Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Cycle 2022

Marking Scheme

Mathematics

Ordinary Level

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

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

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

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

Future Marking Schemes

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

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	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, 5, 10	0, 4, 7, 10	0, 3, 5, 8, 10
15-mark scale			0, 5, 10, 15	0, 6, 10, 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*. 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 (20)

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

Question 2 (35)

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

Question 3 (30)

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

Question 4 (10)

(a)	5C
(b)	5C

Question 5 (15)

(a)	5A
(b), (c)	5B
(d)	5B

Question 6 (30)

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

Question 7 (25)

(a)	15D
(b)	10D

Question 8 (30)

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

Question 9 (15)

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

Question 10 (10)

(a)	5C
(b)	5C

Question 11 (25)

(a)(i)	10C
(a)(ii)	5A
(b)	5C
(c)	5B

Question 12 (20)

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

Question 13 (5)

5D

Model Solutions & Marking Notes

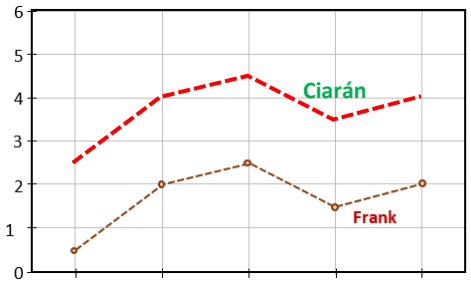
Note: The model solutions for each question are not intended to be exhaustive – there may be other correct solutions. Any Examiner unsure of the validity of the approach adopted by a particular candidate to a particular question should contact his / her Advising Examiner.

Where "work of merit" is referred to in the marking notes, example(s) are given to demonstrate the standard of work to be considered work of merit in that particular question.

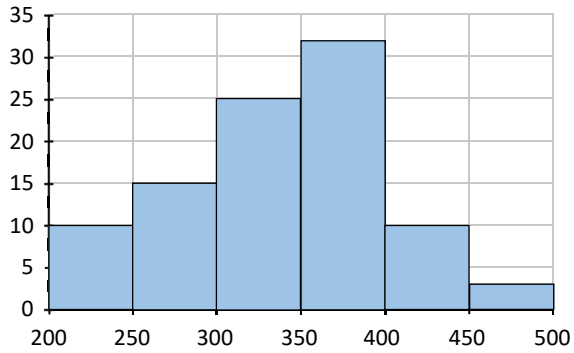
Q1	Model Solution – 20 Marks	Marking Notes
(a)	**(i)** 421 **(ii)** $\frac{216}{5}$ or $43 \cdot 2$ **(iii)** $24 \div 2 = 12$ **(iv)** 81	**Scale 15D (0, 6, 10, 12, 15)** *Low Partial Credit* • Work of merit in one part, for example: 9 – 7 in part (iii) *Mid Partial Credit* • 2 correct *High Partial Credit* • 3 correct
(b), (c)	**(b)** 16 **(c)** $30 - 16 = 14$ $14 \div 2 = 7$ $16 + 7 = 23$ **OR** $\frac{16+30}{2} = \frac{46}{2} = 23$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • Work of merit in one part, for example: in (**b**), answer of 15; in (**c**), a relevant operation indicated, or begins to list numbers from 16 to 30 *High Partial Credit* • 1 part correct • Work of merit in both parts

