Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate 2018

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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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, 3, 5	0, 2, 3, 5	0, 2, 3, 4, 5
10-mark scale		0, 3, 7, 10	0, 2, 6, 9, 10
15-mark scale		0, 4, 12, 15	0, 3, 9, 13, 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

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*.

Summary of mark allocations and scales to be applied

Question 1 (20)
(a)   5B
(b)   15C

Question 2 (30)
(a)   10C
(b)   10D
(c)   10D

Question 3 (10)
(a),(b)   10D

Question 4 (15)
(a)   5C
(b)   10C

Question 5 (25)
(a)   5B
(b)   10D
(c)   10C

Question 6 (40)
(a),(b)   10C
(c),(d)   10D
(e),(f)   10D
(g),(h)   10C

Question 7 (15)
(a)   5C
(b)   10C

Question 8 (25)
(a)   15C
(b)   10C

Question 9 (25)
(a)   5B
(b),(c)   5D
(d)   5B
(e)   10D

Question 10 (30)
(a)   15C
(b)   10C
(c)   5B

Question 11 (10)
             10D

Question 12 (15)
(a)   10D
(b)   5C

Question 13 (15)
(a),(b)   15D

Question 14 (25)
(a)   15C
(b)   10C

Model Solutions & Marking Notes

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

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

In general, accept a candidate's work in one part of a question for use in subsequent parts of the question, unless this oversimplifies the work involved.
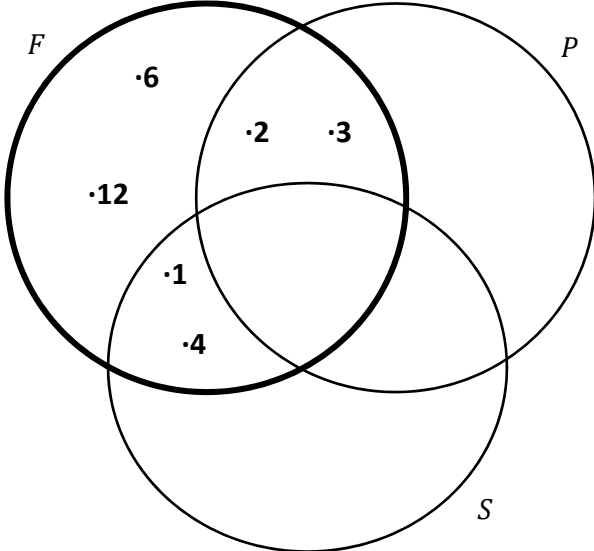
Q1	Model Solution – 20 Marks	Marking Notes
(a)	1st Difference $= 7 - 1 = 6$ Answer: 13, 19, 25	**Scale 5B (0, 3, 5)** Accept correct answer without supporting work. *Partial Credit* • Shows understanding of linear patterns, for example: explains linear properly; correct first difference found • Three consecutive terms in linear sequence (possibly including 1 and 7) • Correct relevant formula, for example: $T_n = a + (n-1)d$ or $y = mx + c$ *Full Credit –1* • Apply a * if two of the new first differences are 6, for example: 13, 19, 26 or 12, 18, 24.
(b)	*Any pattern continuing on from 1, 7 with a (non-zero) constant second difference.* *For example*: 14, 22, 31 *or any other quadratic sequence continuing on from 1, 7*	**Scale 15C (0, 4, 12, 15)** Accept correct answer without supporting work. *No Credit* • Answer of 13, 19, 25, or finds first difference *Low Partial Credit* • Shows understanding of quadratic patterns, for example: indicates or refers to second differences • Correct relevant formula, for example: $an^2 + bn + c$ *High Partial Credit* • Writes sequence with at least 2 equal non-zero second differences (not necessarily consecutive)

Q2	Model Solution – 30 Marks	Marking Notes

(a)	(i) 750 [kcal]
	
	(ii) 300 kcal in 30 mins
	     means 600 kcal in 1 hour
	     $\therefore$ 155 [beats per minute]
		Scale 10C (0, 3, 7, 10)
		Accept correct answer without supporting work
		Tolerance: ± 10 on y-axis and ± 1 on x-axis.
		Low Partial Credit:
		• Work of merit in (i) **or** (ii), for example: relevant indication on graph for either part (including indication of 300 kcal); or 125 given as answer in (ii)
		
		High Partial Credit
		• (i) **or** (ii) correct
		• Work of merit in both parts

(b)		

Stage	Slow	Sprint	Total
1	60	50	110
2	60	100	160
3	60	150	210
4	60	200	260
5	60	250	310
n	60	$50n$	$60 + 50n$

Scale 10D (0, 2, 6, 9, 10)

Accept correct answer without supporting work

Note: Accept Total as correct if it is either equal to the sum of Slow and Sprint, **or** (for stages 3, 4, and 5) if it is 50 greater than the Total from the previous row.

Note: If final Sprint entry not in terms of *n*, award *MPC* at most.

Low Partial Credit
• One entry correct

Mid Partial Credit
• Five entries correct

High Partial Credit
• Seven entries correct, including at least one of the entries in terms of n

Full Credit −1
• Nine entries correct (i.e. all but one), including both of the entries in terms of n

Q2	Model Solution – 30 Marks	Marking Notes
(c)	Total distance $= 60 + 150 = 210$ [m] Slow run: Time $= \frac{D}{S} = \frac{60}{2} = 30$ [seconds] Sprint: Time $= \frac{D}{S} = \frac{150}{7 \cdot 5} = 20$ [seconds] Total time $= 30 + 20 = 50$ [seconds] Average Speed $= \frac{D}{T} = \frac{210}{50} = 4 \cdot 2$ [m/s]	**Scale 10D (0, 2, 6, 9, 10)** *Low Partial Credit* • Work of merit, for example: relevant formula; finds total distance *Mid Partial Credit* • One correct time calculated *High Partial Credit* • Total stage time calculated • One correct time calculated and 210 divided by some incorrect figure derived from some work of merit • Correct answer with no supporting work

Q3	Model Solution – 10 Marks	Marking Notes
(a), (b)	(a) $\frac{14}{35} \times 100 = \frac{2}{5} \times 100 = 40$ [%] (b) $\frac{200}{0 \cdot 88} = €227 \cdot 27 \ldots$ $227 \cdot 27 \ldots \times 1 \cdot 18 = 268 \cdot 181 \ldots$ $= [\$] 268 \cdot 18$ [2 D.P.] **OR** $\frac{1 \cdot 18}{0 \cdot 88} = 1 \cdot 3409 \ldots$ So £1 $= \$1 \cdot 3409 \ldots$ £200 $\times 1 \cdot 3409 \ldots = 268 \cdot 18 \ldots$ $= [\$] 268 \cdot 18$ [2 D.P.] **OR** $\frac{0 \cdot 88}{1 \cdot 18} = 0 \cdot 7457 \ldots$ So \$1 $= £0 \cdot 7457 \ldots$ £200 $\div 0 \cdot 7457 \ldots = 268 \cdot 18 \ldots$ $= [\$] 268 \cdot 18$ [2 D.P.]	**Scale 10D (0, 2, 6, 9, 10)** Accept correct answer without supporting work *Low Partial Credit* • Work of merit in (a) **or** (b), that is: a relevant product or relevant quotient (including reciprocals) *Mid Partial Credit* • (a) correct • Work of merit in (a) **and** (b) *High Partial Credit* • (a) correct, **and** work of merit in (b) • (b) correct *Full Credit −1* • Incorrect or no rounding

