Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate 2017

Marking Scheme

Mathematics

Higher Level

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

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

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

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

Future Marking Schemes

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

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Paper 1

Structure of the marking scheme

Candidate responses are marked according to different scales, depending on the types of response anticipated. Scales labelled A divide candidate responses into two categories (correct and incorrect), scales labelled B divide responses into three categories (correct, partially correct, and incorrect), and so on. The scales and the marks that they generate on this examination paper 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, 5, 10	0, 5, 7, 10	0, 4, 6, 8, 10
15-mark scale		0, 8, 11, 15	0, 7, 9, 12, 15

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

Marking scales – level descriptors

A-scales (two categories)

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

B-scales (three categories)

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

C-scales (four categories)

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

D-scales (five categories)

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

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

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

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

Summary of mark allocations and scales to be applied

Question 1 (25)

(a)	15D
(b)	10C

Question 2 (20)

(a)	15D
(b)	5C

Question 3 (15)

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

Question 4 (15)

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

Question 5 (25)

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

Question 6 (35)

(a)	15C
(b)	5B
(c)	15D

Question 7 (5)

(a), (b)	5D

Question 8 (30)

(a), (b)	15D
(c)	5D
(d)	10D

Question 9 (25)

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

Question 10 (10)

(a)	5B
(b), (c)	5D

Question 11 (20)

(a)	10C
(b)	10C

Question 12 (35)

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

Question 13 (15)

15D

Question 14 (20)

(a), (c)	10D
(b)	5B
(d)	5B

Question 15 (5)

5B

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 – 25 Marks	Marking Notes
(a)	(i) BMI $= \frac{77{\cdot}5}{(1{\cdot}63)^2}$ $= 29{\cdot}169\ldots$ $= 29{\cdot}2$ [1 D.P.] (ii) w $=$ BMI $\times h^2$ $= 24 \times (1{\cdot}63)^2$ $= 63{\cdot}76\ldots$ $= 63{\cdot}8$ [kg] [1 D.P.]	**Scale 15D (0, 7, 9, 12, 15)** Accept correct answers without work. Accept correct answer without units in (ii). *Low Partial Credit* • Work of merit in one part, for example: some correct substitution into either (i) **or** (ii). *Mid Partial Credit* • (i) correct. • Work of merit in both (i) **and** (ii). *High Partial Credit* • Swaps 77·5 and 1·63 but finishes correctly. • (ii) correct. • (i) correct **and** work of merit in (ii). *Full Credit –1* • Apply a * to incorrect rounding the first time it occurs.
(b)	*Answer*: less than Jo's *Justification – accept*: Alex is dividing the same top line as Jo by a bigger number. **OR** $\frac{w}{(h+0{\cdot}10)^2} < \frac{w}{h^2}$ *or any valid justification*	**Scale 10C (0, 5, 7, 10)** *Low Partial Credit* • Correct answer. • Work of merit in justification, for example: attempts to substitute in particular values to check. *High Partial Credit* • Correct answer with work of merit in justification. • Justification fully correct. *Full Credit –1* • Apply a * if answer given as "Jo's BMI is greater than Alex's"

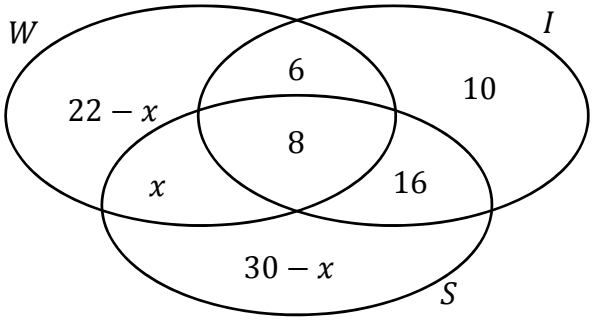
Q2	Model Solution – 20 Marks	Marking Notes
(a)	Profit $= 49 - 25 = €24$ (i) Mark up $= \frac{24}{25} \times 100 = 96\ [\%]$ (ii) Margin $= \frac{24}{49} \times 100$ $= 48{\cdot}9\ldots$ $=49\ [\%]$ [nearest %]	**Scale 15D (0, 7, 9, 12, 15)** Accept correct answers without work. Accept correct answer without % sign (96 and 49). *Low Partial Credit* • Work of merit in either (i) **or** (ii), for example: $49 - 25$; or something $\times\ 100$. *Mid Partial Credit* • Work of merit in both (i) **and** (ii). • Either (i) **or** (ii) correct. *High Partial Credit* • One part correct **and** work of merit in the other. • Both correct as decimals rather than percentages ($0{\cdot}96$ and $0{\cdot}49$). • Calculates Margin in (i) and Mark up in (ii). *Full Credit –1* • Apply a * for incorrect rounding in (ii)
(b)	$\text{Markup} = 50\% = 0{\cdot}5 = \frac{\text{Profit}}{\text{Cost}}$ $\Rightarrow \quad \text{P} = 0{\cdot}5\text{C}$ $\Rightarrow \quad \text{Selling Price (S)} = \text{C} + \text{P} = 1{\cdot}5\text{C}$ $\Rightarrow \quad \text{Margin} = \frac{\text{P}}{\text{S}} = \frac{0{\cdot}5\text{C}}{1{\cdot}5\text{C}} = \frac{1}{3}$ $= 33[\%]$ [nearest %] **OR** $\frac{\frac{x}{2}}{x+\frac{x}{2}} \times 100 = \frac{1}{3} \times 100$ $= 33\frac{1}{3}$ $= 33[\%]$[nearest %]	**Scale 5C (0, 2, 3, 5)** Accept correct answer without work. Accept correct answer without % sign (33). Accept justification using particular values. *Low Partial Credit* • Makes relevant use of 50%, for example: 150%, or $1{\cdot}5$, or $C = 2P$. *High Partial Credit* • $\frac{1}{3}$, or 0·33, or $0 \cdot \dot{3}$ *Full Credit –1* • Apply a * for incorrect rounding, if not already applied in (a)(ii)

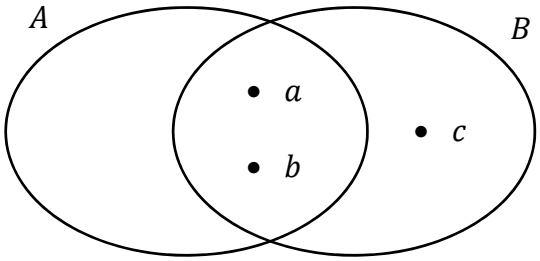
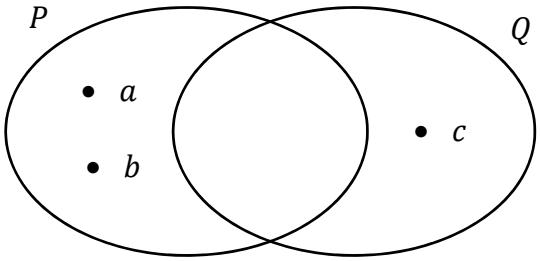
Q3	Model Solution – 15 Marks	Marking Notes
(a)	868 million $= 868 \times 10^6$ $= 8{\cdot}68 \times 10^2 \times 10^6$ $= 8{\cdot}68 \times 10^8$	**Scale 5C (0, 2, 3, 5)** Accept correct answer without work. *Low Partial Credit* • Some work of merit, for example: $1\,000\,000$, or $8{\cdot}68$. *High Partial Credit* • Correct value but not in correct form, for example: 868 000 000, or 868×10^6 • $8{\cdot}68 \times 10^2$ or $8{\cdot}68 \times 10^6$
(b), (c)	(b) $1{\cdot}3$ secs $\rightarrow 380\,000$ km 1 sec $\rightarrow \frac{380\,000}{1{\cdot}3}$ km 1 min $\rightarrow 60 \times \frac{380\,000}{1{\cdot}3}$ km $= 1{\cdot}75 \times 10^7$ [km/min] [2 D.P.] (c) $\frac{8{\cdot}68 \times 10^8}{1{\cdot}75 \times 10^7} = 49{\cdot}6$ [minutes]	**Scale 10D (0, 4, 6, 8, 10)** Accept correct answers without units. *Low Partial Credit* • Some relevant calculation in either (b) **or** (c). *Mid Partial Credit* • (b) **or** (c) correct • Some relevant calculation in both (b) **and** (c). *High Partial Credit* • One part correct **and** some relevant calculation in the other • Correct answers with no supporting work in (c) *Full Credit –1* • Apply a * for incorrect rounding in (b). • Apply a * in (c) if candidate uses values in (c) other than their answer from (b).

