Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2017

Mathematics

Higher Level

Paper 2

Solutions and Marking scheme

300 marks

Marking Scheme – Paper 1, Section A and Section B

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	E
No of categories	2	3	4	5	6
5 mark scales	0, 5	0, 3, 5	0, 2, 4, 5	0, 2, 3, 4, 5	
10 mark scales		0, 5, 10	0, 4, 5, 10	0, 3, 5, 8, 10	
15 mark scales			0, 6, 9, 15	0, 5, 7, 9, 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
- correct response

B-scales (three categories)
- response of no substantial merit
- partially correct response
- correct response

C-scales (four categories)
- response of no substantial merit
- response with some merit
- almost correct response
- correct response

D-scales (five categories)
- response of no substantial merit
- response with some merit
- response about half-right
- almost correct response
- correct response

E-scales (six categories)
- response of no substantial merit
- response with some merit
- response almost half-right
- response more than half-right
- almost correct response
- correct response

Summary of mark allocations and scales to be applied

Section A

Question 1
     (a)   10C
     (b)   5D
     (c)   5B
     (d)   5C

Question 2
     (a)   5A
     (b)   5C
     (c)   5B
     (d)(i)   5C
     (d)(ii) 5C

Question 3
     (a)   10C
     (b)   5C
     (c)   10C

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

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

Question 6
     (a)   15C
     (b)   10C

Section B

Question 7
     (a)   10C
     (b)(i)   10B
     (b)(ii) 10C
     (b)(iii) 5C
     (c)   5C

Question 8
     (a) (i)   10D
     (a) (ii) 5D
     (a)(iii) 15D
     (b)(i)   15C
     (b)(ii) 10C
     (b)(iii) 5C

Question 9
     (a)   10B
     (b)   5C
     (c)   10C
     (d)   10B
     (e)   5C
     (f)   10C

NOTE: In certain cases, typically involving incorrect rounding, omission of units, a misreading that does not oversimplify the work or an arithmetical error that does not oversimplify the work, a mark that is one mark below the full-credit mark may also be awarded.
Rounding and units penalty to be applied only once in each section (a), (b), (c) etc.
Throughout the scheme indicate by use of * where an arithmetic error occurs.
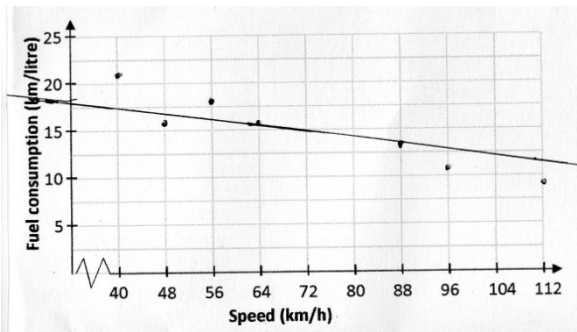
Detailed marking notes

Model Solutions & Marking Notes

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

Q1	Model Solution – 25 Marks	Marking Notes
(a)	$$\frac{4}{5} \times \frac{1}{5} \times \frac{4}{5} \times \frac{1}{5} \times \frac{4}{5} \times \frac{1}{5} \times \frac{4}{5} = \frac{256}{78125}$$ **or** $$= 0{\cdot}0032768$$	**Scale 10C (0, 4, 5, 10)** *Low Partial Credit:* • $\frac{4}{5}$ • $\left(\frac{1}{5}\right)^3$ *High Partial Credit:* • $\frac{4}{5} \times \frac{1}{5} \times \frac{4}{5} \times \frac{1}{5} \times \frac{4}{5} \times \frac{1}{5} \times \frac{4}{5}$ in any order
(b)	$$\binom{6}{3}\left(\frac{1}{5}\right)^3 \left(\frac{4}{5}\right)^3 \left(\frac{1}{5}\right)$$ $$= \frac{1280}{78125} \text{ or } \frac{256}{15625}$$ **or** $0{\cdot}016384$	**Scale 5D (0, 2, 3, 4, 5)** *Low Partial Credit:* • $\binom{6}{3}$ or$\left(\frac{1}{5}\right)^3$ or $\left(\frac{4}{5}\right)^3$ • $\frac{1}{5}$ for last day *Mid Partial Credit:* • $\binom{6}{3}\left(\frac{1}{5}\right)^3 \left(\frac{4}{5}\right)^3$ and stops or continues • $\binom{7}{4}\left(\frac{1}{5}\right)^4 \left(\frac{4}{5}\right)^3$ and continues *High Partial Credit:* • $\binom{6}{3}\left(\frac{1}{5}\right)^3 \left(\frac{4}{5}\right)^3 \left(\frac{1}{5}\right)$