Q2	Model Solution – 35 Marks	Marking Notes
(a)	**(i)** $18{\cdot}95 + 4{\cdot}95 = [€]23{\cdot}90$ **(ii)** $50 - 23{\cdot}90 = [€]26{\cdot}10$	**Scale 15C (0, 5, 10, 15)** Accept correct answers with no or incorrect unit *Low Partial Credit* • A correct value chosen from one table • Adds two incorrect figures from the different tables, e.g. 15.95 + 4.50 = 20.45 *High Partial Credit* • (i) or (ii) correct
(b)	$4 \times 3 = 12$	**Scale 5B (0, 2, 5)** *Partial Credit* • Work of merit, for example: some relevant listing *Full Credit (-1)* • Lists all 12 possible outcomes or the other 11 possible outcomes
(c)	$72 \times \frac{15}{100} = 10{\cdot}8 = [€]11$	**Scale 5B (0, 2, 5)** *Partial Credit* • Work of merit, for example: relevant use of 72 or 15% *Full Credit (-1)* • No rounding or incorrect rounding
(d)	3 people: €96 1 person: $96 \div 3 = 32$ 8 people: $8 \times 32 = [€]256$	**Scale 10C (0, 4, 7, 10)** *Low Partial Credit* • Work of merit, for example: some relevant multiplication or division *High Partial Credit* • Tips found for one person (€32)

Q3	Model Solution – 30 Marks	Marking Notes
(a)	$180 \times 80 \times 20 = 288\,000$ [cm^3]	**Scale 5B (0, 2, 5)** *Partial Credit* • Work of merit, for example: use of $180, 80$ and 20, or finds the area of one side e.g. 180 × 80 • Volume = l x b x h *Full Credit (-1)* • 180 × 80 × 20
(b)	$60 \times 800 = 48\,000$ cm^3 per minute $\frac{288000}{48000} = 6$ minutes	**Scale 10C (0, 4, 7, 10)** *Low Partial Credit* • Work of merit, for example: indicates 60, or multiplication/division by 800 *High Partial Credit* • One correct calculation: 60×800, or $\frac{288000}{60}$, or $\frac{288000}{800}$
(c)	$9{:}35 + 0{:}45$ $= 9{:}80 = 10{:}20$ [p.m.]	**Scale 10B (0, 5, 10)** Accept correct answer with no or incorrect unit *Partial Credit* • Work of merit, for example: indicates 60, or adds two relevant times
(d)	$\frac{15{\cdot}95}{0{\cdot}9} = €17{\cdot}72$ **OR** $\frac{1}{0 \cdot 9} = 1 \cdot \dot{1}$ $15.95 \times 1 \cdot \dot{1} = €17{\cdot}72$	**Scale 5B (0, 2, 5)** Accept correct answer with no unit. *Partial Credit* • $15 \cdot 95 \times 0 \cdot 9$ • 14.35 or 14.36 or 14.356 without work • $\frac{0{\cdot}9}{15{\cdot}95}$ *Full Credit –1* • $15 \cdot 95 \times 1.1 = 17.55$ • £17·72 [correct answer, incorrect unit]

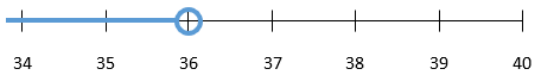
Q4	Model Solution – 10 Marks	Marking Notes
(a)	**(i)** [Week] 3 **(ii)** 2 [GB] **(iii)** [Week] 4	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • One correct *High Partial Credit* • Two correct
(b)		**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • One point plotted correctly • Value(s) calculated, but not plotted *High Partial Credit* • 3 points plotted correctly *Full Credit (-1)* • Points plotted correctly but not joined • Ciaran's weekly data usage calculated by adding a value ≠2, consistently to each point, and the graph drawn

Q5	Model Solution – 15 Marks	Marking Notes
(a)	Jerome / Marcella / Tim / Denise	**Scale 5A (0, 5)**
(b), (c)	**(b)** There are 3 students who cycled **(c)** Tim / Denise	**Scale 5B (0, 2, 5)** *Partial Credit* • Work of merit in one part, for example: lists the students in C in part (b) • One part correct
(d)	$\frac{4}{6}$ or $\frac{2}{3}$	**Scale 5B (0, 2, 5)** *Partial Credit* • Numerator or denominator correct