Q4	Model Solution – 15 Marks	Marking Notes
(a), (b)(i)	(a) $£0{\cdot}7241 = €1{\cdot}00$ $£1 = € \frac{1}{0{\cdot}7241}$ $£380 = € \frac{380}{0{\cdot}7241}$ $= €524{\cdot}789 \ldots$ $= [€]524{\cdot}79$ [2 D.P.] (b)(i) $3 + 7 = 10$ $\Rightarrow$ Juice in *Fruitex* $= \frac{3}{10} \times 20$ $= 6$ [litres]	**Scale 10D (0, 4, 6, 8, 10)** Accept correct answers without work. Accept correct answers without units. *Low Partial Credit* • Some relevant calculation in either (a) **or** (b). *Mid Partial Credit* • Either (a) **or** (b) correct. • Some relevant calculation in both (a) **and** (b). *High Partial Credit* • Either (a) or (b) correct, **and** some relevant calculation in the other part. *Full Credit –1* • Apply a * for incorrect rounding in (a). • Apply a * in (b)(i) if the amount of water is found (14 litres), or if 6 and 14 are found but answer is not identified.
(b)(ii)	$7 + 8 = 15$ $\Rightarrow$ Juice in mix $= \frac{7}{15} \times 60$ $= 28$ litres $\Rightarrow$ Juice in *Juicy* $= 28 - 6 = 22$ litres $\Rightarrow$ Water in *Juicy* $= 40 - 22 = 18$ litres $\Rightarrow$ Ratio of juice to water in *Juicy* $= 22:18$ $= 11:9$ **OR** $7:8 = 15$ [Ratio in mixture] $\Rightarrow$ $28:32 = 60$ [Litres in mixture] $-$ $\underline{6:14}$ [Litres in *Fruitex*] $=$ $22:18$ [Ratio in *Juicy*] $=$ $11:9.$ [Ratio in *Juicy*]	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • Work of merit using the correct ratio, for example: $7 + 8$ *High Partial Credit* • Finds 22 litres **or** 18 litres • Correct answer without work *Full Credit –1* • Apply a * for ratio not in simplest form.

Q5	Model Solution – 25 Marks	Marking Notes
(a), (b)	(a)(i) $20 + (5 \times 12) = [€]\ 80$ (a)(ii) $[€]\ 20 + 12n$ (b) $[€]\ 15 + 6n$	**Scale 15C (0, 8, 11, 15)** Accept correct answers without work. Accept correct answers without units. *Low Partial Credit* • Work of merit in one of the three parts, for example: in (a)(i): one relevant calculation; in (a)(ii): $7 + 12n$ (coefficient of n correct), or $20 + 9n$ (constant correct) *High Partial Credit* • Work of merit in (a)(ii) **and** (b) • (a)(ii) **or** (b) correct

Q5	Model Solution – 25 Marks	Marking Notes
(c)	**Interpretation 1**, **Method 1**: $\frac{1}{4}(12n+20)+\frac{2}{3}(6n+15)=200$ $3n+5+4n+10 = 200$ $7n+15 = 200$ $7n = 185$ $n = \frac{185}{7} = 26{\cdot}4\ldots$ i.e. 27 [weeks] **OR** **Interpretation 1, Method 2**: Pete: Starts with 5, plus 3 each week Maeve: Starts with 10, plus 4 each week In total: They start with 15, plus 7 each week $\frac{200-15}{7} = 26{\cdot}4\ldots$ i.e. 27 [weeks] **OR** **Interpretation 2, Method 1**: Pete: $\frac{1}{4}(12n+20) = 200$ $12n+20 = 800$ $n = 65$ [weeks] Maeve: $\frac{2}{3}(6n+15) = 200$ $12n+30 = 600$ $n = 47{\cdot}5$ i.e. 48 [weeks] **OR** **Interpretation 2, Method 2**: Pete: Starts with 5, plus 3 each week $\frac{200-5}{3} = 65$ [weeks] Maeve: Starts with 10, plus 4 each week $\frac{200-10}{4} = 47{\cdot}5$ i.e. 48 [weeks] **OR** **Either Interpretation, Method 3**: Solution via trial and improvement.	**Scale 10D (0, 4, 6, 8, 10)** Accept correct answer without units. Accept solution using interpretation 1 or interpretation 2. If using trial and improvement, must have supporting work to show that the given answer is the smallest number of weeks that is sufficient. Consider the solution as having 4 steps: **Step 1**: Sets up correct expression for either Pete **or** Maeve. **Step 2**: Sets up correct expressions for Pete **and** Maeve; **OR** Solves correctly for either Pete **or** Maeve. **Step 3**: Distributes the fractions correctly in equation(s). **Step 4**: Solves equation(s). *Low Partial Credit* • 1 step correct. • $12n+20+6n+15=200$ solved correctly. • $12n+20=200$ **and** $6n+15=200$ both solved correctly. *Mid Partial Credit* • 2 steps correct. *High Partial Credit* • 3 steps correct. • Correct answer, but without supporting work to show that it is the smallest number of weeks that is sufficient. *Full Credit –1* • Apply * for incorrect / no rounding. • Apply * if $\frac{1}{4}$ and $\frac{2}{3}$ swapped.

Q6	Model Solution – 35 Marks	Marking Notes
(a)		**Scale 15C (0, 8, 11, 15)** Accept correct answer without work. *Low Partial Credit* • 2 regions correct *High Partial Credit* • 4 regions correct, which must include one of W only or S only, in terms of x
(b)	$36 + 10 + 16 + (30 - x) = 80$ $92 - x = 80$ $x = 12$	**Scale 5B (0, 2, 5)** Accept correct answer without work. *Partial Credit* • Work of merit, for example: some relevant use of 80 or x, or solves an incorrect linear equation correctly
(c)	**S1**: 8 students have all 3 apps, *or equivalent* **S2**: $24 = \#(I \cap S)$ **S3**: 10 students have Instagram only, *or equivalent* **S4**: $\#S > \#W$	**Scale 15D (0, 7, 9, 12, 15)** *Low Partial Credit* • Work of merit in one of the four statements. *Mid Partial Credit* • 2 statements correct. *High Partial Credit* • 3 statements correct. *Full Credit –1* • Apply a * for a missing #, at most once.

Q7	Model Solution – 5 Marks	Marking Notes
(a), (b)	(a) *Any two sets A and B for which $A \subset B$, for example:* $A = \{1,2,3\};\ B = \{1,2,3\}$ **OR**  *or any other valid example* (b) *Any two sets P and Q for which $P \cap Q = \{\}$, for example:* $P = \{1,2,3,4\};\ Q = \{5,6,7,8\}$ **OR**  *or any other valid example*	**Scale 5D (0, 2, 3, 4, 5)** *Low Partial Credit* • Work of merit in either (a) **or** (b), for example: in (a), indication of a set fully inside a larger set; in (b), indication of mutually exclusive sets, or some explanation of what's left in P after taking away Q *Mid Partial Credit* • (a) **or** (b) correct. • Work of merit in both (a) **and** (b). *High Partial Credit* • (a) or (b) correct, **and** work of merit in the other part.