(c)	$$1 - \left(\frac{4}{5}\right)^n$$	**Scale 5B (0, 3, 5)** *Partial Credit:* • 1 or $\left(\frac{4}{5}\right)^n$ • any correct term from the expansion
(d)	$$1 - \left(\frac{4}{5}\right)^n > 0{\cdot}99$$ $$\left(\frac{4}{5}\right)^n < 0{\cdot}01$$ $$\left(\frac{4}{5}\right)^{20{\cdot}6377} \approx 0{\cdot}01000000517$$ $$n = 21$$	**Scale 5C (0, 2, 4, 5)** *Low Partial Credit:* • Ans **(c)** $> 0{\cdot}99$ *High Partial Credit:* • viable solution to inequality • $n = 20{\cdot}6377$ and stops

Q2	Model Solution – 25 Marks	Marking Notes
(a)	Correlation coefficient $= -0\cdot957$	**Scale 5A (0, 5)**
(b)	Plots Line of Best Fit on Graph 	**Scale 5C (0, 2, 4, 5)** *Low Partial Credit:* • 3 correct plots *High Partial Credit:* • All plots correct with an incorrect line of best fit • All plots correct and no line of best fit
(c)	As speed increases by 1 km/h the average distance travelled on 1 litre of fuel decreases by $0\cdot15$km **or** The rate at which fuel consumption in km/l is decreasing as the speed in km/h increases	**Scale 5B (0, 3, 5)** *Partial Credit:* • Some reference to speed and fuel consumption • Reference to rate of change
(d) (i)	$\dfrac{260}{96} - \dfrac{260}{112} = \dfrac{65}{168} = 0\cdot3869$ hrs $= 23\cdot21$ $= 23$ to nearest minute	**Scale 5C (0, 2, 4, 5)** *Low Partial Credit:* • $\dfrac{260}{96}$ or $\dfrac{260}{112}$ *High Partial Credit:* • $\dfrac{260}{96} - \dfrac{260}{112}$ or equivalent • Answer in hours
(d) (ii)	$\left(\dfrac{260}{9} \times 1\cdot329\right) - (\dfrac{260}{11} \times 1\cdot329)$ $= €6\cdot98$	**Scale 5C (0, 2, 4, 5)** *Low Partial Credit:* • Amount of Mary's fuel or amount of Jane's fuel *High Partial Credit:* $\left(\dfrac{260}{9} - \dfrac{260}{11}\right) \times 1\cdot329$ or equivalent

