Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Applied 2016

Marking Scheme

Mathematical Applications

Common 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 are summarised in this table:

Scale label	A	B	C	D
No of categories	2	3	4	5
5-mark scale	0, 5	0, 3, 5	0, 2, 4, 5	
10-mark scale		0, 5, 10	0, 3, 8, 10	0, 2, 5, 8, 10
15-mark scale			0, 5, 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, or a misreading 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.

The only marks that may be awarded for a question are those on the scale above, or *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		Question 2		Question 3		Question 4		Question 5	
(a)	5B	(a)	15C	(a)	10B	(a)	10C	(a)	10B
(b)	5B	(b)	10C	(b)	10C	(b)	10B	(b)	5C
(c)	5B	(c)	5B	(c)	15C	(c)	5B	(c)	5B
(d)	5B	(d)	10C	(d)	5B	(d)	10C	(d)	10D
(e)	5B	(e)	5B	(e)	5B	(e)	5C	(e)	10C
(f)	5B	(f)	5A	(f)	5B	(f)	10B	(f)	5B
(g)	5B							(g)	5A
(h)	5B								
(i)	5B								
(j)	5B								

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.

Q1	Model Solution – 50 Marks	Marking Notes
(a)	€122·50 ÷ 5 = €24·50	**Scale 5B (0, 3, 5)** Accept correct answer with no work. Accept answer in euro without unit. **Partial Credit** • Any use of 5 other than correct use • Misplaced decimal, otherwise correct **Full Credit –1** • Correct answer in cent, but with no unit.
(b)	€180 × 15% = €27 Sale price = €180 – €27 = €153 **OR** 100% – 15% = 85% €180 × 85% = €153	**Scale 5B (0, 3, 5)** Accept correct answer with no work. Accept answer in euro without unit. **No Credit** • Answer = €180 • Answer = €180 ± 15 = 195 or 165 **Partial Credit** • Finds 27 (reduction) or 207 (increase of 15%) • Misplaced decimal, otherwise correct • Uses 100 • Answer = 180 ÷ 15 = 12 **Full Credit –1** • Correct answer in cent, but with no unit.
(c)	$(3{\cdot}14)^3$ = 30·959144 = 30·96 (2 D.P.)	**Scale 5B (0, 3, 5)** Accept correct answer with no work. **No Credit** • Answer = 3·14 ±3 **Partial Credit** • Multiplies by 3 (i.e. 9·42) • Shows understanding of cubing, e.g. 3·14×3·14×3·14 • Finds cubed root (i.e. 1·4643…) **Full Credit –1** • Correct answer with incorrect or no rounding. • Uses a power ≠ 3 but > 1, finishes correctly

Q1	Model Solution – 50 Marks	Marking Notes
(d)	x = 180 – 145 = 35	**Scale 5B (0, 3, 5)** Accept correct answer with no work. Accept value of x without degree sign. **No Credit** • Answer = 145° **Partial Credit** • Measures angle using protractor • Finds 360 – 145 or 145 – 90 • Adds instead of subtracts • Uses 180
(e)	7000 + 40 + 2 = 7042 m	**Scale 5B (0, 3, 5)** Accept correct answer with no work. Accept answer in metres without unit. **No Credit** • Adds with no conversion (i.e. 247) **Partial Credit** • Converts either 7 km or 200cm correctly **Full Credit –1** • Total correctly added in km or centimetres • Correct answer with incorrect unit
(f)	€300 × £0·7345 = £220·35	**Scale 5B (0, 3, 5)** Accept correct answer with no work. Accept answer in £ sterling without unit. **No Credit** • Answer = €300 or £0·7345 **Partial Credit** • Indicates correct multiplication • Divides by £0·7345 (i.e. £408·44) • Misplaced decimal, otherwise correct **Full Credit –1** • Correct answer with incorrect unit