Q8	Model Solution – 30 Marks	Marking Notes
(a), (b)	(a) Answer: *Lecky* Reason: Cuts *y*-axis at $(0, 0)$ **OR** $b(x)$ starts at 50 *or any other valid reason* (b) Domain: $0 \leq x \leq 1000$ Range: $50 \leq l(x) \leq 325$	**Scale 15D (0, 7, 9, 12, 15)** Accept $0, 1000$ and $50, 325$ in (b) *Low Partial Credit* • Work of merit in either (a) **or** (b), for example: in (a), answer or reason correct; in (b), domain or range correct but in the wrong box; or a pair of values in either box with minimum or maximum correct. *Mid Partial Credit* • Work of merit in both (a) **and** (b) • Either (a) **or** (b) correct *High Partial Credit* • Either (a) or (b) correct, **and** work of merit in the other part. *Full Credit –1* • Apply a * to 275 given as the range in (b)
(c)	(i) $100 < x < 800$ **OR** "Between 100 and 800" **OR** $(100, 800)$ (ii) "*Buzz* is cheaper if the number of units used is between these two values." *or any other valid explanation*	**Scale 5D (0, 2, 3, 4, 5)** Accept tolerance of $\pm\mathbf{20}$ in (i) Note that answer to (i) must be in a valid form. *Low Partial Credit* • Work of merit in either (i) **or** (ii), for example: in (i), 100 or 800 identified on graph; or relevant region of graph identified; in (ii), explanation of some merit. *Mid Partial Credit* • Either (i) **or** (ii) correct. • Work of merit in both (i) **and** (ii). *High Partial Credit* • Either (i) or (ii) correct, **and** work of merit in the other part.

Q8	Model Solution – 30 Marks	Marking Notes
(d)	(i) Slope $= \frac{325-50}{1000-0}$ $= \frac{275}{1000}$ **or** $0{\cdot}275$ **or** $\frac{11}{40}$ (ii) "The cost of electricity rises by €$0{\cdot}275$ for every one unit increase of usage." *or any other valid explanation*	**Scale 10D (0, 4, 6, 8, 10)** Accept: "each unit costs €$\mathbf{0{\cdot}275}$", or equivalent, in (ii) *Low Partial Credit* • Work of merit in either (i) **or** (ii), for example: in (i), uses diagram to show understanding of slope; or $\frac{\text{Rise}}{\text{Run}}$ with some substitution; or $\frac{11}{20}$; in (ii), explanation of some merit. *Mid Partial Credit* • Either (i) **or** (ii) correct. • Work of merit in both (i) **and** (ii). *High Partial Credit* • Either (i) or (ii) correct, **and** work of merit in the other part.

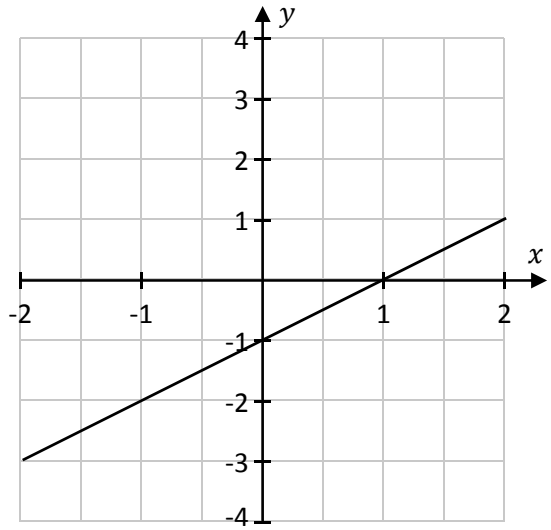
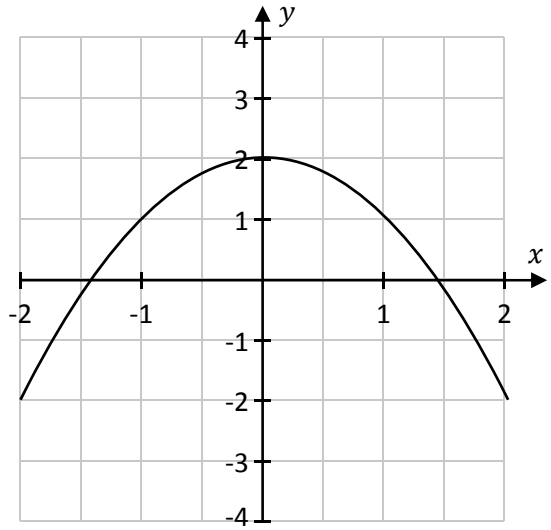
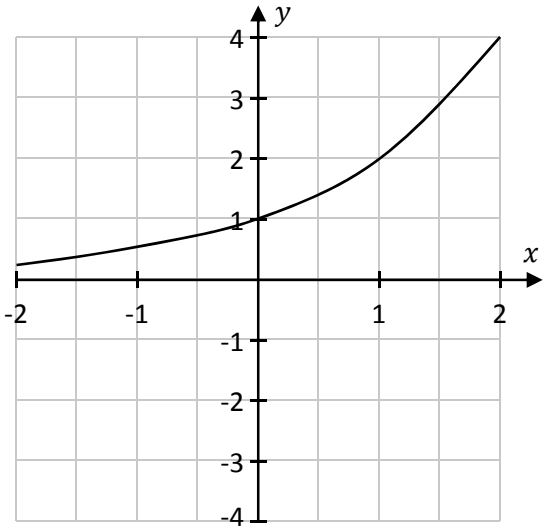
Q9	Model Solution – 25 Marks	Marking Notes
(a)	$x = \frac{-(-2)\pm\sqrt{(-2)^2-4(1)(-4)}}{2(1)}$ $x = \frac{2 \pm \sqrt{20}}{2}$ $x = 1 \pm \sqrt{5}$	**Scale 10C (0, 5, 7, 10)** Accept "$1+\sqrt{5}$ and $1-\sqrt{5}$". Consider the solution as having 3 steps: **Step 1**: Identifies a, or b, or c. **Step 2**: Full correct substitution into the quadratic formula. **Step 3**: Evaluates the quadratic formula. *Low Partial Credit* • 1 step *High Partial Credit* • 2 steps • Correct answer without work *Full Credit –1* • Apply a * for the correct answer not in surd form ($-1{\cdot}236$ … and $3{\cdot}236$ …)
(b)	$(c+\sqrt{d})^2$ $= (c+\sqrt{d}).(c+\sqrt{d})$ $= c^2 + c\sqrt{d} + c\sqrt{d} + (\sqrt{d})^2$ $= c^2 + 2c\sqrt{d} + d$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • $(c+\sqrt{d}).(c+\sqrt{d})$ • c^2 • $c\sqrt{d}$ *High Partial Credit* • $c^2 + c\sqrt{d} + c\sqrt{d} + (\sqrt{d})^2$
(c)	$\mathbb{N}$ $\mathbb{Z}$ $\mathbb{Q}$ $\mathbb{R}\setminus\mathbb{Q}$ 16 Yes Yes Yes No $\sqrt{6}$ No No No Yes $\frac{2}{3}$ No No Yes No -4 No Yes Yes No	**Scale 10D (0, 4, 6, 8, 10)** Note that 12 answers are required. *Low Partial Credit* • 4 answers correct *Mid Partial Credit* • 1 row or 1 column fully correct *High Partial Credit* • 2 rows or 2 columns fully correct

Q10	Model Solution – 10 Marks	Marking Notes
(a)	$2^{3+5+10} = 2^{18}$	**Scale 5B (0, 2, 5)** Accept correct answer without work. *No Credit* • Evaluates the given number. *Partial Credit* • Work of merit involving indices, for example: 18, 2^8, 2^{13}, 2^{15}
(b), (c)	(b) $8^{25} = (2^3)^{25} = 2^{75}$ (c) $\sqrt{8} = (2^3)^{\frac{1}{2}} = 2^{\frac{3}{2}}$ **or** $2^{1\cdot5}$	**Scale 5D (0, 2, 3, 4, 5)** Accept correct answer without work for both parts. *No Credit* • Evaluates the given number. *Low Partial Credit* • Work of merit in either (b) **or** (c) involving indices, for example: 8 written as 2^3 in (b) or (c); or a square root written as a power of $\frac{1}{2}$ in (c). *Mid Partial Credit* • Either (b) **or** (c) correct. • Work of merit in both (b) **and** (c). *High Partial Credit* • Either (b) or (c) correct, **and** work of merit in the other part.