Q6	Model Solution – 30 Marks	Marking Notes
(a), (b)	**(a)** $10 + 15 + 25 + 32 + 10 + 3 = 95$ **(b)** $350 - 400$	**Scale 10C (0, 4, 7, 10)** *Low Partial Credit* • Work of merit in one part, for example: some relevant addition in (a), or shows understanding of mode in (b) *High Partial Credit* • (a) or (b) correct • Work of merit in both parts
(c)	(i) 3 (ii) $10 + 3 = 13$	**Scale 5B (0, 2, 5)** *Partial Credit* • (i) **or** (ii) correct • (i) **and** (ii) reversed
(d)		**Scale 10C (0, 4, 7, 10)** *Low Partial Credit* • Work of merit, for example: any correct point/bar *High Partial Credit* • 3 bars correct
(e)	*Any relevant explanation, with reference to the context of the question, for example:* Half of the students jumped less than 331 cm **OR** Half of the students jumped more than 331 cm **OR** That's the middle jump, when the lengths are put in order	**Scale 5B (0, 2, 5)** *Partial Credit* • Shows some understanding of the median • Mentions 'average'

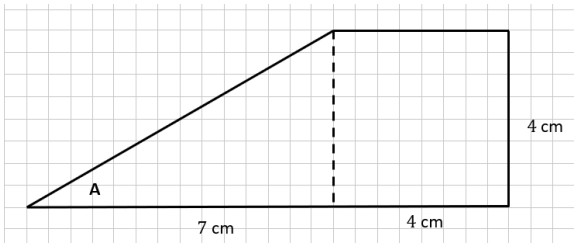
Q7	Model Solution – 25 Marks	Marking Notes
(a)	**(i)** Isosceles **(ii)** $180 - (70 + 70) = 40[°]$ **(iii)** $B = 180 - 70 = 110[°]$	**Scale 15D (0, 6, 10, 12, 15)** Accept correct answers with no or incorrect unit *Low Partial Credit* • Work of merit in one part, for example: mentions $180°$, or some relevant addition or subtraction *Mid Partial Credit* • (ii) **or** (iii) correct • (i) correct **and** work of merit towards (ii) or (iii) *High Partial Credit* • Two parts correct • (i) correct **and** work of merit in (ii) and (iii)
(b)	Yes No No Yes	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit* • One correct *Mid Partial Credit* • Two correct *High Partial Credit* • Three correct

Q8	Model Solution – 30 Marks	Marking Notes
(a)	**(i)** 98.6 [°F] **(ii)** 38 [°C]	**Scale 10C (0, 4, 7, 10)** Tolerance of ± 0.2 *Low Partial Credit* • Some relevant work on graph *High Partial Credit* • (i) or (ii) correct • Correct answers, work not shown on graph • Draws correct lines on graph but no answers given
(b)	$(32,\ 89 \cdot 6)$	**Scale 5B (0, 2, 5)** Tolerance of ± 0.2 for y-value. *Partial Credit* • x or y coordinate found • Co-ordinates reversed, otherwise correct

Q8	Model Solution – 30 Marks	Marking Notes
(c)	$\frac{95-86}{35-30} = \frac{9}{5}$ or $1{\cdot}8$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • Work of merit, for example: correct slope formula • Labels the points (x_1, y_1) and (x_2, y_2) *High Partial Credit* • Formula fully substituted
(d), (e)	**(d)** **2.** Temperature is between 36 and 38 **3.** $T > 38$ **(e)**  	**Scale 10D (0, 3, 5, 8, 10)** 3 items are required: the description, the inequality, and the graph. *Low Partial Credit* • Work of merit in one part, for example: lists some values between 36 and 38 in **2.**, or lists some values greater than 38 in **3.** *Mid Partial Credit* • One item correct • Work of merit in 2 items *High Partial Credit* • Two items correct • One item correct and work of merit in the other 2 items.