Q4	Model Solution – 15 Marks	Marking Notes
(a)	$\{1, 2, 3, 4, 6, 12\}$	**Scale 5C (0, 2, 3, 5)** Accept correct answer without supporting work *Note*: If incorrect excess factors are given, award at most *High Partial Credit* *Low Partial Credit* • One correct factor. *High Partial Credit* • Four correct factors.
(b)		**Scale 10C (0, 3, 7, 10)** Accept correct answer without supporting work. Ignore any elements in Venn diagram placed outside set F If a region contains an incorrect element, award at most *HPC*. If an element is written twice in F then that element is not correctly placed If answer from (a) has elements in 3 regions, *FC* may be awarded for (b); if answer from (a) only has elements in 2 regions, award at most *HPC* for (b); if answer from (a) only has elements in 1 region, award at most *LPC* for (b). *Low Partial Credit* • 1 region with all relevant elements (with or without excess elements) • 3 elements correctly placed *High Partial Credit* • 2 regions with all relevant elements and no excess • 5 elements correctly placed

Q5	Model Solution – 25 Marks	Marking Notes
(a)	$$3(6) - 4(5^2)$$ $$= \quad 18 - 4(25)$$ $$= \quad 18 - 100$$ $$= \quad -82$$	**Scale 5B (0, 3, 5)** Accept correct answer without supporting work *Partial Credit* • Some correct substitution or relevant calculation.
(b)	$$2x(4 - 5x + x^2) - 3(4 - 5x + x^2)$$ $$= \quad 8x - 10x^2 + 2x^3 - 12 + 15x - 3x^2$$ $$= \quad 2x^3 - 13x^2 + 23x - 12$$	**Scale 10D (0, 2, 6, 9, 10)** *Low Partial Credit* • One term correctly multiplied *Mid Partial Credit* • Three terms correctly multiplied *High Partial Credit* • 2nd line fully correct • 4 terms correct in 2nd line, finished correctly • Correct answer without supporting work
(c)	$$10de - df - 5ef + 2d^2$$ $$= \quad 10de - 5ef + 2d^2 - df$$ $$= \quad 5e(2d - f) + d(2d - f)$$ $$= \quad (2d - f)(5e + d)$$ **OR** $$10de - df - 5ef + 2d^2$$ $$= \quad 10de + 2d^2 - 5ef - df$$ $$= \quad 2d(5e + d) - f(5e + d)$$ $$= \quad (5e + d)(2d - f)$$	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit* • Work of merit, for example: a common factor identified from given expression *High Partial Credit* • $5e(2d - f) + d(2d - f)$ or equivalent • Correct answer without supporting work • $5e(2d - f) - d(2d - f)$ or similar, and finishes correctly.

Q6	Model Solution – 40 Marks	Marking Notes

(a),
(b)
	(a) 16, 32, 64
	
	(b) Domain: $\{1, 2, 3, 4, 5, 6\}$
	        Range: $\{2, 4, 8, 16, 32, 64\}$
		Scale 10C (0, 3, 7, 10)
		
		Accept correct answers without supporting work.
		
		Accept answers in index form ($\mathbf{2^4}$, $\mathbf{2^5}$, $\mathbf{2^6}$)
		
		Low Partial Credit
		• Work of merit in (a) **or** (b), for example:
		   in (a), one correct entry; indicates doubling; indication of 2^1, 2^2, or 2^3;
		   in (b), three correct entries in either domain or range; or full domain in place of range; or full range in place of domain (but see note below regarding *FC-1*)
		
		High Partial Credit
		• (b) correct
		• (a) correct **and** work of merit in (b)
		
		Full Credit –1
		• Apply a * for domain **and** range correct but swapped

(c),
(d)
	(c) 2, 4, 8, 16, 32, 64, 128, 256, 512
	       i.e. 9 [folds]
	
	(d) 512, 1024, 2048, 4096
	       i.e. $4 \cdot 096 \times 10^3$ [layers]
	            OR
	   2^{12} $= 4096$
	        $= 4 \cdot 096 \times 10^3$ [layers]
		Scale 10D (0, 2, 6, 9, 10)
		
		Accept correct answers without supporting work.
		
		Consider solution as requiring 3 steps:
		Step 1: solves part (c)
		Step 2: finds 4096 in part (d)
		Step 3: writes answer for (d) in correct form.
		
		Low Partial Credit
		• Work of merit in (c) **or** (d), for example: some correct continuation of candidate's pattern from (a); divides 500 by 2 (in (c)); some relevant use of 2^x
		
		Mid Partial Credit
		• 1 step correct (including expressing any number relevant to their solution in the form $a \times 10^n$)
		
		High Partial Credit
		• 2 steps correct

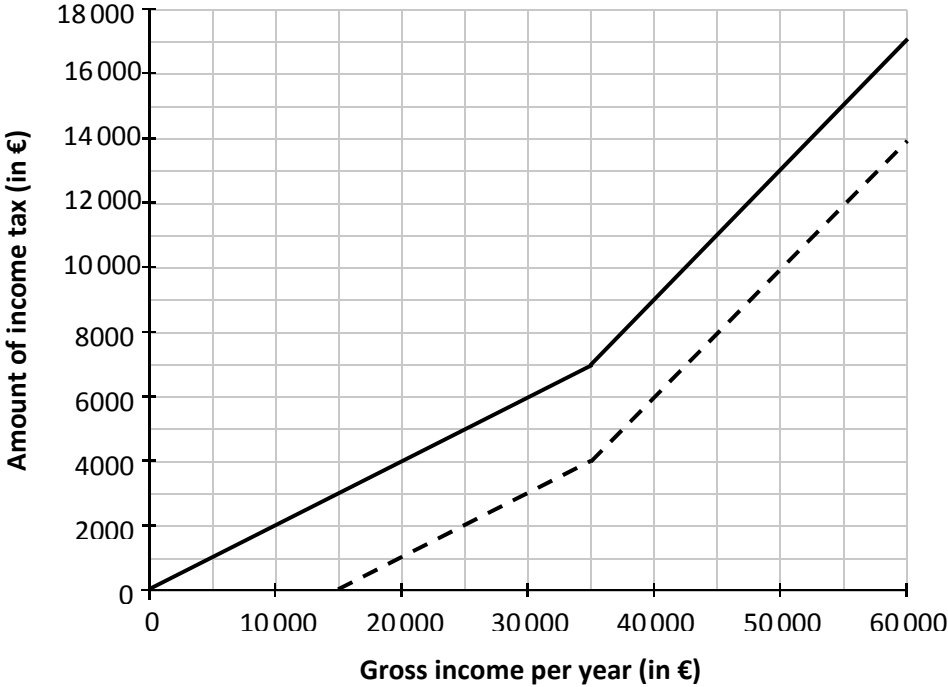| Q6	Model Solution – 40 Marks	Marking Notes
(e), (f)	**(e)** There will be more than 10 000 layers after 14 folds *or any other valid explanation* **(f)** *Answer*: Exponential *Reason*: It doubles each time **OR** The first differences are the same as the original sequence **OR** The variable is a power *or any other valid reason*	**Scale 10D (0, 2, 6, 9, 10)** *Low Partial Credit* • Work of merit in (e) **or** (f), for example: in (e), mentions 14 folds or 10 000 layers; in (f), correct box ticked; or shows understanding of linear / quadratic / exponential pattern. *Mid Partial Credit* • (e) **or** (f) correct • Work of merit in (e) **and** (f) *High Partial Credit* • One part correct **and** work of merit in the other part
(g), (h)	**(g)** $k \times 2 \times 2 \times 2 = 8k$ **(h)** $2^p \times 2 \times 2 \times 2$ $= 2^p \times 2^3 = 2^{p+3}$	**Scale 10C (0, 3, 7, 10)** Accept correct answers without supporting work. If a particular value is used for k or 2^p or p, award *LPC* at most, even if relevant work is presented in both (g) and (h) *Low Partial Credit:* • Work of merit in (g) **or** (h), for example: indicates multiplication by 2; indicates 8 in (g) *High Partial Credit* • (g) **or** (h) correct. • Work of merit in both (g) **and** (h)