Q11	Model Solution – 20 Marks	Marking Notes
(a)	$116 - 40 = 76$ $\frac{76}{4} = 19$ $40 - 19 = 21$ $40 + 19 = 59$, etc. Answer: 21, 40, 59, 78, 97, 116	**Scale 10C (0, 5, 7, 10)** Accept correct answer without work. *Low Partial Credit* • Applies knowledge of linear sequences, for example: $116 - 40$, or indicates a common difference. *High Partial Credit* • Finds or uses 19. • Uses $\frac{76}{n}$ (for $n \in \mathbb{N}, n \neq 4$) and finishes correctly from one of the given values.
(b)	1st differences: $1,\ 3,\ 5,\ 8,\ 8,\ 11$ 2nd differences: $2,\ 2,\ 3,\ 0,\ 3$ 1st differences should be: $1,\ 3,\ 5,\ 7,\ 9,\ 11$, i.e. 2nd difference of 2. Answer: $5,\ 6,\ 9,\ 14,\ 21,\ 30,\ 41$	**Scale 10C (0, 5, 7, 10)** Accept correct answer without work. Accept correct sequence not written in answer boxes. *Low Partial Credit* • Finds 2 first differences of given sequence. *High Partial Credit* • Finds all 2nd differences of given sequence. • Identifies 2 as the correct 2nd difference.

Q12	Model Solution – 35 Marks	Marking Notes
(a)	$(n-2)(n-9)$ **OR** n | -9 n | n^2 | $-9n$ -2 | $-2n$ | 18 so $(n-2)(n-9)$ **OR** $n^2-11n+18$ $=\ n^2-9n-2n+18$ $=\ n(n-9)-2(n-9)$ $=\ (n-9)(n-2)$	**Scale 5C (0, 2, 3, 5)** Accept correct answer without work. *Low Partial Credit* • Work of merit, for example: $(n-2)$ or $(n-9)$, or any pair of factors of 18, or $n^2-9n-2n+18$. • Some correct substitution into the quadratic formula *High Partial Credit* • Factors which multiply to give 2 correct coefficients of the given expression, including the signs, for example: $(n+2)(n+9)$, or $(n-5)(n-6)$. • $n(n-9)-2(n-9)$ • Solves $n^2-11n+18=0$ (without factorising).
(b)	$y(w-1)+1(w-1)$ $=\ (w-1)(y+1)$ or $(1-w)(-y-1)$ **OR** $w(y+1)-1(y+1)$ $=\ (y+1)(w-1)$ or $(1-w)(-y-1)$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • Work of merit, for example: a common factor identified from given expression *High Partial Credit* • $w(y+1)-1(y+1)$ • Correct answer without work
(c)	$\frac{5}{3(4)-2}-\frac{7}{6(4)-12}$ $=\ \frac{5}{10}-\frac{7}{12}$ $=\ -\frac{5}{60}=-\frac{1}{12}$ **or** $-0{\cdot}083\ldots$	**Scale 10B (0, 5, 10)** Accept correct answer without work *Partial Credit* • $3(4)-2$ or $6(4)-12$
(d)	$\frac{(2e-3)(2e+3)}{(2e-3)(e+3)}$ $=\ \frac{(2e+3)}{(e+3)}$	**Scale 5D (0, 2, 3, 4, 5)** *Low Partial Credit* • Work of merit in either numerator **or** denominator *Mid Partial Credit* • Numerator **or** denominator factorised correctly *High Partial Credit* • Numerator or denominator factorised correctly, **and** work of merit in the other

Q12	Model Solution – 35 Marks	Marking Notes
(e)	**Method 1**: $(x-3)(ax^2+bx+c)$ $= \quad ax^3+bx^2+cx-3ax^2-3bx-3c$ x^3 term: $a=2$ constant: $c=4$ x^2 term: $b-3a=-13$ $b=-13+3(2)=-7$ **OR** **Method 2**: $2x^2-7x \quad +4$ $x-3\overline{)2x^3-13x^2+25x-12}$ $\underline{2x^3-6x^2}$ $-7x^2+25x-12$ $\underline{-7x^2+21x}$ $4x-12$ $\underline{4x-12}$ 0 $\Rightarrow \quad a=2, b=-7, c=4$ **OR** **Method 3**: $\begin{array}{\|c\|c\|c\|c\|} \hline & 2x^2 & -7x & 4 \\ \hline x & 2x^3 & -7x^2 & 4x \\ \hline -3 & -6x^2 & 21x & -12 \\ \hline \end{array}$ $\Rightarrow \quad a=2, b=-7, c=4$	**Scale 10D (0, 4, 6, 8, 10)** Accept $2x^2-7x+4$ as answer. *Low Partial Credit* • Multiplication set up (Method 1) • Division set up (Method 2) • Array set up (Method 3) with either $2x^3$ or -12 placed correctly *Mid Partial Credit* • 1 coefficient correct *High Partial Credit* • 2 coefficients correct • Correct answer without work

Q13	Model Solution – 15 Marks	Marking Notes
Points on $y = x - 1$ are $(-2, -3)$ and $(2, 1)$. 		**Scale 15D (0, 7, 9, 12, 15)** *Low Partial Credit* • Work of merit for 1 graph, for example: 1 point found, with supporting work; or y-intercept correct; or slope correct for line; or two points correct on graph. *Mid Partial Credit* • 1 correct graph **and** work of merit on 1 other graph. • Work of merit on all 3 graphs. *High Partial Credit* • 2 correct graphs **and** work of merit on 3rd • 5 points plotted for all 3 graphs *Full Credit –1* • Apply a * for one point incorrectly plotted
Points on $y = 2 - x^2$ are: $(-2, -2); (-1, 1); (0, 2); (1, 1); (2, -2)$. 	Points on $y = 2^x$ are: $(-2, 0{\cdot}25); (-1, 0{\cdot}5); (0, 1); (1, 2); (2, 4)$. 	

Q14	Model Solution – 20 Marks	Marking Notes
(a), (c)	(a) $360 + 180 = 540°$ $540 + 180 = 720°$ (c) $\frac{360}{4} = 90°$ $\frac{540}{5} = 108°$ $\frac{720}{6} = 120°$	**Scale 10D (0, 4, 6, 8, 10)** Accept correct answers without units (degree symbol). *Low Partial Credit* • 1 of the 5 values correct. *Mid Partial Credit* • (a) **or** (c) correct. *High Partial Credit* • (a) or (c) correct, **and** 1 value correct in the other part.
(b)	$180(n-2)$ [degrees] **OR** $180n - 360$ [degrees]	**Scale 5B (0, 2, 5)** Accept correct answer without units. Accept correct formula in words. *Partial Credit* • Work of merit, for example: $180n$, or $360n - 360$.
(d)	$\frac{180(n-2)}{n}$ [degrees] **OR** $\frac{180n-360}{n}$ [degrees]	**Scale 5B (0, 2, 5)** Accept correct answer without units. Accept correct formula in words. *Partial Credit* • Work of merit, for example: $\frac{k}{n}, k \in \mathbb{R}$.

