$ $= 14953{\cdot}98103$ $= 14{,}954\ [\text{cm}^2]$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit • Relevant formula written *High Partial Credit:* • Finds circumference • Fully correctly-substituted C.S.A. formula
(c) (iii)	$a = 170$ cm or $1{\cdot}7$m $170(b-3) = 14\,954$ $170b - 510 = 14\,954$ $170b = 15\,464$ $b = 90{\cdot}96$ $b = 91\ [\text{cm}]$ Or Area of Cardboard: $= 14954 + (3 \times 170)$ $= 14954 + 510$ $= 15464$ $b \times 170 = 15464$ $b = 90{\cdot}96$ $b = 91\ [\text{cm}]$	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit* • Work of merit e.g. Indicates a valid area • One correct dimension indicated e.g. $a = 170$ cm *High Partial Credit* • Equation relating S.A. to dimension b formed correctly. i.e. $170(b-3) = 14\,954$

Q9	Model Solution – 50 Marks	Marking Notes
(d)	$l^2 = 14^2 + 22^2$ $l = \sqrt{14^2 + 22^2}$ $= 2\sqrt{170}$ $= 26{\cdot}1 \text{ cm}$ $C.S.A. = \pi rl$ $= \pi(14)(26{\cdot}1)$ $= 1147{\cdot}9 \text{ cm}^2$	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit* • Work of merit • Relevant formula written • One correct substitution indicated e.g. $r = 14$ *High Partial Credit* • l calculated correctly • $C.S.A. = \pi(14)(26{\cdot}1)$ • Work of merit in both parts *Full Credit (-1)* • Correct answer, no units • Not rounding as required

Q10	Model Solution – 50 Marks	Marking Notes
(a) (i)	$$m_{AC} = \frac{7-3}{8-5} = \frac{4}{3}$$ $$m_{DF} = \frac{8-0}{16-10} = \frac{8}{6} = \frac{4}{3}$$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit e.g. slope formula written down *High Partial Credit:* • Correct formula, with fully correct substitution or gets slope of AC or DF
(a) (ii)	$m_{AC} = m_{DF}$ Therefore they are parallel lines.	**Scale 5B (0, 3, 5)** *Partial Credit:* • Mentions that the slopes are equal with no inference
(b)	$\lvert DE\rvert = 8$ $\lvert AB\rvert = 4$ $\frac{\lvert DE\rvert}{\lvert AB\rvert} = \frac{8}{4}$ $\therefore k = 2$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit e.g. Relevant formula written • Length |DE| or |AB| found *High Partial Credit:* • Corresponding lengths or areas calculated *Full Credit:* • Correct answer without supporting work
(c)	$\text{Image area} = k^2 \times (\text{Object area})$ $\lvert\Delta DEF\rvert = 2^2 \times 8$ $\lvert\Delta DEF\rvert = 32$ [square units] **Or** $\frac{1}{2}(8)(8) = 32$ [square units]	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit e.g. Relevant formula written *High Partial Credit:* • Fully correct substituted formula *Full Credit:* • Correct answer without supporting work

Q10	Model Solution – 50 Marks	Marking Notes
(d)	$$m_{BE} = \frac{0-3}{18-9} = \frac{-3}{9} = -\frac{1}{3}$$ $$y - 0 = -\frac{1}{3}(x - 18)$$ $$y = -\frac{1}{3}x + 6$$	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit:* • Relevant formula written *High Partial Credit:* • m_{BE} correct • Formula substituted correctly or consistently • One incorrect substitution and finishes correctly *Full Credit(-1)* • Answer not in the required format
(e) **(i)**	$$\text{Centre of enlargement} = (0,6)$$ 	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit One correct construction line drawn *High Partial Credit:* • Construction lines drawn but centre of enlargement not established
(e) **(ii)**	From earlier: $$y = -\frac{1}{3}x + 6$$ and $\text{Centre of enlargement} = (0,6)$ $$6 = -\frac{1}{3}(0) + 6$$ $$6 = 6$$ [Centre of enlargement lies on line BE]	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit One correct substitution into equation of line • Any valid method of verification *High Partial Credit:* • Fully correct substitution into equation of line

Q10	Model Solution – 50 Marks	Marking Notes
(f)	$\lvert DE\rvert = 8$ $\lvert DF\rvert = 10(\text{Pythagoras})$ $\lvert EF\rvert = \sqrt{68}(\text{Pythagoras})$ $cos\angle DFE = \frac{10^2 + \left(\sqrt{68}\right)^2 - 8^2}{2(10)(\sqrt{68})}$ $\angle DFE = 50{\cdot}9^{\circ}$ Or $Tan\ \angle DFE = \left\lvert\frac{m_1 - m_2}{1 + m_1 m_2}\right\rvert$ $m_{DF} = \frac{4}{3}$ $m_{FE} = \frac{8-0}{16-18}$ $m_{FE} = -4$ $Tan\ \angle DFE = \left\lvert\frac{\frac{4}{3} - (-4)}{1 + \frac{4}{3}(-4)}\right\rvert$ $Tan\ \angle DFE = \left\lvert -\frac{16}{13}\right\rvert$ $\angle DFE = 50{\cdot}90614111$ $\angle DFE = 50{\cdot}9°$	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit:* • Relevant formula written *High Partial Credit:* • $\lvert DF\rvert$ or $\lvert EF\rvert$correct • $m_{DE}\ or\ m_{FE}\ correct$ • Formula substituted correctly or consistently • One incorrect substitution and finishes correctly *Full Credit (-1)* • Correct answer, incorrect rounding **Note:** Incorrect calculator mode (apply once in entire paper). For $Cos\angle DFE$: **Rad: 1·0** **Grad: 64·4** For $Tan\angle DFE$: **Rad: 0·9** **Grad: 56·6**