Q3	Model Solution – 25 Marks	Marking Notes
(a)	$A(0,6) \rightarrow G\left(\dfrac{2}{3}, \dfrac{4}{3}\right)$ $\rightarrow P\left(\dfrac{2}{3} + \dfrac{1}{2}\left(\dfrac{2}{3}\right), \dfrac{4}{3} + \dfrac{1}{2}\left(\dfrac{-14}{3}\right)\right)$ $= \left(\dfrac{3}{3}, -\dfrac{3}{3}\right)$ $P = (1, -1)$ **or** $P = (x, y)$ $\left(\dfrac{2x + 1(0)}{3}, \dfrac{2y + 6}{3}\right) = \left(\dfrac{2}{3}, \dfrac{4}{3}\right)$ $x = 1, \quad y = -1$ **or** $P = (x, y)$ $\left(\dfrac{3\left(\frac{2}{3}\right) - 1(0)}{3 - 1}, \dfrac{3\left(\frac{4}{3}\right) - 1(6)}{3 - 1}\right)$ $= \left(\dfrac{2}{2}, \dfrac{-2}{2}\right) = (1, -1)$	**Scale 10C (0, 4, 5, 10)** *Low Partial Credit:* - $P\left(\dfrac{4}{3}, -\dfrac{10}{3}\right)$ or equivalent, i.e ratio 1:1 - $\dfrac{2}{3}$ or $\dfrac{1}{3}$ identified as part of change in x ordinate - $-\dfrac{14}{3}$ or $-\dfrac{7}{3}$ identified as part of change in y ordinate - Ratio formula with some substitution *High Partial Credit:* - one relevant co-ordinate of P found
(b)	$C(4, 2) \rightarrow P(1, -1) \rightarrow B(1 - 3, -1 - 3)$ $= (-2, -4)$ $B(x, y) \rightarrow \left(\dfrac{4 + x}{2}, \dfrac{2 + y}{2}\right) = (1, -1)$ $x = -2, \quad y = -4$ $B = (-2, -4)$	**Scale 5C (0, 2, 4, 5)** *Low Partial Credit:* - P as mid-point of BC *High Partial Credit:* - one relevant co-ordinate of B found ***Note:*** Accept (−2, −4) without work Accept correct graphical solution

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(c)

$$AC \perp BC$$

$$AC = \frac{2-6}{4-0} = -1$$

$$BC = \frac{2+4}{4+2} = 1$$

$$-1 \times 1 = -1$$

lines are perpendicular

or

Slope AB = 5.

Altitude from C : $y - 2 = -\frac{1}{5}(x - 4)$

$$\rightarrow x + 5y = 14 \dots . (i).$$

Slope AC = -1.

Altitude from B :

$$y + 4 = 1(x + 2)$$

$$\rightarrow x - y = 2 \dots \dots (ii)$$

$\rightarrow$ Solving (i)and (ii)

$$x = 4$$

$$y = 2$$

Scale 10C (0, 4, 5, 10)
Low Partial Credit:
- Identifies significance of right-angled triangle
- one equation of perpendicular from vertex to opposite side found

High Partial Credit:
- slope of AC and slope of BC found but no conclusion
- two equations of perpendiculars from vertex to opposite side found

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Q4	Model Solution – 25 Marks	Marking Notes
(a)	$$x^2 + y^2 + 2gx + 2fy + c = 0$$ $(0,0) \Rightarrow 0+0+0+0+c = 0$ $$\Rightarrow c = 0$$ $(6{\cdot}5, 0) \Rightarrow 42{\cdot}25 + 0 + 13g + 0 + 0 = 0$ $$\Rightarrow g = -3{\cdot}25$$ $(10, 7) \Rightarrow 100 + 49 + 2(-3{\cdot}25)(10)$ $$+ 2f(7) = 0$$ $$14f = -84$$ $$f = -6$$ $$x^2 + y^2 - 6{\cdot}5x - 12y = 0$$ **or** $\perp$ Bisector of $[AB]$ $\quad x = \dfrac{13}{4} \quad (l_1)$ $\perp$ Bisector of $[AC]$ Midpoint $[AC] = \left(5, \ \dfrac{7}{2}\right)$, Slope $[AC] = \dfrac{7}{10}$ Eq. of mediator $[AC]$ $$y - \frac{7}{2} = -\frac{10}{7}(x - 5)$$ $$10x + 7y = \frac{149}{2} \quad (l_2)$$ $$l_1 \cap l_2 = \left(\frac{13}{4}, 6\right)$$ $$r = \sqrt{\left(\frac{13}{4} - 0\right)^2 + (6-0)^2} = \frac{\sqrt{745}}{4}$$ $$\left(x - \frac{13}{4}\right)^2 + (y-6)^2 = \frac{745}{16}$$ **or** $(-g, -f) \in$ mediator $(0,0)$ and $(6{\cdot}5, 0)$. $$\therefore -g = 3{\cdot}25$$ Centre $(3{\cdot}25, -f)$. Since $(0,0) \in$ of circle $\therefore c = 0$. Equation of circle $$x^2 + y^2 - 6{\cdot}5x + 2fy + 0 = 0$$ $(10, 7)$ on circle: $100 + 49 - 65 + 14f = 0$ $$84 + 14f = 0$$ $$f = -6$$ $$x^2 + y^2 - 6{\cdot}5x - 12y = 0$$	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* - $c = 0$ - One relevant equation in g and/or f *Mid Partial Credit:* - 2 of *g, f, c* found *High Partial Credit:* - g , f, and *c* found or equivalent *Low Partial Credit:* - Effort at formulating equation of 1 $\perp$ bisector *Mid Partial Credit:* - Point t of intersection of 2 $\perp$ bisectors found *High Partial Credit:* - Point of intersection of 2 $\perp$ bisectors and radius *Low Partial Credit:* - $c = 0$ - One point substituted into equation of circle - Midpoint $(0,0)$ and $(6{\cdot}5, 0)$ formulated *Mid Partial Credit:* - 2 of *g, f, c* found *High Partial Credit:* - g , f, and c found or equivalent