Q15	Model Solution – 5 Marks	Marking Notes
	Answer: C Reason: Some x values have more than one y value *or any other valid reason*	**Scale 5B (0, 2, 5)** *Partial Credit* • **C** identified as answer • Shows understanding of the relevant feature of a function, for example: vertical line drawn.

Paper 2

Structure of the marking scheme

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

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

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

Marking scales – level descriptors

A-scales (two categories)

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

B-scales (three categories)

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

C-scales (four categories)

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

D-scales (five categories)

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

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

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

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

Summary of mark allocations and scales to be applied

Question 1 (10)

10D

Question 2 (20)

(a)	10C
(b)	10D

Question 3 (20)

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

Question 4 (45)

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

Question 5 (30)

(a), (b)	15C
(c)	5A
(d)	10C

Question 6 (30)

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

Question 7 (15)

15D

Question 8 (35)

(a)(i)	10C
(a)(ii)	10C
(b)	15D

Question 9 (35)

(a)	10B
(b)	10C
(c)	15D

Question 10 (25)

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

Question 11 (20)

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

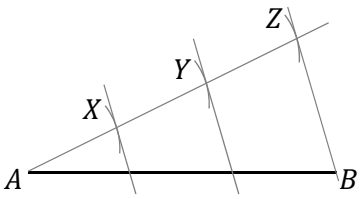
Question 12 (15)

(a)	10C
(b)	5D

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 – 10 Marks	Marking Notes
	B D C A	**Scale 10D (0, 3, 5, 7, 10)** Accept D as rotation for up to *High Partial Credit*, but not for *Full Credit* *Low Partial Credit* • 1 correct *Mid Partial Credit* • 2 correct *High Partial Credit* • 3 correct

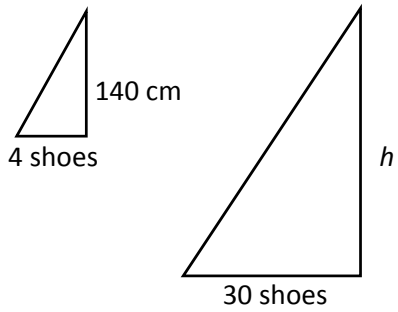
Q2	Model Solution – 20 Marks	Marking Notes
(a)	*Construction presented, with all necessary construction lines.*  	**Scale 10C (0, 4, 6, 10)** Tolerance: ± 2 mm *Low Partial Credit* • $[AB]$ divided in 3 equal parts, with no construction lines • Ray from A or B, with points X, Y, and Z within tolerance • Complete sketch *High Partial Credit* • Points X, Y and Z within tolerance and finished outside tolerance
(b)	Let $\lvert AD\rvert = h$ and $\lvert AB\rvert = 5a$. Area rectangle $= 5ah$ Left-hand shaded area: $ah + \frac{1}{2} \times 2a \times h = 2ah$ Right-hand shaded area: $ah + \frac{1}{2} \times a \times h = 1{\cdot}5ah$ % shaded $= \frac{3{\cdot}5ah}{5ah} \times 100 = 70$ [%] **OR** Unshaded region: $\frac{1}{2} \times 2a \times h + \frac{1}{2} \times a \times h = 1{\cdot}5ah$ % shaded $= \frac{3{\cdot}5ah}{5ah} \times 100 = 70$ [%]	**Scale 10D (0, 3, 5, 7, 10)** Accept correct answer without % sign (70) Accept solutions where particular dimensions of shape are chosen (as long as these are consistent with the question) *Low Partial Credit* • Finds the area (or the percentage or fraction of the total area) of a relevant shape • Correct formula with relevant substitution *Mid Partial Credit* • Finds the area of one of the shaded regions *High Partial Credit* • Finds the area of both shaded regions • Finds the area of the unshaded region • Correct answer without work *Full Credit –1* • Apply a * if the answer is not given as a percentage, for example 0·7 or $\frac{70}{100}$

Q3	Model Solution – 20 Marks	Marking Notes
(a), (b)	(a) $\frac{4}{3}\pi r^3 = \frac{4}{3}\pi(6)^3$ $= 288\pi$ [mm^3] (b) Volume of large sphere: $\frac{4}{3}\pi r^3 = \frac{4}{3}\pi(25)^3$ $= \frac{62500}{3}\pi$ [mm^3] Number of ball bearings: $\frac{62500}{3} \div 288 = 72{\cdot}3\ldots$ i.e. 73	**Scale 15D (0, 5, 8, 10, 15)** In (a), accept correct answer without units *Low Partial Credit* • Substitutes radius into correct formula • Relevant division *Mid Partial Credit* • Volume of one sphere correct *High Partial Credit* • Volumes of both spheres correct • One error and finishes correctly, for example $4\pi r^2$ or $k\pi r^3$ (where $k \in \mathbb{Q}$, $k \neq \frac{4}{3}$) used instead of $\frac{4}{3}\pi r^3$ • Correct answers without work *Full Credit –1* • Apply a * if the answer in (a) is not in terms of π • Apply a * if there is no rounding or incorrect rounding in (b)
(c)	$\frac{4}{3}\pi R^3 = 350 \times 288\pi$ $\Rightarrow \quad R^3 = 75600$ $\Rightarrow \quad R = 42{\cdot}2\ldots = 42$ [mm] [nearest mm]	**Scale 5D (0, 2, 3, 4, 5)** Accept correct answer without units Accept a candidate's volume formula from (a) and (b) for *Full Credit* here, as long as it involves a power of R greater than 1. If the power of R is 1, award at most *High Parital Credit*. *Low Partial Credit* • $350 \times 288\pi$ • Forms an equation using $\frac{4}{3}\pi R^3$ *Mid Partial Credit* • Forms correct equation using $\frac{4}{3}\pi R^3$ *High Partial Credit* • Finds R^3 • One error and finishes correctly • Correct answer without work *Full Credit –1* • Apply a * if there is no rounding or incorrect rounding, if a * has not been applied for incorrect rounding in (b)

Q4	Model Solution – 45 Marks	Marking Notes
(a)	$8 + 39 = 47$ $\Rightarrow \quad p = 7$	**Scale 10B (0, 4, 10)** Accept correct answer without work *Partial Credit* • Work of merit for range *Full Credit* − 1 • Apply a * if $p = 47$ instead of 7
(b), (c)	(b)(i) 19 [copies] (b)(ii) $\frac{17+1}{2} = 9$th value, i.e. median $= 21$ [copies] (c) $\frac{431}{17} = 25{\cdot}35 \ldots$ $= 25{\cdot}4$ [copies] [1 D.P.]	**Scale 15D (0, 5, 8, 10, 15)** Accept correct answers without work Accept correct answers without units *Low Partial Credit* • Work of merit in the relevant part • 1 value correct (mode, median, or mean), but in the wrong part *Mid Partial Credit* • 1 part correct ((b)(i), (b)(ii), or (c)) *High Partial Credit* • 2 parts correct • All 3 values correct, 1 in the correct part and the other 2 swapped *Full Credit –1* • Apply a * for no rounding or incorrect rounding in (c)
(d) (i), (ii)	(i) 19 [copies] (ii) $\frac{18+1}{2} = 9{\cdot}5$th value, i.e. median $= \frac{21+25}{2}$ $= 23$ [copies]	**Scale 10C (0, 4, 6, 10)** Accept correct answers without work Accept correct answers without units *Low Partial Credit* • Work of merit in (ii) • 1 value correct (mode or median), but in the wrong part *High Partial Credit* • 1 part correct ((i) or (ii))
(d) (iii)	18-week total $= 18 \times 28{\cdot}5 = 513$ 18th week $= 513 - 431$ $= 82$ [copies]	**Scale 10C (0, 4, 6, 10)** Accept correct answers without units *Low Partial Credit* • Work of merit for mean *High Partial Credit* • Total number of copies for 18 weeks (513) • One error and finishes correctly • Correct answer without work