Q7	Model Solution – 15 Marks	Marking Notes
(a)	Number of €5 notes Number of €2 coins 3 6 5 1 *or with Way 2 = (5, 1) and Way 3 = (3, 6)*	**Scale 5C (0, 2, 3, 5)** Accept correct answers without supporting work. *Low Partial Credit* • Some work of merit, for example: attempt at trial and improvement *High Partial Credit* • One way correct
(b)	All even numbers can be made using €2 coins. €5 is the smallest odd number which can be made. All remaining odd numbers can be made using a €5 note and the required number of €2 coins. **OR** No €2: 5, 10, 15, ... = all no's ending in 0 or 5 One €2: 7, 12, 17, ... = all no's ending in 2 or 7 Two €2: 4, 9, 14, ... = all no's ending in 4 or 9 Three €2: 6, 11, 16, ... = all no's ending in 6 or 1 Four €2: 8, 13, 18, ... = all no's ending in 8 or 3 **OR** $2k$ gives all even $5 + 2k$ gives all odd **OR** *or any other valid explanation*	**Scale 10C (0, 3, 7, 10)** Accept indication of how to make all possible values, without full explanation. *Low Partial Credit* • Some work of merit, for example: gives one way of making an amount other than €2 or €5 *High Partial Credit* • Shows how to make all values in one infinite subset of the natural numbers that are greater than 3, for example: all even numbers; or all (relevant) odd numbers; or all multiples of five

Q8	Model Solution – 25 Marks	Marking Notes
(a)	$x = \dfrac{-(-4) \pm \sqrt{(-4)^2 - 4(1)(-7)}}{2(1)}$ $= \dfrac{4 \pm \sqrt{16+28}}{2}$ $= \dfrac{4 \pm \sqrt{44}}{2}$ $= 5 \cdot 316\ldots$ or $-1 \cdot 316\ldots$ $= 5 \cdot 32$ or $-1 \cdot 32$ [2 D.P.]	**Scale 15C (0, 4, 12, 15)** Note: If one root is given, award *HPC* at most Consider the solution as having 3 steps: Step 1: Correct formula Step 2: Full correct substitution into the quadratic formula. Step 3: Evaluates the quadratic formula. *Low Partial Credit* • 1 step correct • Identifies a, or b, or c • Correctly factorised and stops • 1 correct answer without work *High Partial Credit* • 2 steps correct • 2 correct answers without work *Full Credit –1* • Apply a * for incorrect rounding, or for answers in surd form: $2 + \sqrt{11}$, $2 - \sqrt{11}$
(b)	*Answer*: **A** *Justification*: It is the only one that crosses the y-axis at -2 [and $f(0) = -2$] **OR** Not **C** because the roots are wrong, and not **B** because the y-intercept is wrong.	**Scale 10C (0, 3, 7, 10)** If multiple boxes are ticked, ignore all ticks (unless answer is clearly identified) Award *FC* if candidate inputs an x value into $f(x)$ and generates the corresponding y value that uniquely defines graph A. *Low Partial Credit* • Correct graph identified • Work of merit in justification, for example: explains why it is not B **or** C; shows understanding that graph crosses x-axis at roots *High Partial Credit* • Correct graph identified **and** work of merit in justification

Q9	Model Solution – 25 Marks	Marking Notes
(a)	$\frac{45}{15} \times 10\,000 = 30\,000$ [views]	**Scale 5B (0, 3, 5)** Accept correct answer without supporting work. *Partial Credit* • Work of merit, for example, some correct multiplication or division indicated including reciprocals
(b), (c)	(b) $\frac{80\,000}{10\,000} \times 15 = [\text{€}]120$ (c) $\frac{15}{10\,000} = [\text{€}]0{\cdot}0015$ **OR** $[\text{€}]1 \cdot 5 \times 10^{-3}$ **OR** $[\text{€}]\frac{3}{2000}$	**Scale 5D (0, 2, 3, 4, 5)** Accept correct answers without supporting work. Accept correct answers in euro, without unit. *Low Partial Credit* • Work of merit in (b) **or** (c), for example, some correct multiplication or division indicated, including reciprocals *Mid Partial Credit* • (b) **or** (c) correct • Work of merit in both (b) **and** (c) *High Partial Credit* • (b) **or** (c) correct **and** work of merit in the other part *Full Credit −1* • Correct answer(s) given in cent (with unit)
(d)	Profit = Revenue - Cost $[\text{€}]\, 0{\cdot}0015x - 70$	**Scale 5B (0, 3, 5)** Accept correct answer without supporting work. *Partial Credit* • One correct term in expression, for example: -70 • Correct relevant formula: Profit = Revenue – Cost

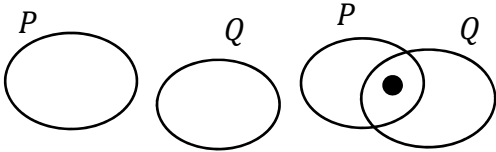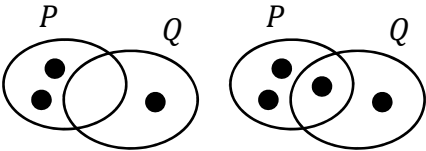| Q9	Model Solution – 25 Marks	Marking Notes
(e)	(i) $$\frac{0\cdot0015x-70}{7}=200$$ **OR** $$0\cdot0015x-70=1400$$ (ii) $$0\cdot0015x=1470$$ $$x=980\,000$$	**Scale 10D (0, 2, 6, 9, 10)** In (ii), correct answer without work is considered work of merit (rather than correct) *Note*: in (ii), candidate must deal adequately with the 15 and the 10 000, otherwise it is considered at most work of merit in (ii). *Low Partial Credit* • Work of merit in (i) **or** (ii), for example: (i) 7×200 ; (ii) 1470, or $\div15$, or $\times10\,000$ *Mid Partial Credit* • (i) **or** (ii) correct • Work of merit in (i) **and** (ii) *High Partial Credit* • One part correct **and** work of merit in the other part *Full Credit –1* • Apply a * for the -70 missing or misused in (e)

Q10	Model Solution – 30 Marks	Marking Notes
(a)	Balance = 50 000 − 35 000 = 15 000 20% of €35000 + 40% of €15000 $= \quad 0 \cdot 2 \times 35000 + 0 \cdot 4 \times 15000$ $= \quad 7000 + 6000$ $= \quad$ €13 000	**Scale 15C (0, 4, 12, 15)** Accept correct answer without supporting work. *Low Partial Credit* • Work of merit, for example finds 15 000 *High Partial Credit* • 7000 **or** 6000 calculated
(b)		
	Marking Notes for Q10(b) are on the next page.	

Q10	Model Solution – 30 Marks	Marking Notes
(b)	When $x = 35\,000$, $y = 0 \cdot 2 \times 35000 = 7000$ When $x = 60\,000$, Balance $= 60\,000 - 35\,000 = 25\,000$, so $y \quad = 7000 + (0 \cdot 4 \times 25000)$ $\quad\quad = 7000 + 10\,000 = 17\,000$	**Scale 10C (0, 3, 7, 10)** Accept correct answer without supporting work. Tolerance: 1,000 on x-axis and 500 on y-axis Note: Graph must have a change of slope at $x = 35\,000$ for Full Credit *Low Partial Credit* • Some correct relevant calculation • Given line continued correctly for one box • Plots $(50\,000, 13\,000)$ or $(35\,000, 7\,000)$ *High Partial Credit* • One section of graph correct, that is: given line continues until $x = 35\,000$ and stops; or correct line drawn from $x = 35\,000$ to $x = 60\,000$ • Graph correct below $x = 30\,000$ **and** from $x = 40\,000$ up to $x = 60\,000$
(c)	*See dotted line graph above.*	**Scale 5B (0, 3, 5)** Note: if incorrect graph is given in (b) in the domain $[\mathbf{15\,000}, \mathbf{60\,000}]$, award FC in (c) if it is shifted correctly. *Partial Credit* • Graph in (b) (over a domain of width at least 10 000) shifted vertically or horizontally • Some relevant calculation • Two points plotted correctly