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(b)

Slope $AC = \frac{7}{10}$

Slope $CB = \frac{0-7}{6\cdot5-10} = 2$

$$\tan\theta = \pm\frac{\dfrac{7}{10} - 2}{1 + \dfrac{7}{5}} = \pm\frac{-13}{24}$$

$$\theta = 28\cdot44$$

or

Cosine rule

$|AB|^2 = 42\cdot25,$

$|AC|^2 = 149$

$|BC|^2 = 61\cdot25$

$$\cos\theta = \frac{149 + 61\cdot25 - 42\cdot25}{2 \times \sqrt{149} \times \sqrt{61\cdot25}} = 0\cdot8793$$

$$\Rightarrow \theta = 28\cdot44$$

Scale 15C (0, 6, 9, 15)

Low Partial Credit:
- one relevant slope

High Partial Credit:
- $\tan\theta$ fully substituted

Low Partial Credit:
- one relevant length

High Partial Credit:
- $\cos\theta$ fully substituted

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Q5	Model Solution – 25 Marks	Marking Notes
(a)	Proof: $\|< AEF\| = \|< AED\| \dots right\ angles$ $\|< FAE\| + \|< EAD\| = 90^{o}$ $\|< EAD\| + \|< ADE\| = 90^{o}$ $remaining\ angles\ in\ \Delta AED$ $\therefore \|< FAE\| = \|< ADE\|$ **or** $\therefore \|< AFE\| = \|< DAE\|$ $\therefore \Delta AFE\ and\ \Delta DAE\ equiangular$ $\therefore\ similar$	**Scale 10C (0, 4, 5, 10)** *Low Partial Credit:* • Identifies one angle of same size in each triangle *High Partial Credit:* • Identifies second angle of same size in each triangle • Implies triangles are similar without justifying $\|< FAE\| = \|< ADE\|$
(b)	$\dfrac{\|AD\|}{13} = \dfrac{12}{5}$ $\|AD\| = 31 \cdot 2$ cm	**Scale 5C (0, 2, 4, 5)** *Low Partial Credit:* • $\|AF\| = 13$ • One set of corresponding sides identified, e.g. $\dfrac{\|AD\|}{13}$ **or** $\dfrac{12}{5}$ *High Partial Credit:* • $\dfrac{\|AD\|}{13} = \dfrac{12}{5}$ or equivalent
(c)	$\dfrac{39}{13} = \dfrac{\|AB\|}{12}$ $\|AB\| = 3 \times 12 = 36$ cm	**Scale 5C (0, 2, 4, 5)** *Low Partial Credit:* • $\|AG\| = 39$ • One set of corresponding sides identified *High Partial Credit:* • $\dfrac{39}{13} = \dfrac{\|AB\|}{12}$ or equivalent

(d)

Area = Area$ABCD$ − AreaΔAFD

−ΔAreaABG + AreaΔAFE

$= (31 \cdot 2)(36) - \dfrac{1}{2}(31 \cdot 2)(13)$

$\qquad - \dfrac{1}{2}(36)(15) + \dfrac{1}{2}(5)(12)$

$\qquad = 680 \cdot 4$ cm²

or (method 2)