Q5	Model Solution – 30 Marks	Marking Notes
(a), (b)	(a) *Any three even positive numbers, for example:* 2, 4, 6. (b) $1-\frac{2}{7}=\frac{5}{7}$ **or** 0·71…	**Scale 15C (0, 5, 10, 15)** Accept correct answers without work *Low Partial Credit* • Work of merit in (a) **or** (b) *High Partial Credit* • (a) **or** (b) correct • Work of merit in (a) **and** (b)
(c)	The total number of pens must be a multiple of 7 **OR** There would be $\frac{2}{7}\times 20 = 5{\cdot}7$ … red pens in the box *or any other valid explanation*	**Scale 5A (0, 5)**
(d)	Ratio red : blue : green $= 2:5:\frac{7}{3}$ ∴ P(blue) $=\frac{5}{9\frac{1}{3}}=\frac{15}{28}$ **OR** P(blue) $=\frac{5}{7}\times 75\%=\frac{5}{7}\times\frac{3}{4}=\frac{15}{28}$ **OR** Trial and improvement: Trial / Red or Blue (3 parts) / Green (1 part) 1 / 7 (2 + 5) / $\frac{7}{3}$ 2 / 14 (4 + 10) / $\frac{14}{3}$ 3 / 21 (6 + 15) / $\frac{21}{3}=7$ Trials 1 and 2 are not possible P(blue) $=\frac{15}{28}$ **OR** Let the ratio red : blue : green $= 2:5:x$ P(green) $=\frac{x}{x+7}=\frac{1}{4}$ ∴ $x=\frac{7}{3}$ P(blue) $=\frac{5}{7+\frac{7}{3}}=\frac{15}{28}$	**Scale 10C (0, 4, 6, 10)** *Low Partial Credit* • Mention of 75% or $\frac{3}{4}$ • Work of merit for trial and improvement, for example: mentions 2 and 5; $\frac{7}{28}$; $\frac{21}{28}$ *High Partial Credit* • Finds $[x=]\ \frac{7}{3}$ or finds $9\frac{1}{3}$ • Finds ratio of blue to green (for example, 15 and 7), or finds ratio of blue to total (for example, 15 and 28) • Correct answer without work *Full Credit –1* • Apply a * for the answer not given as a fraction in its simplest form

Q6	Model Solution – 30 Marks	Marking Notes
(a), (b)	(a) $\frac{96+90}{360} = \frac{186}{360}$ **or** $\frac{31}{60}$ *or equivalent* (b) 160 150 170 120 $96°$ $90°$ $102°$ $72°$ $90° \rightarrow 150$ $\Rightarrow 360° \rightarrow 150 \times 4 = 600$ $\Rightarrow 96° \rightarrow \frac{96}{360} \times 600 = 160$ $170 \rightarrow \frac{170}{600} \times 360 = 102°$ $600 - (160 + 150 + 170) = 120$ $360 - (96 + 90 + 102) = 72°$	**Scale 15D (0, 5, 8, 10, 15)** 5 answers are required for (a) and (b) combined In (b), accept answers without units (degree symbol) *Low Partial Credit* • Work of merit, for example mention of $96 + 90$ or 360 *Mid Partial Credit* • 2 correct answers *High Partial Credit* • 3 correct answers • 5 correct answers, but with no supporting work for (b)
(c)	*Any questions relating to eating or exercise that would generate each type of data, for example:* Numerical continuous: What volume of water do you drink each day? Numerical discrete: How many press-ups can you do in 30 seconds? Categorical nominal: Which do you prefer, pizza or salad?	**Scale 10C (0, 4, 6, 10)** *Low Partial Credit* • Work of merit in one question, for example: a question that would generate numerical data for one of the first 2 questions; or a question that would generate categorical [ordinal] data for the third question *High Partial Credit* • 2 questions correct *Full Credit –1* • Apply a * to a question that is not about eating or exercise, the first time it occurs.
(d)	So that the results aren't biased **OR** So that results will apply to the whole population instead of just the sample *or any other valid explanation*	**Scale 5B (0, 2, 5)** *Partial Credit* • Answer of some merit, for example refers to accuracy / inaccuracy of results

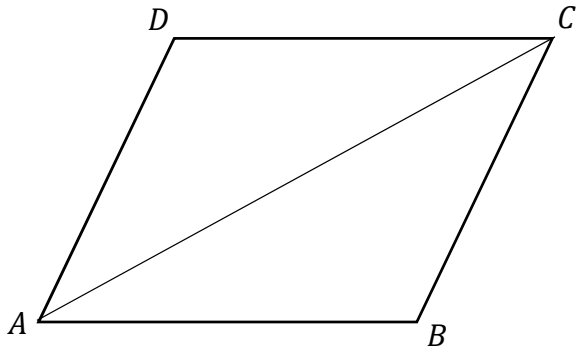
Q7	Model Solution – 15 Marks	Marking Notes
	Diagram:  $\frac{h}{30} = \frac{140}{4}$ $\Rightarrow \quad h = 30 \times \frac{140}{4} = 1050$ cm $= 10{\cdot}5$ [m]	**Scale 15D (0, 5, 8, 10, 15)** Accept correct answer without units Diagram(s) not necessary for *Full Credit* *Low Partial Credit* • Draws 1 labelled diagram (with 2 relevant labels) *Mid Partial Credit* • Sets up one ratio correctly • Solves correctly from incorrect ratios *High Partial Credit* • Sets up correct equation • Correct answer without work *Full Credit –1* • Apply a * if the answer is given in cm • Apply a * if the answer is calculated using trigonometric ratios (for example, using tan)

Q8	Model Solution – 35 Marks	Marking Notes
(a)(i)	$\cos Y = \frac{10}{12}$ $Y = \cos^{-1}\frac{10}{12}$ $= 33{\cdot}557\ldots° = 33{\cdot}6°$ [1 D.P.] **OR** $\lvert BC\rvert = \sqrt{12^2 - 10^2} = 2\sqrt{11}$ $\tan Y = \frac{2\sqrt{11}}{10}$ or $\sin Y = \frac{2\sqrt{11}}{12}$ $Y = \tan^{-1}\frac{2\sqrt{11}}{10}$ or $\sin^{-1}\frac{2\sqrt{11}}{12}$ $= 33{\cdot}557\ldots° = 33{\cdot}6°$ [1 D.P.] **OR** $\sin\angle ACB = \frac{10}{12}$ $\lvert\angle ACB\rvert = \sin^{-1}\frac{10}{12} = 56{\cdot}4426\ldots°$ $Y = 180° - 90° - 56{\cdot}4426\ldots°$ $= 33{\cdot}5574\ldots° = 33{\cdot}6°$ [1 D.P.]	**Scale 10C (0, 4, 6, 10)** Accept answer given in radians or gradients *Low Partial Credit* • A trigonometric ratio with some correct substitution • Incorrect trigonometric ratio, for example $\tan Y = \frac{10}{12}$, and finishes correctly *High Partial Credit* • $\cos Y = \frac{10}{12}$ or equivalent • $\lvert\angle ACB\rvert$ correct $(56{\cdot}4°)$ • Correct answer without work *Full Credit –1* • Apply a * if the units (for example, degree symbol) are incorrect or omitted • Apply a * for no rounding or incorrect rounding