Q11	Model Solution – 10 Marks	Marking Notes
	$-3 \leq x \leq 1, \qquad x \in \mathbb{Z}$ *or any other valid inequality*	**Scale 10D (0, 2, 6, 9, 10)** *Low Partial Credit* • Work of merit, for example: One correct box ticked; one inequality partially correct.
	$x \leq 3, \quad x \in \mathbb{N}$ **OR** $0 \cdot 5 < x < 4, \quad x \in \mathbb{Z} \text{ or } x \in \mathbb{N}$ *or any other valid inequality*	*Mid Partial Credit* • One part fully correct (inequality and matching domain) • Two inequalities correct, but incorrect or no box(es) ticked
	$-2 < x < 4, \quad x \in \mathbb{R}$	*High Partial Credit* • Two parts fully correct (inequality and matching domain) • Three inequalities correct, but incorrect or no box(es) ticked *Full Credit −1* • Apply a * the first time the strictness of an inequality is incorrect; ignore any subsequent such errors

Q12	Model Solution – 15 Marks	Marking Notes
(a)	$$\frac{2}{n-3} - \frac{5}{2n+5}$$ $$= \frac{2(2n+5) - 5(n-3)}{(n-3)(2n+5)}$$ $$= \frac{4n+10-5n+15}{(n-3)(2n+5)}$$ $$= \frac{-n+25}{(n-3)(2n+5)}$$ **OR** $$= \frac{-n+25}{2n^2-n-15}$$	**Scale 10D (0, 2, 6, 9, 10)** *Low Partial Credit* • Work of merit , for example: Correct common denominator; some correct multiplication implied in numerator • $\frac{2(n-3)-5(2n+5)}{(n-3)(2n+5)}$ and continues *Mid Partial Credit* • Numerator set up correctly and denominator correct • Two terms correct out of $4n+10-5n+15$ in numerator and finishes correctly • No or incorrect common denominator but numerator correct as per solution *High Partial Credit* • $\frac{4n+10-5n+15}{(n-3)(2n+5)}$ • 3 terms correct in numerator and finishes correctly • Correct answer without supporting work *Full Credit −1* • Shows common denominator as denominator in calculations but then drops it subsequently
(b)	$(4x-3)^2 + 24x$ $= 16x^2 - 12x - 12x + 9 + 24x$ $= 16x^2 - 24x + 9 + 24x$ $= 16x^2 + 9,$ and $x^2 \geq 0$ so $16x^2 + 9 > 0$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • Correctly evaluates the expression for one real value of x • $(4x-3)(4x-3)$ *High Partial Credit* • One correct term in multiplication of given expression • Indication that $(\ )^2 \geq 0$ *Full Credit −1* • $16x^2 + 9$, but with no conclusion

Q13	Model Solution – 15 Marks	Marking Notes
(a), (b)	(a) 1 Sometimes true 2 Never true 3 Always true 4 Always true (b) *Gives two examples: one where statement is true and one where statement is not true. For example:* True for {1, 2} and {3, 4}; False for {1, 2} and {1, 3}. **OR** True if $P = 7$ days of the week and $Q =$ months of year; False if $P = 7$ days of the week and $Q =$ days of the weekend **OR** True for: False for: **OR** True for: False for: **OR** States "True if $P \cap Q = \emptyset$, otherwise false." *or any other valid justification*	**Scale 15D (0, 3, 9, 13, 15)** *Low Partial Credit* • One statement correct in (a) • No statements correct in (a) but work of merit in (b), for example: answers "Always True" for Statement 1 and gives example where it is true *Mid Partial Credit* • Two statements correct in (a) • One statement correct in (a) **and** work of merit in (b), for example: Statement 1 correct and gives example where it is true (or where it is false) *High Partial Credit* • All four statements correct in (a) • Three statements correct in (a) **and** work of merit in (b) • One statement correct in (a) **and** (b) correct as per solution

Q14	Model Solution – 25 Marks	Marking Notes
(a)	$$\frac{(2n-5)(n+3)}{(n+3)(n-3)}$$ $$=\quad \frac{2n-5}{n-3}$$	**Scale 15C (0, 4, 12, 15)** *Low Partial Credit* • Work of merit in numerator or denominator, for example: guide number correctly identified in top line (-30 or 30) *High Partial Credit* • Numerator **or** denominator factorised correctly • Correct answer without work

(b)	(i) $(x+a)(x+b)=0$
	     $x+a=0$ or $x+b=0$
	     $x=-a$ or $x=-b$
	
	(ii) $(x+a)(x+b)\div(x+a)$
	     $=x+b$
		Scale 10C (0, 3, 7, 10)
		
		Accept correct answer without supporting work.
		
		Low Partial Credit
		• Work of merit in (i) **or** (ii), for example: replaces $x^2+(a+b)x+ab$ with $(x+a)(x+b)$
		• One correct term in answer if using long division in (ii)
		
		High Partial Credit
		• (i) **or** (ii) correct
		• Work of merit in (i) **and** (ii)

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 on this examination paper are summarised in this table:

Scale label	B	C	D
No of categories	3	4	5
5-mark scale	0, 3, 5	0, 2, 3, 5	0, 2, 3, 4, 5
10-mark scale		0, 3, 7, 10	0, 2, 6, 8, 10
15-mark scale		0, 6, 10, 15	0, 5, 9, 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 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*.

Summary of mark allocations and scales to be applied

Question 1 (15)

| (a), (b) | 10C |
| (c) | 5B |

Question 2 (25)

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

Question 3 (30)

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

Question 4 (25)

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

Question 5 (15)

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

Question 6 (40)

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

Question 7 (30)

(a)	15D
(b)(i)	10D
(b)(ii)	5C

Question 8 (10)

| | 10C |

Question 9 (10)

| | 10D |

Question 10 (35)

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

Question 11 (15)

| | 15D |

Question 12 (30)

(a)	5B
(b)	5C
(c)	20D

Question 13 (15)

| (a) | 5B |
| (b) | 10D |

Question 14 (5)

| | 5D |

Model Solutions & Marking Notes

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

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

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

Q1	Model Solution – 15 Marks	Marking Notes
(a), (b)	(a) $\quad X = 40°$ (b) $\quad$ Triangle *AOD* is isosceles $\quad Y = \frac{180-40}{2} = \frac{140}{2} = 70°$ **OR** $\mid$angle *BOD*$\mid = 2Y$ $\quad 140 = 2Y$ $\quad Y = 70°$	**Scale 10C (0, 3, 7, 10)** Accept correct answers without work. Accept correct answers given on diagram. *Low Partial Credit* • (a) correct • Work of merit in (b), for example: indicates that *AOD* is isosceles; mentions 180°; indicates that exterior angle equals sum of interior opposite angles; *High Partial Credit* • (a) correct **and** work of merit in (b) • (b) correct *Full Credit –1* • Apply a * for no or incorrect units Apply it only the first time it occurs (in (a) or in (b))

Q1	Model Solution – 15 Marks	Marking Notes
(c)	$Y + Z = 180°$ [opposite angles in a cyclic quadrilateral] $Z = 180 - 70 = 110°$ **OR** $2Z = |$reflex angle $BOD|$ $2Z = 220$ $Z = 110°$	**Scale 5B (0, 3, 5)** Accept correct answer without work. Accept correct answer on diagram for work. *Partial Credit* • Work of merit, for example: correct relevant statement about cyclic quadrilateral $ABCD$; angle at the centre is twice angle at the circumference; mentions 140° or 220°; extends [*OA*] beyond *A* *Full Credit −1* • Apply a * for no or incorrect units, if it has not already been applied in (a) or (b)