Area = Area$ABCD$ − AreaΔABG − AreaΔAED

$= (31 \cdot 2)(36) - \dfrac{1}{2}(36)(15)$

$\qquad - \dfrac{1}{2}(12)\sqrt{31 \cdot 2^2 - 12^2}$

$\qquad = 1123 \cdot 2 - 270 - 172 \cdot 8$

$\qquad = 680 \cdot 4$ cm²

or (method 3)

Area = AreaΔDCG + AreaΔGED

$= \dfrac{1}{2}(36)(16 \cdot 2) + \dfrac{1}{2}(27)\sqrt{31 \cdot 2^2 - 12^2}$

$\qquad = 291 \cdot 6 + 388 \cdot 8$

$\qquad = 680 \cdot 4$ cm²

Scale 5C (0, 2, 4, 5)
Low Partial Credit:
- One relevant area formulated
- Relevant equation for area *GCDE*

High Partial Credit:
- Relevant individual areas found but fails to finish
- Area calculated but with one relevant area omitted (except method 3)

Q6	Model Solution – 25 Marks	Marking Notes
(a)	$$|AJ| = 6371 + 0 \cdot 214$$ $$|JH|^2 = |AJ|^2 - |AH|^2$$ $$|JH| = \sqrt{(6371 + 0 \cdot 214)^2 - 6371^2}$$ $$= 52 \cdot 21 = 52$$	**Scale 15C (0, 6, 9, 15)** *Low Partial Credit:* • |AJ| formulated • indication of Pythagoras *High Partial Credit:* • Pythagoras fully substituted
(b)	$$\cos 53° = \frac{r}{6371} \text{ or } \sin 37^o = \frac{r}{6371}$$ $$r_{S_1} = 6371 \times \cos 53 = 3834 \cdot 1635$$ $$l_{S_1} = 2\pi r_{S_1} = 2\pi(3834 \cdot 1635) = 24091$$	**Scale 10C (0, 4, 5, 10)** *Low Partial Credit:* • $\cos 53°$ **or** $\sin 47°$ *High Partial Credit:* • radius of s_1 calculated and stops • length of circle formula fully substituted

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Q7	Model Solution – 40 Marks	Marking Notes
(a)	$$\text{Vol of space} = \text{Cylinder} - 2 \times \text{Cone}$$ $$= \pi R^2 (2R) - \frac{2}{3}\pi R^2 (R)$$ $$= 2\pi R^3 - \frac{2}{3}\pi R^3$$ $$= \frac{4}{3}\pi R^3$$	**Scale 10C (0, 4, 5, 10)** *Low Partial Credit:* • A relevant volume formulated *High Partial Credit:* • Vol of space formulated in terms of π and R
(b) (i)	$$12^2 = 6^2 + |AB|^2$$ $$|AB| = \sqrt{12^2 - 6^2} = \sqrt{108} = 6\sqrt{3}$$	**Scale 10B (0, 5, 10)** *Partial Credit:* • indication of Pythagoras
(b) (ii)	$$\frac{h_1}{h_2} = \frac{6}{12} = \frac{r}{12}$$ $$r = 6 \text{ cm}$$	**Scale 10C (0, 4, 5, 10)** *Low Partial Credit:* • indication of similar triangles • indication of a relevant ratio *High Partial Credit:* • corresponding ratios identified but fails to finish **Note**: Accept correct answer without work
(b) (iii)	$$\text{Cylinder} = \pi 12^2 - \pi 6^2 = 108\pi$$ $$\text{Sphere} = \pi \left(6\sqrt{3}\right)^2 = 108\pi$$	**Scale 5C (0, 2, 4, 5)** *Low Partial Credit:* • Surface Area in Fig. 3 substituted • Surface Area in Fig 4 substituted *High Partial Credit:* • One Surface Area found
(c)	$$\text{Vol} = \pi(12^2)(6)$$ $$- \left(\frac{1}{3}\pi 12^2 \times 12 - \frac{1}{3}\pi 6^2 \times 6\right)$$ $$\text{Vol} = 360\pi \text{ cm}^3$$	**Scale 5C (0, 2, 4, 5)** *Low Partial Credit:* • Vol of cylinder found • Vol of truncated cone substituted • Vol of one cone found (12 or 6) *High Partial Credit:* • Volume fully substituted but fails to finish • Volume of truncated cone found