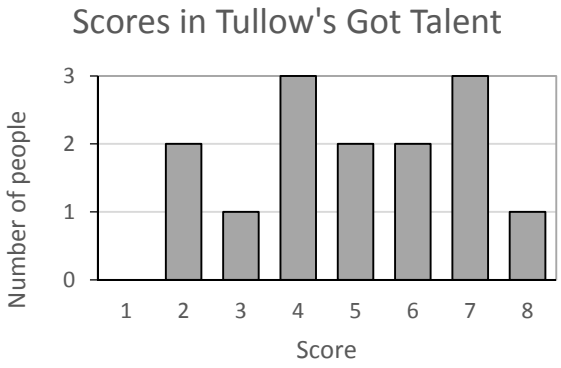
Q1	Model Solution – 50 Marks	Marking Notes
(g)	13:10 – 08:25 = 4 hrs 45 mins = 240 + 45 mins = 285 mins	**Scale 5B (0, 3, 5)** Accept correct answer with no work. Accept answer in minutes with no unit. **No Credit** • Answer = 13:10 or 8:25 **Partial Credit** • Uses 1 hour = 100 minutes and finishes correctly (i.e. 4:85 = 5hrs 25 min or 325 min) • Adds instead of subtracts (i.e. 21:35 or 1295 min) • Answer = 4 hours plus incorrect minutes • Correct conversion of time to minutes with work **Full Credit –1** • Correct answer with incorrect unit. • 4 hrs 45 minutes
(h)	100 ÷ 1·25 = 80 km per hour **OR** 75 mins for 100 km ⇒ 15 mins for 20 km ⇒ 60 mins for 80 km, i.e. 80 km/hr	**Scale 5B (0, 3, 5)** Accept correct answer with no work. Accept correct answer with no units. **Partial Credit** • Uses 1 hour = 100 minutes and finishes correctly (i.e. 86·9565) • Multiplies instead of divides • Works with inverted formula • Shows DST triangle • 100 km ÷ incorrect time • Answer = 100/75 = 1.3333 km/hr
(i)	0·084, 80%, $\frac{9}{11}$ (0·084, 0·80, 0·8181...)	**Scale 5B (0, 3, 5)** Accept correct answer with no work. Accept correct answer in decimal format **No Credit** • No correct entry **Partial Credit** • Two of given values in correct order (other than the ordering given) • One value correctly converted to decimal or percentage **Full Credit –1** • Order reversed, i.e largest to smallest

Q1	Model Solution – 50 Marks	Marking Notes
(j)	Size **B** is better value. **A**: €8·00 ÷ 200 = €0·04 per g **B**: €4·50 ÷ 150 = €0·03 per g **OR** **A**: 200 g ÷ 8·00 = 25 g per euro **B**: 150 g ÷ 4·50 = 33·3... g per euro	**Scale 5B (0, 3, 5)** Must have some relevant calculation(s) done to be awarded *Full Credit* **No Credit** • Answer = Size A with no work **Partial Credit** • Calculates the cost of one unit of one pack only • Misplaced decimal, otherwise correct • Correct answer with no supporting work

Q2	Model Solution – 50 Marks	Marking Notes
(a)	*3 years*: *Monthly repayment per €1000*: €32·06 *Total monthly repayment*: €32·06 × 8 = €256·48 *5 years*: *Monthly repayment per €1000*: €21·06 *Total monthly repayment*: €21·06 × 8 = €168·48	**Scale 15C (0, 5, 10, 15)** Accept correct answers without work. Accept answer in euro without unit. **No Credit** • Answer = 8 **Low Partial Credit** • One entry correct • Indicates multiplication by 8 **High Partial Credit** • Two entries correct • Picks monthly repayments from the incorrect row, i.e. €0 - €5000, and multiplies by 8 (i.e. €33·34 × 8 = €266·72 and €22·13 × 8 = €177·04) **Full Credit –1** • Answer given in cent but with no unit
(b)	*Advantage of 3-year loan*: The loan is paid off in less time *or any other valid reason* *Advantage of 5-year loan*: The monthly repayment is smaller *or any other valid reason*	**Scale 10C (0, 3, 8, 10)** **Low Partial Credit** • Work of merit in either part **High Partial Credit** • One advantage correct