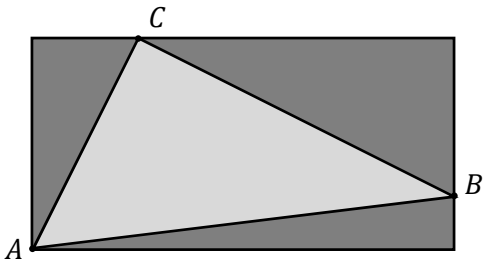
Q8	Model Solution – 35 Marks	Marking Notes
(a)(ii)	$x^2 + x^2 = 12^2$ $2x^2 = 144$ $x = \sqrt{72}$ $x = 8{\cdot}485 \ldots = 8{\cdot}49$ [2 D.P.] **OR** $\cos 45° = \frac{x}{12}$ or $\sin 45° = \frac{x}{12}$ $x = 12\cos 45°$ or $12 \sin 45°$ $x = 8{\cdot}485 \ldots = 8{\cdot}49$ [2 D.P.] **OR** Draw line from *D* perpendicular to *AC*: $\frac{12}{x} = \frac{x}{6}$ $x^2 = 72$ $x = \sqrt{72}$ $x = 8{\cdot}485 \ldots = 8{\cdot}49$ [2 D.P.] **OR** Draw line from *D* perpendicular to *AC*: $\cos 45° = \frac{6}{x}$ or $\sin 45° = \frac{6}{x}$ $x = \frac{6}{\cos 45°}$ or $\frac{6}{\sin 45°}$ $x = 8{\cdot}485 \ldots = 8{\cdot}49$ [2 D.P.]	**Scale 10C (0, 4, 6, 10)** *Low Partial Credit* • Some correct use of Pythagoras' Theorem • A trigonometric ratio with some correct substitution • Incorrect trigonometric ratio and finishes correctly • Mention of 45° *High Partial Credit* • $2x^2 = 144$ • $x = \frac{6}{\cos 45°}$ or $\frac{6}{\sin 45°}$ • $x = 12\cos 45°$ or $12 \sin 45°$ • $x^2 = 72$ • One error and finishes correctly • Correct answer without work *Full Credit –1* • Apply a * for no rounding or incorrect rounding, if a * has not been applied for no or incorrect rounding in (a)(i) • Apply a * if the calculator is in the incorrect mode

Q8	Model Solution – 35 Marks	Marking Notes
(b)	**Method 1**: $\lvert\angle PRQ\rvert = 22°$ **Step 1** $\lvert\angle Q \text{ internal}\rvert = 180 - 2 \times 22$ $= 136°$ **Step 2** $\lvert\angle Q \text{ external}\rvert = 360 - 136$ $= 224°$ **Step 3** $\lvert\angle T\rvert = \frac{224}{2} = 112°$ **Step 4** **OR** **Method 2**: *Extend PQ to a point M on k and join R to M.* **Step 1** $\lvert\angle PRM\rvert = 90°$ $\lvert\angle PRQ\rvert = 22°$ **Step 2** $\lvert\angle QRM\rvert = 90° - 22°$ $= 68°$ $\lvert\angle RMQ\rvert = 68°$ **Step 3** $\lvert\angle T\rvert = 180 - 68°$ $= 112°$ **Step 4**	**Scale 15D (0, 5, 8, 10, 15)** Accept work without reasons for *Full Credit* Accept up to step 3 without work in Method 1 *Low Partial Credit* • Indication that the sum of the angles in a triangle is 180° • Indication that the angle at the centre of a circle is twice the angle at the circumference standing on the same arc • 1 step correct *Mid Partial Credit* • 2 steps correct *High Partial Credit* • 3 steps correct • Correct answer without work *Full Credit –1* • Apply a * if the units are incorrect or omitted, if a * has not been applied for incorrect or omitted units in (a)(i)

Q9	Model Solution – 35 Marks	Marking Notes
(a)	Axiom Corollary Proof	**Scale 10B (0, 4, 10)** *Partial Credit* • 1 correct
(b)	(i) "it must be a square" (ii) *Answer*: False *Justification*: A rectangle has 4 right angles but might not be a square *or any other valid justification*	**Scale 10C (0, 4, 6, 10)** Part (b) requires 3 answers: completing the converse in (i); the answer in (ii); and the reason in (ii). *Low Partial Credit* • 1 answer correct *High Partial Credit* • 2 answers correct

Q9	Model Solution – 35 Marks	Marking Notes
(c)	**Step 1**: *Diagram*:  *Given*: Parallelogram $ABCD$. *To Prove*: $\|AB\| = \|CD\|$ and $\|BC\| = \|AD\|$ *Construction*: Join A to C with a line segment.	**Scale 15D (0, 5, 8, 10, 15)** Accept proof without reasons for up to *High Partial Credit.* Proof must have both reasons to achieve *Full Credit.* Accept proof without Step 3 for *Full Credit.* Accept Step 1 with "To Prove" not filled in, or filled in incorrectly. If "To Prove" is filled in correctly in Step 1, accept Steps 1, 2, and 4 for *Full Credit.* Steps must be in a logical order to be considered correct. *Low Partial Credit* • Diagram (including diagonal drawn) *Mid Partial Credit* • 2 steps correct *High Partial Credit* • 3 steps correct
	Step 2: *Proof*: $\|\angle CAB\| = \|\angle ACD\|$ and $\|\angle ACB\| = \|\angle CAD\|$ *Reason*: Alternate angle theorem	
	Step 3: $[AC]$ is common to both triangles	
	Step 4: ΔACD is congruent to ΔCAB *Reason*: ASA	
	Step 5: $\therefore \quad \|AB\| = \|CD\|$ and $\|BC\| = \|AD\|$	

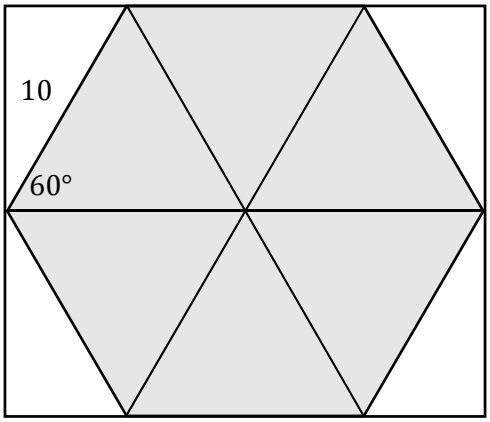
Q10	Model Solution – 25 Marks	Marking Notes
Note: Work on the diagram can be awarded credit in at most one part.		
(a)	$A\ (2, 1)$ $B\ (10, 2)$ $C\ (4, 5)$	**Scale 10C (0, 4, 6, 10)** *Low Partial Credit* • 1 correct • All three reversed (y, x) *High Partial Credit* • 2 correct *Full Credit −1* • Apply a * if the points are incorrectly labelled • Apply a * if just 1 of the 6 ordinates is incorrect
(b)	*Using slopes:* Slope $[AC] = \frac{5-1}{4-2} = 2$ Slope $[BC] = \frac{5-2}{4-10} = \frac{3}{-6} = -\frac{1}{2}$ Product of slopes $= (2)\left(-\frac{1}{2}\right) = -1$ $\Rightarrow$ right angle at C **OR** *Using Pyth Thm:* $\lvert AC\rvert = \sqrt{2^2 + 4^2} = \sqrt{20}$ $\lvert BC\rvert = \sqrt{3^2 + 6^2} = \sqrt{45}$ $\lvert AB\rvert = \sqrt{1^2 + 8^2} = \sqrt{65}$ $\left(\sqrt{65}\right)^2 = \left(\sqrt{20}\right)^2 + \left(\sqrt{45}\right)^2$ So $\lvert AB\rvert^2 = \lvert AC\rvert^2 + \lvert BC\rvert^2$	**Scale 5D (0, 2, 3, 4, 5)** *Low Partial Credit* • Correct relevant formula (for example, for slope or distance, or Pythagoras Theorem) with some relevant substitution • Indication of property of slopes of perpendicular lines • Indicates that the angle in a semi-circle is 90° *Mid Partial Credit* • Slope of *AC* **or** *BC* correct • Finds lengths of 2 sides • Constructs a semi-circle with diameter [*AB*] *High Partial Credit* • Slope of *AC* **and** *BC* correct • Finds length of 3 sides • One error and finishes correctly