Q8	Model Solution – 60 Marks	Marking Notes
(a) **(i)**	$$\mu = 63 \cdot 5 \qquad \sigma = 10$$ $$z = \frac{50 - 63 \cdot 5}{10} = -1 \cdot 35$$ $$P(z > -1 \cdot 35) = P(z < 1 \cdot 35)$$ $$= 0 \cdot 9115$$ $$91 \cdot 15\%$$	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* • μ or σ identified *Mid Partial Credit:* • z found *High Partial Credit:* • $P(z < 1 \cdot 35)$ and stops
(a) **(ii)**	$$P(x > Z) = 0 \cdot 015$$ $$P(x < Z) = 0 \cdot 985$$ $$Z = 2 \cdot 17$$ $$\frac{x - 63 \cdot 5}{10} = 2 \cdot 17$$ $$x = 85 \cdot 2 \text{ kg}$$	**Scale 5D(0, 2, 3, 4, 5)** *Low Partial Credit:* • identifies $0 \cdot 985$ *Mid Partial Credit:* • identifies $2 \cdot 17$ *High Partial Credit:* • formula for x fully substituted
(a) **(iii)**	$$n = 150, \qquad \bar{x} = 62, \qquad s = 10 \text{ kg}$$ $$H_o \rightarrow \text{mean weight has not changed}$$ $$H_1 \rightarrow \text{mean weight has changed}$$ $$z = \frac{62 - 63 \cdot 5}{\frac{10}{\sqrt{150}}}$$ $$= -1 \cdot 8371 > -1 \cdot 96$$ Mean weight has not changed **or** Confidence interval: $$\bar{x} \pm 1 \cdot 96 \frac{\sigma}{\sqrt{n}}$$ $$62 \pm 1 \cdot 96 \frac{10}{\sqrt{150}}$$ $$62 \pm 1 \cdot 96 (0 \cdot 8165)$$ $$62 \pm 1 \cdot 6003$$ $$[60 \cdot 3997, 63 \cdot 6003]$$ $63 \cdot 5$ falls within this interval $$\therefore \text{insufficient evidence to reject}$$ $$\text{the null hypothesis}$$ The mean weight has not changed	**Scale 15D (0, 5, 7, 9, 15)** *Low Partial Credit:* • z formulated with some substitution • states null/alternative hypothesis only • reference to $\pm 1 \cdot 96$ *Mid Partial Credit:* • z fully substituted *High Partial Credit:* • $z = -1 \cdot 8371 > -1 \cdot 96$ • fails to contextualise the answer

(b) (i)

Tree diagram:

Random school day in Galway

- $\frac{1}{3}$ → R
  - $\frac{1}{2}$ → T
    - $\frac{1}{2}$ → L : $\frac{1}{12}$
    - $\frac{1}{2}$ → no L : $\frac{1}{12}$
  - $\frac{1}{2}$ → no T
    - $\frac{1}{5}$ → L : $\frac{1}{30}$
    - $\frac{4}{5}$ → no L : $\frac{4}{30}$
- $\frac{2}{3}$ → no R
  - $\frac{1}{4}$ → T
    - $\frac{1}{5}$ → L : $\frac{2}{60}$
    - $\frac{4}{5}$ → no L : $\frac{8}{60}$
  - $\frac{3}{4}$ → no T
    - $\frac{1}{8}$ → L : $\frac{6}{96}$
    - $\frac{7}{8}$ → no L : $\frac{42}{96}$

(b) (i)

Scale 15C (0, 6, 9, 15)