Q9	Model Solution – 15 Marks	Marking Notes
(a), (b), (c)	**(a)** $110 - 75 = [€]\ 35$ **(b)** $120 + 45 = [€]\ 165$ **(c)** $5n - 3n = [€]\ 2n$	**Scale 10D (0, 3, 5, 8,10)** *Low Partial Credit* • Work of merit in one part, for example: selling price = cost price + profit *Mid Partial Credit* • 1 part correct • Work of merit in two parts *High Partial Credit* • 2 parts correct • 1 correct and work of merit in the two other parts
(d)	$\frac{80}{320} \times 100 = 25\%$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • Numerator or denominator correct • Shows relevant knowledge of percentages *High Partial Credit* • Fraction correct • 0.25 • Finds profit as a percentage of the selling price

Q10	Model Solution – 10 Marks	Marking Notes
(a)	$\left[\frac{14}{21}+\frac{15}{21}\right]=\frac{29}{21}$	**Scale 5C (0, 2, 3, 5)** Accept correct answer without work *Low Partial Credit* • Work of merit, for example: finding common denominator *High Partial Credit* • $\frac{14}{21}$ or $\frac{15}{21}$
(b)	4k -7 +7 = 41 +7 $4k=41+7$ $4k=48$ $k=12$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • Work of merit, for example: some correct transposition or trial and error *High Partial Credit* • $4k=48$ • Transposes the 7 incorrectly and finishes correctly

Q11	Model Solution – 25 Marks	Marking Notes
(a)(i)		**Scale 10C (0, 4, 7, 10)** *Low Partial Credit* • Any correct point or line segment • Sketch effort *High Partial Credit* • Two lines correct *Full Credit – 1* • Ruler not used
(a)(ii)	$30°$	**Scale 5A (0, 5)** • Accept $28 \leq A \leq 32$
(b)	$B^2=96^2+180^2$. B^2 = 9216 + 32400 $B^2=41616$ $B=204$ [cm] B	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • Some substitution into formula • 96^2 or 180^2 evaluated • States Pythagoras' Theorem *High Partial Credit* • Fully correct substitution • 96^2 and 180^2 correctly evaluated

Q11	Model Solution – 25 Marks	Marking Notes
(c)	$\tan^{-1}\left(\frac{96}{180}\right) = 28{\cdot}07\ldots = 28\ [°]$.	**Scale 5B (0, 2, 5)** *Partial Credit* • $\tan^{-1}\frac{m}{n}$ *Full Credit (-1)* • Calculator in incorrect mode • No rounding or incorrect rounding

Q12	Model Solution – 20 Marks	Marking Notes
(a)	*Area is measured in*: km^2 *Distance is measured in*: km	**Scale 5B (0, 2, 5)** *Partial Credit* • One correct
(b), (c)	**(b)** $2 \times \pi \times 5 = 31{\cdot}41 \ldots = 31{\cdot}4$ [km] [1 DP] **(c)** $\pi \times r^2 = \pi \times 5^2$ $= 78{\cdot}53 \ldots = 78{\cdot}5$ [km^2] [1 DP]	**Scale 10C (0, 4, 7, 10)** *Low Partial Credit* • Work of merit, for example: identifies $r = 5$, or correct formula in (c) *High Partial Credit* • One part correct • Correctly fully substituted formula in both parts *Full Credit –1* • Incorrect or no rounding in one or both parts, otherwise correct
(d)	*Answer*: Sequence 1 *Reason*: *any valid reason, for example*: It goes up by the same amount each time **OR** Sequence 2 changes by different amounts	**Scale 5B (0, 2, 5)** *Partial Credit* • Sequence 1 identified • Indicates a difference between two terms • Wrong sequence but correct reason

Q13	Model Solution – 5 Marks	Marking Notes
(a)(b) & (c)	**(a)** 2a + 6a -5n +2n = 8a – 3n . **(b)** $y = \frac{3(10)+70}{5} = \frac{100}{5} = 20$ **(c)** $(x-3)(x-4)$	**Scale 5D (0, 2, 3, 4, 5)** *Low Partial Credit* • Work of merit in one part, for example: in (a): indicates which terms are in the same variable, or in (b): substitutes $n = 10$ or In (c): x^2 or 12 factorised correctly *Mid Partial Credit* • 1 part correct or work of merit in two parts *High Partial Credit* • Two correct parts • 1 correct part and work of merit in the other 2 parts