Q10	Model Solution – 25 Marks	Marking Notes
Note: Work on the diagram can be awarded credit in at most one part.		
(c)	$\lvert AC\rvert = \sqrt{2^2+4^2} = \sqrt{20}$ $\lvert BC\rvert = \sqrt{3^2+6^2} = \sqrt{45}$ Area $= \frac{1}{2} \times \sqrt{20} \times \sqrt{45}$ $= 15$ **OR** *Construct rectangle as below, containing A, B, and C:*  Area rectangle $= 8 \times 4 = 32$ Area 3 small triangles $= \frac{1}{2}(8 \times 1) + \frac{1}{2}(6 \times 3) + \frac{1}{2}(4 \times 2)$ $= 4 + 9 + 4 = 17$ $\Rightarrow$ Area $ABC = 32 - 17 = 15$	**Scale 5D (0, 2, 3, 4, 5)** *Low Partial Credit* • Correct formula with relevant substitution *Mid Partial Credit* • Finds $\lvert AC\rvert$ **or** $\lvert BC\rvert$ • Area of rectangle correct • Area of 1 of the 3 small triangles correct *High Partial Credit* • Area of rectangle and 1 small triangle correct • Finds $\lvert AC\rvert$ **and** $\lvert BC\rvert$

Q10	Model Solution – 25 Marks	Marking Notes
Note: Work on the diagram can be awarded credit in at most one part.		
(d)	$\lvert AB\rvert = \sqrt{1^2 + 8^2} = \sqrt{65}$ $\frac{1}{2} \times \lvert AB\rvert \times \lvert CD\rvert = 15$ $\Rightarrow \quad \frac{1}{2} \times \sqrt{65} \times \lvert CD\rvert = 15$ $\Rightarrow \quad \lvert CD\rvert = \frac{15\times 2}{\sqrt{65}}$ $= \frac{30}{\sqrt{65}}$ **or** $\frac{6\sqrt{65}}{13}$ **OR** Equation of AB: $y - 1 = \frac{1}{8}(x - 2)$ Equation of DC: $y - 5 = -8(x - 4)$ D (point of intersection of these): $4 = \frac{1}{8}x - \frac{1}{4} + 8x - 32$ i.e. $65x = 290$ so $x = \frac{58}{13}$ and $y = \frac{17}{13}$ So $\lvert CD\rvert = \sqrt{\left(4 - \frac{58}{13}\right)^2 + \left(5 - \frac{17}{13}\right)^2}$ $= \frac{30}{\sqrt{65}}$ **or** $\frac{6\sqrt{65}}{13}$	**Scale 5D (0, 2, 3, 4, 5)** *Low Partial Credit* • Correct formula with relevant substitution *Mid Partial Credit* • $\lvert AB\rvert$ correct • Equations of *AB* **and** *CD* correct *High Partial Credit* • $\frac{1}{2} \times \sqrt{65} \times \lvert CD\rvert = 15$ • Correct answer without work • Coordinates of *D* correctly found $\left(\frac{58}{13}, \frac{17}{13}\right)$ • One error and finishes correctly *Full Credit –1* • Apply a * if the answer is not given in surd form

Q11	Model Solution – 20 Marks	Marking Notes
(a)	r t q $y = 2x - 3$	**Scale 10D (0, 3, 5, 7, 10)** Accept correct answers without work *Low Partial Credit* • 1 line correct • 1 aspect of equation correct (slope or *y*-intercept) *Mid Partial Credit* • 2 lines correct • Equation correct *High Partial Credit* • 3 lines correct • Equation correct and 1 line correct
(b)	$2x + 3 = x - 3$ $x = -6$ $y = -6 - 3 = -9$ Ans: $(-6, -9)$ **OR** E2: $y = 2x + 3$ E1× (-1): $\underline{-y = -x + 3}$ $0 = x + 6$ $x = -6$ $y = -6 - 3 = -9$ Ans: $(-6, -9)$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • Some work of merit in solving the simultaneous equations algebraically, for example $2x + 3 = x - 3$; or one equation rearranged • Correct answer without work *High Partial Credit* • 1 value correct ($x = -6$ or $y = -9$) with supporting algebraic work • One error and finishes correctly • Correct answer subbed into both equations
(c)	$3 + 3 = 6$	**Scale 5B (0, 2, 5)** Accept correct answer without work *Partial Credit* • Work of merit, for example: vertical line drawn to cut *r* and *t*; or *y* intercepts correct; or correct distance formula with relevant substitution *Full Credit –1* • Apply a * if x-intercepts are used instead of y-intercepts

Q12	Model Solution – 15 Marks	Marking Notes
(a)	$\sin 60° = \frac{x}{10}$ $\Rightarrow \quad x = 10 \times \frac{\sqrt{3}}{2} = 5\sqrt{3}$ [units]	**Scale 10C (0, 4, 6, 10)** Accept correct answer without units *Low Partial Credit* • A trigonometric ratio with some correct substitution • Incorrect trigonometric ratio, for example $\tan 60° = \frac{10}{x}$, and finishes correctly *High Partial Credit* • $\sin 60° = \frac{x}{10}$, or equivalent (for example, $\frac{x}{10} = \frac{\sqrt{3}}{2}$) • One error and finishes correctly • Correct answer without work *Full Credit –1* • Apply a * if the answer is not in surd form • Apply a * if the calculator is in the incorrect mode

Q12	Model Solution – 15 Marks	Marking Notes
(b)	*Using 6 equilateral triangles:* $6 \times \left(\frac{1}{2} \times \text{base} \times \text{height}\right)$ $= \quad 6 \times \left(\frac{1}{2} \times 10 \times 5\sqrt{3}\right)$ $= \quad 6 \times 25\sqrt{3}$ $= \quad 150\sqrt{3}$ [square units] **OR**  *Inscribe hexagon in rectangle of width* $2 \times 10 = 20$ *and height* $2x = 10\sqrt{3}$*:* Area rect $- 4 \times$ area tri from (a) $= \quad \left(20 \times 10\sqrt{3}\right) - 4 \times \left(\frac{1}{2} \times 5 \times 5\sqrt{3}\right)$ $= \quad 200\sqrt{3} - 50\sqrt{3}$ $= \quad 150\sqrt{3}$ [square units]	**Scale 5D (0, 2, 3, 4, 5)** Accept correct answer without units *Low Partial Credit* • Breaks one equilateral triangle in half • Inscribes hexagon in relevant rectangle • Correct formula with relevant substitution • Finds the base of the triangle in (a) *Mid Partial Credit* • Gets area of a relevant triangle • Gets area of a relevant rectangle *High Partial Credit* • One error and finishes correctly • Correct answer without work *Full Credit −1* • Apply a * if the answer is not given in the form $a\sqrt{3}$, where $a \in \mathbb{N}$, if a * has not been applied for an answer not in surd form in (a).

Marcanna Breise as ucht freagairt trí Ghaeilge

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

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

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

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

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

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