Q2	Model Solution – 50 Marks	Marking Notes
(c)	€256·48 × 36 = €9233·28 **OR** €32·06 × 8 × 36 = €9233.28	**Scale 5B (0, 3, 5)** Accept correct answer with no work. Accept answer in euro without unit. **No Credit** • Answer = €8000 **Partial Credit** • Relevant answer in part (a) × 8 • Uses 2 year monthly repayments figure from table • Relevant answer in part (a) × 3 years or 12 months or 2 years or 24 months or 5 years or 60 months • Selects wrong figure from (a), and multiplies by 36 • Works out correct total for 5-year loan (i.e. 168·48 × 60 = €10108·80) • Works out correct total for 2 year loan (i.e. €45·94 × 8 × 24 = €8820·48) • Correct answer from part (a) used with work • Use of €32·06 × 24 or 36 or 60 (i.e. €769·44 or €1154·16 or €1923·60) **Full Credit –1** • Answer given in cent but with no unit.
(d)	*Age of car (in years)*: 2015 – 2013 = 2 *Maximum term*: 8 – 2 = 6 years	**Scale 10C (0, 3, 8, 10)** **No Credit** • Answer = 8 years or 2015 +8 = 2023 **Low Partial Credit** • 2015 – 8 = 2007 or 2013 – 8 = 2005 **High Partial Credit** • 2015 – 2013 = 2 years **Full Credit –1** • Correct answer with no unit

Q2	Model Solution – 50 Marks	Marking Notes
(e)	$\left(1+\frac{2}{100}\right)^{12}$ = $(1{\cdot}02)^{12}$ = 1·2682... $\Rightarrow$ APR = 26·82...% = 27% (nearest %)	**Scale 5B (0, 3, 5)** **No Credit** • Answer = 2% **Partial Credit** • 2/100 or 0·02 • 2 × 12 = 24% • Some use of the Compound Interest formula **Full Credit –1** • Correct answer with no or incorrect rounding
(f)	The interest will be very high **OR** She mightn't be able to buy anything else using the credit card for some of that time *or any other valid reason*	**Scale 5A (0, 5)**

<table>
<tr><th>Q3</th><th>Model Solution – 50 Marks</th><th>Marking Notes</th></tr>
<tr><td>(a)</td><td>14</td><td>Scale 10B (0, 5, 10)
Accept correct with no work.
Partial Credit
• Lists all the names
• Attempt at adding all the scores</td></tr>
<tr><td>(b)</td><td><table><tr><td>Score</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>No. of people</td><td>0</td><td>2</td><td>1</td><td>3</td><td>2</td><td>2</td><td>3</td><td>1</td></tr></table></td><td>Scale 10C (0, 3, 8, 10)
Accept correct answer with no work.
No Credit
• No entry correct
Low Partial Credit
• At least one entry correct
High Partial Credit
• 4 entries correct</td></tr>
<tr><td>(c)</td><td>Any valid graph of the data, e.g.:
 
</td><td>Scale 15C (0, 5, 10, 15)
Tolerance ± 1 on plots from candidate's scale.
Tolerance for pie chart: ±3°.
Low Partial Credit
• Attempt to draw any graph freehand
• Uses information from first table (i.e. individual scores)
High Partial Credit
• Incorrect scaling of the frequency axis, otherwise correct
• Omits a bar (or equivalent), otherwise correct
Full Credit –1
• Correct graph, but omits labelling axes / sectors</td></tr>
<tr><td>(d)</td><td>$\frac{2}{14}$ or $\frac{1}{7}$ or 0·1428...</td><td>Scale 5B (0, 3, 5)
Accept correct answer with no work.
Accept 0·14 (or more accurate).
Partial Credit
• Correct numerator or denominator
• Names those who scored exactly 5 (i.e. "Claire, Chris")
• Inverted fraction (i.e. 14/2 or 7)
• Any relevant fraction from candidate's frequency table</td></tr>
</table>