Q2	Model Solution – 25 Marks	Marking Notes
(a)	Volume $= 5 \times 14 \times 24$ $= 1680 \ [\text{cm}^3]$	**Scale 5B (0, 3, 5)** Accept correct answer without work. Accept correct answer without units. *Partial Credit* • Correct volume formula • Finds the area of one face
(b)	Height: $(4 \times 5) + 2 = 22 \ [\text{cm}]$ Width: $(3 \times 14) + 2 = 44 \ [\text{cm}]$ Length: $(3 \times 24) + 2 = 74 \ [\text{cm}]$	**Scale 10D (0, 2, 6, 8, 10)** Accept correct answers without work. Accept correct answers without units. *Low Partial Credit* • Some correct relevant calculation *Mid Partial Credit* • One dimension (including the cover) correctly calculated • Two dimensions correct, with the cover ignored or mishandled *High Partial Credit* • Two dimensions (including the cover) correctly calculated • Three dimensions correct, with the cover ignored or mishandled *Full Credit – 1* • Apply a * for answers in incorrect boxes

Q2	Model Solution – 25 Marks	Marking Notes
(c)	*Total volume including plastic, minus total volume excluding plastic*: $$(22 \times 44 \times 74) - (36 \times 1680)$$ $$= \quad 71\,632 - 60\,480$$ $$= \quad 11\,152 \text{ cm}^3$$ **OR** *Volume of 6 sheets of plastic (there are a number of different ways of doing this)*: $$22 \times 44 \times 2 = 968 \times 2 \times 1 = 1936$$ $$+ \quad 22 \times 72 \times 2 = 1584 \times 2 \times 1 = 3168$$ $$+ \quad \underline{42 \times 72 \times 2 = 3024 \times 2 \times 1 = 6048}$$ $$= 11\,152 \text{ cm}^3$$ **OR** *Volume of plastic excluding edges and corners, plus volume of edges and corners* $$2[(20 \times 42) + (20 \times 72) + (42 \times 72)]$$ $$+ \quad \underline{4(20 + 42 + 72) + 8}$$ $$= 2[840 + 1440 + 3024] + 4(134) + 8$$ $$= \quad 10\,608 + 536 + 8$$ $$= \quad 11\,152 \text{ cm}^3$$ *or any other valid method*	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit* • Work of merit, for example: correct area/volume formula; calculates a relevant volume (other than that in part (a)) • 36×1680 *High Partial Credit* • Finds total volume including cover (71 632) **or** total volume excluding cover (60 480) • Finds volume of plastic cover correctly but mishandles edges and/or corners, for example: finds total surface area including cover (11 704) **or** total surface area excluding cover (10 608) • Correct answer without work *Full Credit −1* • Apply a * for no or incorrect units

Q3	Model Solution – 30 Marks	Marking Notes
(a)	$l^2 = r^2 + h^2$ $l^2 = 5^2 + 12^2$ $l^2 = 25 + 144$ $l^2 = 169$ $l = 13$ cm	**Scale 10C (0, 3, 7, 10)** Accept correct answer without work. *Low Partial Credit* • Correct formula *High Partial Credit* • $l^2 = 169$ • One error and finishes correctly, for example: $l = \sqrt{34}$; $l = \sqrt{119}$ *Full Credit -1* • Apply a * for no or incorrect units
(b)	TSA $= \pi(5)(13) + \pi(5)^2$ $= 65\pi + 25\pi = 90\pi$ $= 282 \cdot 74...$ [cm²] $= 282 \cdot 7$ [cm²] [1 D.P.]	**Scale 10C (0, 3, 7, 10)** Accept correct answer without units. *Low Partial Credit* • A correct relevant formula (curved surface area or area of circle) • Total surface area of cylinder formula *High Partial Credit* • Fully correct substitution into correct formulae • Finds curved surface area only • One error and finishes correctly, for example, total surface area of a cylinder • Correct answer without work *Full Credit – 1* • Apply * for 90π • Apply * for no or incorrect rounding

Q3	Model Solution – 30 Marks	Marking Notes
(c)	Circle: Radius of circle $= 5$ [cm] Circumference $= 2\pi(5) = 31 \cdot 41 \ldots$ $\qquad\qquad\quad = 31 \cdot 4$ [cm] [1 D.P.] Sector: Radius of Sector $= 13$ [cm] Length of Arc $= 31 \cdot 4$ [cm]	**Scale 10D (0, 2, 6, 8, 10)** Accept correct answers without units. Accept correct answers without work. Accept correct answers in incorrect or no boxes for up to *High Partial Credit.* A length measured from the diagram of the net is **not** considered correct. *Low Partial Credit* • Some correct relevant calculation indicated • Correct relevant formula • One measurement correct *Mid Partial Credit* • Two measurements correct *High Partial Credit* • Three measurements correct *Full Credit – 1* • Apply a * for no or incorrect rounding, once only
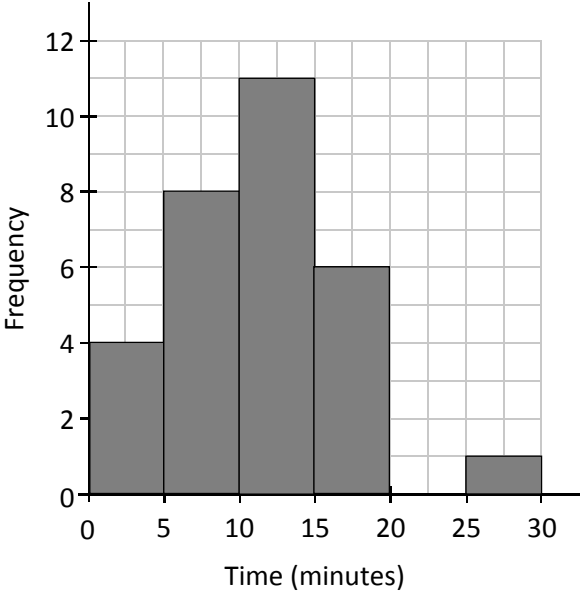
Q4	Model Solution – 25 Marks	Marking Notes
(a), (b)	**(a)** $\quad P(\text{Win}) = \frac{1}{3}$ **(b)** <table><tr><td>**WW**</td><td>**WD**</td><td>**WL**</td></tr><tr><td>**DW**</td><td>**DD**</td><td>**DL**</td></tr><tr><td>L W</td><td>**LD**</td><td>**LL**</td></tr></table>	**Scale 10D (0, 2, 6, 8, 10)** Accept correct answers without work. *Low Partial Credit* • (a) correct • One correct entry in (b) *Mid Partial Credit* • (a) correct **and** three correct entries in (b) • five correct entries in (b) • All eight entries in (b) listed *High Partial Credit* • (a) correct **and** five correct entries in (b) • (a) correct **and** all eight entries in (b) listed • (b) correct *Full Credit – 1* • Apply a * for (a) correct and all eight entries in (b) reversed
(c)	**(i)** $P(WL) = \frac{1}{9}$ or $0 \cdot 11 \dots$ **(ii)** $P(\text{at least one } W) = \frac{5}{9}$ or $0 \cdot 55 \dots$	**Scale 10C (0, 3, 7, 10)** Accept correct answers without work. *Low Partial Credit* • Work of merit in (i) **or** (ii), for example: correct numerator **or** denominator; lists some or all relevant outcomes; use of some relevant fraction, for example $\frac{1}{3}$ *High Partial Credit* • (i) **or** (ii) correct *Full Credit – 1* • Apply a * for no indication of recurrence

Q4	Model Solution – 25 Marks	Marking Notes

(d)	(i)
	