Low Partial Credit:
- 3 boxes filled correctly

High Partial Credit:
- 10 boxes filled correctly

(b) **(ii)**	$\dfrac{1}{12} + \dfrac{1}{30} + \dfrac{2}{60} + \dfrac{6}{96} = \dfrac{17}{80}$ **or** $0{\cdot}2125$	**Scale 10C (0, 4, 5, 10)** *Low Partial Credit:* • 2 relevant fractions transferred *High Partial Credit:* • 4 relevant fractions identified but fails to complete
(b) **(iii)**	$P(R\|L) = \dfrac{P(R \cap L)}{P(L)} = \dfrac{\frac{1}{12} + \frac{1}{30}}{\frac{17}{80}}$ $= \dfrac{28}{51}$ **or** $0{\cdot}5490$	**Scale 5C (0, 2, 4, 5)** *Low Partial Credit:* • $P(L)$ • $P(R \cap L)$ *High Partial Credit:* • Formula fully substituted

Q9	Model Solution – 50 Marks	Marking Notes
(a)	$$\tan 60° = \frac{|TE|}{|CT|}$$ $$\sqrt{3}|CT| = |TE|$$	**Scale 10B (0, 5, 10)** *Partial Credit:* • $\tan 60°$ • effort to express $|TE|$ in terms of another side of the triangle
(b)	$$\tan 30° = \frac{|TE|}{|DT|}$$ $$|TE| = |DT|\frac{1}{\sqrt{3}}$$ $$|TE| = \frac{\sqrt{225+|CT^2|}}{\sqrt{3}}$$ $$|TE| = \sqrt{\frac{225 + |CT|^2}{3}}$$	**Scale 5C (0, 2, 4, 5)** *Low Partial Credit:* • $\tan 30°$ • Use of Pythagoras for $|DT|$ • Effort at expressing $|DT|$ in terms of another side of ΔDET *High Partial Credit:* • $|TE| = |DT|\frac{1}{\sqrt{3}}$
(c)	$$\sqrt{3}|CT| = \sqrt{\frac{225 + |CT|^2}{3}}$$ $$|CT| = \sqrt{\frac{225}{8}}$$ $$= 5\cdot3033 \text{ m}$$ $$= 5\cdot3 \text{ m}$$	**Scale 10C (0, 4, 5, 10)** *Low Partial Credit:* • equates both expressions *High Partial Credit:* • Isolate $|CT|$ in equation

Q9		Marking Notes
(d)	$$\lvert TE \rvert = \sqrt{3}\lvert CT \rvert = 9{\cdot}17986 \text{ m} = 9{\cdot}2 \text{ m}$$	**Scale 10B (0, 5, 10)** *Low Partial Credit* • Substitution into formula for $\lvert TE \rvert$
(e)	$$\cos\theta = \frac{\lvert CT \rvert}{\lvert FT \rvert} = \frac{\lvert CT \rvert}{\lvert TE \rvert} = \frac{\lvert CT \rvert}{\sqrt{3}\lvert CT \rvert} = \frac{1}{\sqrt{3}}$$ $$\theta = 54{\cdot}7$$	**Scale 5C (0, 2, 4, 5)** *Low Partial Credit:* • Some relevant substitution for $\cos\theta$ *High Partial Credit:* • Formula for $\cos\theta$ substituted in terms of $\lvert CT \rvert$
(f)	$$P = \frac{(54{\cdot}7)(2)}{360}$$ $$= 0{\cdot}3038$$ $$= 30{\cdot}4$$	**Scale 10C (0, 4, 5, 10)** *Low Partial Credit:* • (Answer to **part (e)**)$\times 2$ • 360° *High Partial Credit:* • P fully formulated

Marcanna breise as ucht freagairt trí Ghaeilge

(Bonus marks for answering through Irish)

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

Déantar an cinneadh agus an ríomhaireacht faoin marc bónais i gcás gach páipéir ar leithligh.

Is é 5% an gnáthráta agus is é 300 iomlán na marcanna don pháipéar. Mar sin, bain úsáid as an ngnáthráta 5% i gcás iarrthóirí a ghnóthaíonn 225 marc nó níos lú, e.g. 198 marc $\times$ 5% = 9·9 $\Rightarrow$ bónas = 9 marc.

Má ghnóthaíonn an t-iarrthóir níos mó ná 225 marc, ríomhtar an bónas de réir na foirmle [300 − bunmharc] $\times$ 15%, agus an marc bónais sin a shlánú **síos**. In ionad an ríomhaireacht sin a dhéanamh, is féidir úsáid a bhaint as an tábla thíos.

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

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