Q3	Model Solution – 50 Marks	Marking Notes
(e)	$\frac{4}{14} \times 100$ = 28·57...% = 29% (nearest %)	**Scale 5B (0, 3, 5)** Accept correct answer with no work. **No Credit** • Incorrect answer with no work **Partial Credit** • Uses 100 • 4 or 4/total from part (a) • Names those who scored ≥ 7 (i.e. "Kate, Dee, David, Paul") **Full Credit –1** • Correct answer with incorrect or no rounding
(f)	$\frac{4+8+2+6+4+6+7+3+7+4+5+2+7+5}{14}$ = $\frac{70}{14}$ = 5 **OR** $\frac{(2\times2)+(1\times3)+(3\times4)+(2\times5)+(2\times6)+(3\times7)+(1\times8)}{14}$ = $\frac{70}{14}$ = 5	**Scale 5B (0, 3 ,5)** Accept correct answer with no work. **No Credit** • Answer = 14 **Partial Credit** • Indication of addition of two scores • Multiplies one result by its frequency • Indicates division by 14 • Answer = 70 • Finds mode (i.e. 4 or 7) • Attempts to find the median, e.g. puts all scores in order

Q4	Model Solution – 50 Marks	Marking Notes
(a)	Draws rectangle 9·8 cm by 5·2 cm.	**Scale 10C (0, 3, 8, 10)** Accept tolerance of ± 0·1 cm on sides Accept tolerance of ±5° on angles **No Credit** • Circle or triangle drawn **Low Partial Credit** • Rectangle drawn (including sketch without straight edge) • Line segment drawn outside of tolerance (of 0·1 cm) but within 0·5 cm of one correct length **High Partial Credit** • Rectangle with 1 side within tolerance (of 0·1 cm) and other side more than 0·5 cm from correct length • Rectangle correctly drawn, but using scale other than 1:100 • 1 angle outside tolerance of 5°, otherwise correct **Full Credit –1** • Rectangle with 1 side within tolerance (of 0·1 cm) and other side outside tolerance but within 0·5 cm of correct length
(b)	$9{\cdot}8 \times 5{\cdot}2$ $= 50{\cdot}96$ $= 51\ m^2$ (nearest m^2)	**Scale 10B (0, 5, 10)** Accept correct answer with no work. Accept correct answer with no unit. **No Credit** • Adds two sides (i.e. 15) • Divides two sides (i.e. 1·88… or 0·53…) **Partial Credit** • Calculates the perimeter (i.e. 30) • Indicates multiplication of the two values **Full Credit –1** • Correct answer with no or incorrect rounding

Q4	Model Solution – 50 Marks	Marking Notes
(c)	$51 \times €23{\cdot}50$ = €1198·50	**Scale 5B (0, 3, 5)** Accept correct answer with no work. Accept answer in euro without unit. **Partial Credit** • Indicates multiplication of the two values. **Full Credit –1** • Uses unrounded area (i.e. 9·8 × 5·2 × 23·5 = €1197·56) • Answer given in cent, but with no unit.
(d)	$\frac{9{\cdot}8 \times 5{\cdot}2}{0{\cdot}2 \times 0{\cdot}2} = \frac{50{\cdot}96}{0{\cdot}04} = 1274$ **OR** $\frac{9{\cdot}8}{0{\cdot}2} \times \frac{5{\cdot}2}{0{\cdot}2} = 49 \times 26 = 1274$	**Scale 10C (0, 3, 8, 10)** Accept use of rounded answer from part (b) (i.e. 51 ÷ (0·2 × 0·2) = 1275) **Low Partial Credit** • Finds area of one tile (400cm² or 0·04) • Divides one length of rectangle by 0·2 **High Partial Credit** • All correct except for one operation e.g. answer from (b) × 0·04 = 50.96 × 0·04 = 2·0384, or 51 ÷ 0·2 = 255
(e)	$3{\cdot}14 \times 7^2 \times 30$ = 4615·8 cm^3	**Scale 5C (0, 2, 4, 5)** Accept correct answer with no work. **Low Partial Credit** • r = 7 or r = 14 • One correct substitution into formula **High Partial Credit** • r = 14 and finishes correctly • Mishandles or ignores r^2 and finishes correctly, e.g. uses 2r • Misplaced decimal, otherwise correct • Swaps r and h and finishes correctly (i.e. 3·14 × 30² × 7 = 19782) • All correct (with r = 7 or r = 14) except for 1 operation, e.g. 3·14 × 7 × 30 = 659·4 cm^3, or 3·14 × 14 × 30 = 1318·8 cm^3 **Full Credit –1** • Correct answer with incorrect or no unit • Fully correct, except value of $\pi \neq 3{\cdot}14$