	Total outcomes $= 3 \times 3 \times 3 = 27$
	
	OR
	
	Lists: WWW WWD WWL
	        WDW WDD WDL
	        WLW WLD WLL
	
	        DWW DWD…
	
	Answer $= 27$
	
	(ii)
	P(doesn't win) $= \dfrac{2^3}{27} = \dfrac{8}{27}$
	
	OR
	
	Lists: DDD LDD
	        DDL LDL
	        DLD LLD
	        DLL LLL
	
	Answer $= \dfrac{8}{27}$
		Scale 5C (0, 2, 3, 5)
		Accept correct answers without work.
		Low Partial Credit
		• Work of merit in (i) **or** (ii), for example: lists some relevant outcomes in either part; correct numerator **or** denominator in (ii)
		
		High Partial Credit
		• (i) **or** (ii) correct
		
		• Work of merit in (i) **and** (ii)

Q5	Model Solution – 15 Marks	Marking Notes
(a)	(i) Range $= 15 - 3 = 12$ [minutes] (ii) $\quad Q_1 = \frac{6+7}{2} = 6 \cdot 5$ $\quad\quad Q_3 = \frac{13+14}{2} = 13 \cdot 5$ $\quad\quad$ IQR $= 13 \cdot 5 - 6 \cdot 5 = 7$	**Scale 10D (0, 2, 6, 8, 10)** Accept correct answers without work. Accept correct answers without units. Accept any value of Q_1 in the range $6 \leq Q_1 \leq 7$, and any value of Q_3 in the range $13 \leq Q_2 \leq 14$. However, if the IQR is not being given as 7, work must be shown in order for it to be considered correct. In order to be considered correct, both the range and IQR must be given as values rather than as intervals. *Low Partial Credit* • Work of merit in (i) **or** (ii), for example: identifies min **or** max; indicates Q1 **or** Q3 *Mid Partial Credit* • (i) correct • Work of merit in (i) **and** (ii) • Finds value of Q1 **and** Q3 *High Partial Credit* • (i) correct **and** finds value of Q1 **and** Q3 • (ii) correct • (i) **and** (ii) both given as intervals, otherwise correct
(b), (c)	(b) $\quad \frac{1}{4}$ of Range: B $\quad\quad \frac{1}{2}$ of Range: A $\quad\quad \frac{3}{4}$ of Range: C (c) Most of the data is grouped near the middle, so the middle 50% will be squashed into the smallest interval [relative to the range] *or any other valid justification*	**Scale 5D (0, 2, 3, 4, 5)** *Low Partial Credit* • One correct entry in (b) • Work of merit in (c), for example: some relevant reference to the spread of data; reference to the middle 50% *Mid Partial Credit* • One correct entry in (b) **and** work of merit in (c) *High Partial Credit* • (b) correct • Histogram B correct in table **and** (c) correct

Q6	Model Solution – 40 Marks	Marking Notes
(a)	Mean $= \frac{\text{sum}}{14} = \frac{122 \cdot 2}{14} = 8 \cdot 72 \ldots = 8 \cdot 7$ kg [1 D.P.]	**Scale 5C (0, 2, 3, 5)** Accept correct answer without work. *Low Partial Credit* • Work of merit, for example: indicates division by 14, indicates sum of values *High Partial Credit* • $\frac{122 \cdot 2}{14}$ *Full Credit –1* • Apply a * for no or incorrect units • Apply a * for no or incorrect rounding
(b), (c)	(b) Girls: 1 2 2 3 7 0 1 Boys: 1 1 1 4 6 1 0 (c) Answer: No, Eoin is not correct. Reason: The means are roughly the same **OR** The boys' mean is slightly bigger **OR** The distributions in the frequency table are very similar *or any other valid reason*	**Scale 10D (0, 2, 6, 8, 10)** *Low Partial Credit* • Work of merit in (b) **or** (c), for example: in (b), 4 correct values; in (c), answer correct; work of merit in justification *Mid Partial Credit* • Work of merit in (b) **and** (c) • (b) **or** (c) correct *High Partial Credit* • (b) **or** (c) correct, **and** work of merit in the other part *Full Credit –1* • Apply a * for one incorrect entry in (b), otherwise correct

Q6	Model Solution – 40 Marks	Marking Notes
(d)	**Length of time taken to get through security** *[Histogram plotted with Frequency on vertical axis (0 to 12) and Time (minutes) on horizontal axis (0 to 30). Bars: 0–5 at height 4, 5–10 at height 8, 10–15 at height 11, 15–20 at height 6, 25–30 at height 1.]*	**Scale 10C (0, 3, 7, 10)** Accept frequency defined by area key or by scale on frequency axis. *Low Partial Credit* • Work of merit, for example: one axis correctly graduated; one correct bar drawn *High Partial Credit* • Three correct bars in histogram • All bars of correct height, but with gaps between them *Full Credit −1* • Apply a * if one or both axes are incorrectly labelled or not labelled • Apply a * if time scale and/or frequency scale is not shown

Q6	Model Solution – 40 Marks	Marking Notes
(e)	$\dfrac{(2 \cdot 5 \times 5)+(7 \cdot 5 \times 4)+(15 \times 7)+(25 \times 8)+(40 \times 3)+(75 \times 1)+(125 \times 2)}{30}$ $= \dfrac{12 \cdot 5+30+105+200+120+75+250}{30}$ $= \dfrac{792 \cdot 5}{30} = 26 \cdot 416 \ldots$ $= [€]\ 26 \cdot 42$ [nearest cent]	**Scale 10C (0, 3, 7, 10)** Accept correct answer without work. Accept correct answer without units. Accept use of $0 - 4 \cdot 99,\ 5 - 9 \cdot 99$, *etc.* *Low Partial Credit* • Work of merit, for example: indicates division by 30; one correct mid-interval value; numerator with consistent incorrect mid-interval values *High Partial Credit* • Consistent incorrect mid-interval values, finished correctly • Numerator correct, whether evaluated to $792 \cdot 5$ or not • One error and finishes correctly *Full Credit −1* • Apply a * for no or incorrect rounding
(f)	Median $=$ mean of 15th and 16th values Last 2 people in $10 - 20$ class are 15th and 16th, so median is between them. For example, $[€]\ 18 \cdot 50$.	**Scale 5B (0, 3, 5)** Accept any subset of the interval $[15 - 20]$ for *Full Credit*. Accept correct answer without euro symbol. *Partial Credit* • Work of merit, for example: shows understanding of median as middle value *Full Credit − 1* • Apply a * for $10 - 20$ class identified • Apply a * for answer with no justification

Q7	Model Solution – 30 Marks	Marking Notes
(a)	(i) Angle $= 90°$ (ii) slope of $n = -\frac{5}{2}$ Eqn: $y - (-1) = -\frac{5}{2}(x - 6)$	**Scale 15D (0, 5, 9, 12, 15)** Accept correct answers without work. *Low Partial Credit* • Work of merit in (i) **and/or** (ii), for example: in (i), mentions right angle; in (ii), finds slope of n; correct relevant formula ($y = mx + c$ or $y - y_1 = m(x - x_1)$) *Mid Partial Credit* • (i) **or** (ii) correct *High Partial Credit* • (i) **or** (ii) correct, **and** work of merit in the other part *Full Credit –1* • Apply a * for no or incorrect units in (i)
(b) (i)	Line Slope Point k 1 $(0, -1)$ l $\frac{2}{3}$ $(0, -2)$	**Scale 10D (0, 2, 6, 8, 10)** Accept correct answers without work. *Low Partial Credit* • Work of merit towards finding one value, for example: $y = mx + c$; $x = 0$ • One correct entry in table *Mid Partial Credit* • Two correct entries in table *High Partial Credit* • Three correct entries in table *Full Credit –1* • Apply a * if the point(s) where the line crosses the y-axis are given as a value (-1 or -2) instead of a point, or if the co-ordinates are reversed, once only

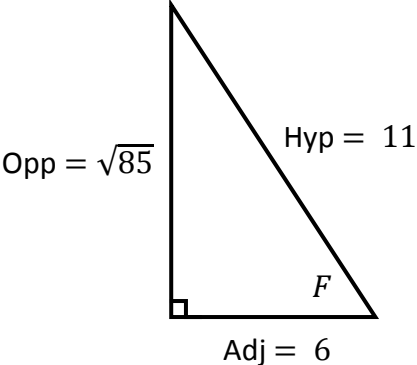| Q7	Model Solution – 30 Marks	Marking Notes
(b) (ii)	$$y = x - 1$$ so $\quad 2x - 3(x - 1) = 6$ so $\quad -x + 3 = 6$ so $\quad x = -3$ and $\quad y = -3 - 1 \ = -4$ Answer: $(-3, -4)$ **OR** $$x - y = 1$$ $$2x - 3y = 6$$ so $\quad -2x + 2y = -2$ $$2x - 3y = 6$$ so $\quad -y = 4 \rightarrow y = -4$ so $\quad x - (-4) = 1 \rightarrow x = -3$ Answer: $(-3, -4)$	**Scale 5C (0, 2, 3, 5)** Accept "$x = -3$ and $y = -4$" for *Full Credit*. *Low Partial Credit* • Work of merit in solving the simultaneous equations algebraically, for example: substitution of $x - 1$ into second equation; rearranges one equation • Correct answer without work or based on construction *High Partial Credit* • Solves for one variable ($x = -3$ or $y = -4$) with supporting algebraic work • One error and finishes correctly • Correct answer with some (non-algebraic) justification, for example: subbed into both equations; reasoning based on y-intercepts and slopes

Q8	Model Solution – 10 Marks	Marking Notes
	Answer: 51 *Justification:* Slope $= -2$ So for every unit across we drop 2 units. So positive integer y-values are: 101, 99, 97, ... , 1. There are 51 odd numbers between 0 and 101 inclusive. **OR** Equation: $y - 101 = -2(x - 1)$ so $\quad y = -2x + 103$ Cuts x-axis when $y = 0$, so $x = 51 \cdot 5$. So required points are when $x = 1$ to 51, inclusive [as all of these points have positive integer y-values] *or any other valid justification*	**Scale 10C (0, 3, 7, 10)** *Low Partial Credit* • Work of merit, for example: finds another point on the line; relevant formula; shows understanding of meaning of slope in context *High Partial Credit* • Finds equation of line • Indicates relevance of odd numbers • One error and finishes correctly • Correct answer without work *Full Credit –1* • Apply a * if $(0, 103)$ is included

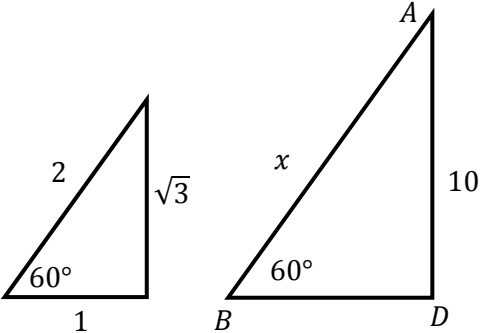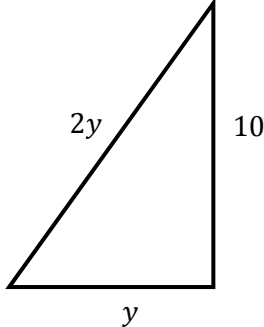| Q9	Model Solution – 10 Marks	Marking Notes
	2. $|QT| = |ST|$ 3. angles opposite equal sides in an isosceles triangle are equal 4. $|QK| = |SK|$ 5. SAS [Side Angle Side] *or any other valid and appropriate statements / reasons*	**Scale 10D (0, 2, 6, 8, 10)** A statement/reason may be accepted as correct even if the previous statements/reasons are not correct. *Low Partial Credit* • One statement/reason correct *Mid Partial Credit* • Two statements/reasons correct *High Partial Credit* • Three statements/reasons correct

Q10	Model Solution – 35 Marks	Marking Notes

(a)	$2 \cdot 1 \div 0 \cdot 175 = 12$ steps
	
	$12 \times 0 \cdot 25 = 3$ metres
	
	OR
	
	$$\frac{x}{2 \cdot 1} = \frac{250}{175}$$
	
	$x = \frac{2 \cdot 1(250)}{175} = 3$ metres
		Scale 15C (0, 6, 10, 15)
		
		Accept 12 risers and 11 treads
		[i.e. top riser has no associated tread],
		so sum of treads $= 11 \times 0 \cdot 25 = 2 \cdot 75$ metres
		
		Low Partial Credit
		
		• Work of merit, for example:
		  identifies correct tread or riser;
		  some relevant calculation, even if using an
		  incorrect tread and/or riser value from table
		
		High Partial Credit
		
		• A correct relevant ratio, for example: $\frac{2 \cdot 1}{0 \cdot 175}, \frac{250}{175}$
		  or equivalent
		
		• Uses incorrect tread and/or riser value from
		  table, but finishes correctly
		
		• Correct answer without work
		
		Full Credit –1
		
		• Apply a * for no or incorrect units

Q10	Model Solution – 35 Marks	Marking Notes
(b)	$\tan A = \dfrac{2\cdot1}{3} = \dfrac{175}{250} = \dfrac{7}{10}$ $A = \tan^{-1}\dfrac{7}{10}$ $A = 34\cdot9\ldots = 35°$ [nearest degree] **OR** $x^2 = \sqrt{175^2 + 250^2} = \sqrt{93\,125}$ $\sin A = \dfrac{175}{\sqrt{93\,125}} = 0\cdot573\ldots$ $A = 34\cdot9\ldots = 35°$ [nearest degree] **OR** $x^2 = \sqrt{175^2 + 250^2} = \sqrt{93\,125}$ $\cos A = \dfrac{250}{\sqrt{93\,125}} = 0\cdot819\ldots$ $A = 34\cdot9\ldots = 35°$ [nearest degree]	**Scale 15C (0, 6, 10, 15)** Accept correct answer with no units. *Low Partial Credit* • Work of merit, for example: correctly identifies opposite or adjacent sides; identifies a correct measurement on diagram; identifies A in small triangle on given diagram • A correct trigonometric ratio • Incorrect trigonometric ratio, for example: $\tan A = \dfrac{10}{7}$ or $\cos A = \dfrac{175}{250}$, and finishes correctly *High Partial Credit* • A correct trigonometric ratio fully subbed in • $\tan A = \dfrac{2\cdot1}{2\cdot75}$ and finishes correctly $(37\cdot3\ldots = 37°$ [nearest degree]) • Correct answer with no work *Full Credit −1* • Apply a * for no or incorrect rounding • Apply a * if the answer is given in radians $(0\cdot6\ldots = 1$ [nearest unit]) or gradients $(38\cdot8\ldots = 39$ [nearest unit])
(c)	Tread = 280 [mm] Riser = 180 [mm]	**Scale 5B (0, 3, 5)** Accept correct answers without units. *Partial Credit* • Tread **or** riser correct. • Tread **and** riser correct for a private building (Tread = 220 mm and Riser = 220 mm) *Full Credit −1* • Apply a * for answers swapped (Tread = 180; Riser = 280)