Q4	Model Solution – 50 Marks	Marking Notes
(f)	1 fold = 2 layers 2 folds = 4 layers 3 folds = 8 layers	**Scale 10B (0, 5, 10)** Accept correct with no work. **No Credit** • Answer = 3 folds **Partial Credit** • Answer = 2, 4, or 6

Q5	Model Solution – 50 Marks	Marking Notes
(a)	$34{\cdot}40 \div 2{\cdot}15$ = 16	**Scale 10B (0, 5, 10)** Accept correct answer with no work. **Partial Credit** • Indicates division • Reciprocal of answer (i.e. $2{\cdot}15 \div 34{\cdot}40 = 0{\cdot}0625$ or 1/16)
(b)	$800 + 4\times50 + 1000 + 800$ = 2800 m	**Scale 5C (0, 2, 4, 5)** Accept correct answer with no work. **Low Partial Credit** • Adds 2 relevant distances **High Partial Credit** • Total for Part 2 correct (i.e. 1200 m) • Ignores or mishandles 50 m, otherwise correct (e.g. 2600, 2650, etc.) **Full Credit –1** • Correct answer with incorrect or no unit
(c)	200 calories in 30 mins 100 calories in 15 mins 500 calories in 75 mins **OR** $30 \times \frac{500}{200}$ = $30 \times 2{\cdot}5$ = 75 mins	**Scale 5B (0, 3, 5)** Accept correct answers with no work. Accept answer in minutes without unit. **Partial Credit** • One incorrect multiplication or division using given numbers • One operation correct (multiplication or division) **Full Credit –1** • 1 hour 15 minutes
(d)	*Length*: m *Volume*: m^3 *Area*: m^2 *Width*: m	**Scale 10D (0, 2, 5, 8, 10)** **Low Partial Credit** • One entry correct **Mid Partial Credit** • Two entries correct **High Partial Credit** • Three entries correct

Q5	Model Solution – 50 Marks	Marking Notes
(e)	$27\,750 \times 0{\cdot}20$ = €5550	**Scale 10C (0, 3, 8, 10)** Accept correct answer with no work. Accept answer in euro without unit. **Low Partial Credit** • Relevant use of 100 • Shows understanding of percentages **High Partial Credit** • Finds 80% (i.e. 22 200) • Finds 120% (i.e. 33 300) • Inverts percentage (i.e. (€27750 ÷ 20) × 100 = €138 750) • Misplaced decimal, otherwise correct **Full Credit –1** • Answer given in cent, but with no unit.
(f)	27 750 – (5550 – 3300) = 27 750 – 2250 = €25 500	**Scale 5B (0, 3, 5)** Accept correct answer with no work. Accept answer in euro without unit. **Partial Credit** • One operation correct, e.g. 27 750 – (€5550 + €3300) = 18 900 **Full Credit –1** • Answer given in cent, but with no unit.
(g)	PRSI / USC / Pension *or any other valid answer*	**Scale 5A (0, 5)**

Bonus marks for answering through Irish

Bonus marks are applied as follows:

If the mark achieved is 150 or less, the bonus is 5% of the mark obtained, rounded **down**.

For instance, 138 marks $\times$ 5% = 6·9 $\Rightarrow$ bonus = 6 marks.

If the mark achieved is above 150, the following table applies:

Bunmharc (Mark achieved)	Marc Bónais (Bonus mark)	Bunmharc (Mark achieved)	Marc Bónais (Bonus mark)
151 – 153	7	174 – 180	3
154 – 160	6	181 – 186	2
161 – 166	5	187 – 193	1
167 – 173	4	194 – 200	0

Credit mark ranges

Candidates are awarded a credit from 0 to 10, inclusive, depending on the mark they are awarded.

The mark ranges associated with each credit are shown below.

Mark Range	Credit
180 – 200	10
162 –179	9
144 – 161	8
126 – 143	7
108 – 125	6
90 – 107	5
72 – 89	4
54 – 71	3
36 – 53	2
18 – 35	1
0 – 17	0