Q11	Model Solution – 15 Marks	Marking Notes
	$\cos F = \dfrac{6}{11} = \dfrac{\text{adj}}{\text{hyp}}$ Hyp $=\ 11$, Opp $= \sqrt{85}$, Adj $=\ 6$, F $\text{Hyp}^2 = \text{Opp}^2 + \text{Adj}^2$ $(11)^2 = x^2 + (6)^2$ $x^2 = 121 - 36 = 85$ $x = \sqrt{85}$ $\sin F = \dfrac{\sqrt{85}}{11}$	**Scale 15D (0, 5, 9, 12, 15)** Consider the solution as requiring four steps: Step 1: Diagram with F, 6, and 11 marked correctly Step 2: Pythagoras Theorem fully subbed Step 3: Length of opposite side found Step 4: Value of $sin\,F$ found For Step 4 to be considered correct, length of 3rd side must have been worked out. *Low Partial Credit* • Work of merit, for example: adj or hyp correctly identified (including on diagram); correct relevant formula • One step correct *Mid Partial Credit* • Two steps correct • $\sin 57^{\text{o}} = 0 \cdot 838..$ with or without diagram • Uses 6 and 11 as opp and adj and finishes correctly *High Partial Credit* • Three steps correct • One error and continues correctly • Correct answer without work *Full Credit-1* • Apply a * if answer is not given in surd form $(0 \cdot 838...)$

Q12	Model Solution – 30 Marks	Marking Notes
(a)	axial symmetry in the line AD	**Scale 5B (0, 3, 5)** *Partial Credit* • Mentions AD • Mirror image • Axis of symmetry *Full Credit – 1* • Apply a * for axial symmetry / line symmetry / reflection in a line, but axis not specified

Q12	Model Solution – 30 Marks	Marking Notes
(b)	$$\sin 60 = \frac{10}{|AB|}$$ $$|AB| = \frac{10}{\sin 60}$$ $$|AB| = \frac{20}{\sqrt{3}} \text{ [cm]} \text{ or } \frac{20\sqrt{3}}{3} \text{ [cm]}$$ **OR** $$\frac{x}{2} = \frac{10}{\sqrt{3}} \quad \text{or} \quad \frac{x}{10} = \frac{2}{\sqrt{3}}$$ $$x = \frac{2 \times 10}{\sqrt{3}} = \frac{20}{\sqrt{3}} \text{ [cm]} \text{ or } \frac{20\sqrt{3}}{3} \text{ [cm]}$$ **OR** $$(2y)^2 = (y)^2 + (10)^2$$ $$4y^2 = y^2 + 100$$ $$3y^2 = 100$$ $$y^2 = \frac{100}{3}$$ $$y = \frac{10}{\sqrt{3}}$$ so $2y = \frac{20}{\sqrt{3}}$ [cm] or $\frac{20\sqrt{3}}{3}$ [cm]	**Scale 5C (0, 2, 3, 5)** Accept correct answer without units. If calculator is in incorrect mode (radians or gradients), award at most *HPC*. *Low Partial Credit* • Some work of merit, for example: relevant drawing with some correct labelling; a correct trigonometric ratio; Pythagoras Theorem • Incorrect trigonometric ratio with $|AB|$ in numerator, for example $\tan 60 = \frac{|AB|}{10}$, and finishes correctly *High Partial Credit* • $\sin 60 = \frac{10}{|AB|}$ or equivalent (for example, $\frac{x}{2} = \frac{10}{\sqrt{3}}$, $y = \frac{10}{\sqrt{3}}$) • Pythagoras Theorem fully subbed correctly (including $2y$ or $\frac{x}{2}$) • Incorrect trigonometric ratio with $|AB|$ in denominator, for example $\tan 60 = \frac{10}{|AB|}$, and finishes correctly • Square(s) mishandled in Pythagoras Theorem, otherwise correct • Correct answer without work *Full Credit –1* • Apply a * if answer is not given in surd form $(11 \cdot 54 \ldots)$

Q12	Model Solution – 30 Marks	Marking Notes
(c)	*Construction 1:* Perpendicular bisector of $[BC]$, extended at least to A *Construction 2:* Bisector of angle at B or C *Construction 3:* Circle k *See diagram below.*	**Scale 20D (0, 5, 10, 15, 20)** Tolerance: AD ± 2 mm, angle bisector ± 2º, circle within 2 mm of at least one point of contact. Accept bisector of angle at A for Construction 1, as long as it is extended at least to D. *Low Partial Credit* • Work of merit in one construction, for example: a relevant construction arc drawn *Mid Partial Credit* • Work of merit in construction 1 **and** construction 2 • Construction 1 **or** 2 correct • Drawing completed within tolerance but with both Construction 1 **and** Construction 2 missing construction lines *High Partial Credit* • Construction 1 **and** 2 correct • Drawing completed within tolerance but with Construction 1 **or** Construction 2 missing construction lines **or** with Construction 1 not fully extended between A and D

Q12	Model Solution – 30 Marks	Marking Notes
(c)		

Q13	Model Solution – 15 Marks	Marking Notes
(a)	S.A. $= 4\pi(9)^2$ $\quad\quad = 324\pi$ [m^2]	**Scale 5B (0, 3, 5)** Accept correct answer without work. Accept correct answer without units. *Partial Credit* • Correct formula • Calculates volume of a sphere correctly (i.e. 972π [m^3]) • $k\pi r^2$ correctly calculated (for $k \neq 4$) *Full Credit −1* • Apply a * if π omitted (i.e. 324 [m^2]) • Apply a * if answer is not given in terms of π
(b)	*Check extreme values, $r = 8$ and $r = 10$.* $r = 8$: S.A. $= 4\pi(8)^2 = 256\pi$ Error $= 324\pi - 256\pi = 68\pi$ % error $= \frac{68\pi}{256\pi} \times 100 = 26 \cdot 5 \ldots = 27\%$ $\quad\quad\quad$ [nearest percent] $r = 10$: S.A. $= 4\pi(10)^2 = 400\pi$ Error $= 400\pi - 324\pi = 76\pi$ % error $= \frac{76\pi}{400\pi} \times 100 = 19\%$ Max value = 27%	**Scale 10D (0, 2, 6, 8, 10)** If candidate was awarded *Partial Credit* in (a) for finding the volume of a sphere, do not penalise candidate in (b) for using volume rather than surface area (max $= 42 \cdot 3 \ldots = 42\%$ [nearest %]). *Low Partial Credit* • Work of merit, for example: correct relevant formula; states error = 1 m *Mid Partial Credit* • Finds surface area when $r = 8$ **or** $r = 10$ *High Partial Credit* • Finds surface area when $r = 8$ **and** $r = 10$ • Finds % error when $r = 8$ **or** $r = 10$ including if estimate from (a) used as denominator *Full Credit −1* • Apply a * if both percentage errors found but max value not identified

Q14	Model Solution – 5 Marks	Marking Notes
	$$\frac{2}{6}\pi R^2 = \pi r^2$$ $$\frac{1}{3}R^2 = \left(\frac{9}{2}\right)^2$$ $$\frac{1}{3}R^2 = \frac{81}{4}$$ $$R^2 = \frac{243}{4}$$ $$R = \sqrt{\frac{243}{4}} = \sqrt{\frac{3^5}{4}}$$ $$R = \frac{3^{\frac{5}{2}}}{2} \text{ [inches]}$$	**Scale 5D (0, 2, 3, 4, 5)** Accept correct answer without units Consider solution as requiring four steps: Step 1: $\frac{2}{6}\pi R^2$ and $\pi\left(\frac{9}{2}\right)^2$ Step 2: Sets up equation Step 3: Isolates R^2 $(=\frac{243}{4})$, or equivalent (for example, isolates R if circumference is being used) Step 4: Finds R in required form Note: if circumference used instead of area, then candidate can be considered to have at most steps 2 and 3 correct. *Low Partial Credit:* • Work of merit, for example: finds radius of small pizza; correct formula *Mid Partial Credit* • 2 steps correct *High Partial Credit* • 3 steps correct (including correct answer in incorrect form, for example: $7 \cdot 79 \dots$ or $\frac{9\sqrt{3}}{2}$)

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		Bunmharc	Marc Bónais
226	11		261 - 266	5
227 - 233	10		267 - 273	4
234 - 240	9		274 - 280	3
241 - 246	8		281 - 286	2
247 - 253	7		287 - 293	1
254 - 260	6		294 - 300	0