Leaving Certificate 2020

Marking Scheme

Mathematics

Higher Level

Paper 2

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Marking Scheme – Paper 2, 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, 2, 5	0, 3, 4, 5	0, 2, 3, 4, 5	
10 mark scales			0, 4, 8, 10	0, 3, 5, 8, 10	
15 mark scales			0, 5, 10, 15	0, 4, 7, 11, 15	
20 mark scales					
25 mark scales					

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

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.

Summary of mark allocations and scales to be applied

Section A

Question 1

(a)	15D
(b)	10D

Question 2

(a)	10D
(b)	15D

Question 3

(a)	15C
(b)	10D

Question 4

(a)	10C
(b)	15D

Question 5

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

Question 6

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

Section B

Question 7

(a)(i)	10C
(a)(ii)	10C
(a)(iii)	10C
(b)	10D
(c)	5D
(d)	10D

Question 8

(a)(i)	15D
(a)(ii)	10D
(b)(i)	5B
(b)(ii)	10D
(c)	10C
(d)	10D
(e)	10D

Question 9

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

Model Solutions & Marking Notes

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

Q1	**Model Solution – 25 Marks**	**Marking Notes**
(a)	Slope of *BC* $m = \frac{3+12}{-4-6} = -\frac{3}{2}$ Equation *BC* $3x + 2y + 6 = 0.$ Perp. Distance from *A* to line *BC* $\frac{3(2)+2(-6)+6}{\sqrt{3^2+2^2}} = \frac{6-12+6}{\sqrt{13}} = \frac{0}{\sqrt{13}} = 0.$ Therefore *A*, *B* and *C* are collinear.	**Scale 15D (0, 4, 7, 11, 15)** *Low Partial Credit:* Slope formula with some substitution Equation of line formula with some substitution Effort at finding are of triangle *ABC* *Mid Partial Credit:* Equation of *BC* *High Partial Credit:* Perp. Distance formula with some substitution from relevant line Area of triangle *ABC* $=0$ but perp. distance not explicit *Full credit* (*–1*) Distance $=0$ but conclusion omitted Area of triangle *ABC* $=0$ **and** perp. dist. $=0$ but conclusion omitted

(b)	Slope of $a = \frac{1}{2}$ Slope of $b = \tan 60° = \sqrt{3}$ $\tan\theta = \pm\dfrac{\sqrt{3}-\frac{1}{2}}{1+\frac{\sqrt{3}}{2}} = \pm\dfrac{2\sqrt{3}-1}{2+\sqrt{3}}$ $= \pm\dfrac{(2\sqrt{3}-1)(2-\sqrt{3})}{(2+\sqrt{3})(2-\sqrt{3})}$ $= \pm(-8+5\sqrt{3})$ $\theta = \tan^{-1}(-8+5\sqrt{3})$ $\theta = 33{\cdot}435°$ **Or** $\theta + \tan^{-1}\frac{1}{2} + 120° = 180°$\` $\theta + 26{\cdot}565° + 120° = 180°$ $\theta = 33{\cdot}435°$	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* Slope of $a = \frac{1}{2}$ Slope of $b = \tan 60°$ *Mid Partial Credit:* Tan formula with some relevant substitution *High Partial Credit:* Tan formula fully substituted *Full credit* (–1) $\theta = +\tan^{-1}(-8+5\sqrt{3})$ **Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* Slope of $a = \frac{1}{2}$ $120°$ *Mid Partial Credit:* $\tan^{-1}\dfrac{1}{2} + 120°$ *High Partial Credit:* $\theta + 26{\cdot}565° + 120° = 180°$ and fails to finish

<table>
<tr><th>Q2</th><th>Model Solution – 25 Marks</th><th>Marking Notes</th></tr>
<tr><td>(a)</td><td>Centre: $(2, -1)$
Radius: $\sqrt{2^2 + (-1)^2 + 4} = 3$
Distance from centre to B: $\sqrt{90}$
Pythagoras: $|BT|^2 = 90 - 3^2 = 81$
$\Rightarrow |BT| = 9$</td><td>Scale 10D (0, 3, 5, 8, 10)
Low Partial Credit:
Centre or radius

Mid Partial Credit:
$\sqrt{90}$

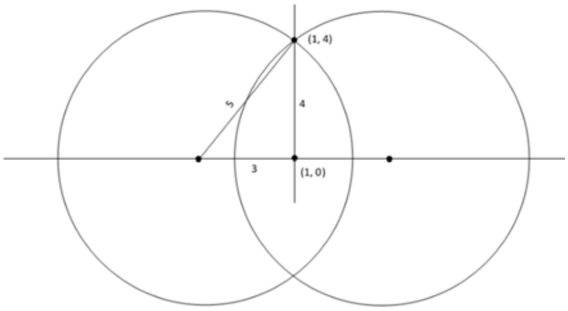
High Partial Credit:
Pythagoras fully substituted (: $|BT|^2$)</td></tr>
<tr><td>(b)</td><td>Centre $(-g, 0)$.
Radius = $\sqrt{g^2 + (0)^2 - c} = 5$
$\Rightarrow g^2 - c = 25$ Equation (i)

Equation is $x^2 + y^2 + 2gx + c = 0$
Sub (1, 4):
$1^2 + 4^2 + 2g(1) + c = 0$
$\Rightarrow 17 + 2g + c = 0$ Equation (ii)
Solve (i) and (ii)
$17 + 2g + (g^2 - 25) = 0$
$\Rightarrow g^2 + 2g - 8 = 0$

Solve for g:
$g = 2$ and $g = -4$
Centres are $(-2, 0)$ and $(4, 0)$
Equations:
$(x + 2)^2 + y^2 = 25$,
$(x - 4)^2 + y^2 = 25$
Or</td><td>Scale 15D (0, 4, 7, 11, 15)
Low Partial Credit:
Centre $(-g, 0)$ or equivalent
Some substitution of (1, 4) into general equation of circle

Mid Partial Credit:
2 relevant equations in g and c

High Partial Credit:
Quadratic in g ($g^2 + 2g - 8 = 0$ or equivalent)</td></tr>
</table>

	Centre: $(-g, 0)$ $$\sqrt{(1+g)^2+(4-0)^2}=5$$ $$(1+g)^2=9$$ $$1+g=\pm 3$$ $g=-4$ or $g=2$ Equations: $(x+2)^2+y^2=25,$ $(x-4)^2+y^2=25$	**Scale 15D (0, 4, 7, 11, 15)** *Low Partial Credit:* Centre $(-g, 0)$ or equivalent Some substitution into distance formula *Mid Partial Credit:* Distance formula fully substituted *High Partial Credit:* Quadratic in g
	or  Centres $(-2, 0)$ and $(4, 0)$; radius =5 Equations: $(x+2)^2+y^2=25,$ $(x-4)^2+y^2=25$	**Scale 15D (0, 4, 7, 11, 15)** *Low Partial Credit:* Diagram with (1, 0) identified *Mid Partial Credit:* -2 or 4 identified *High Partial Credit:* $g=-4$ and $g=2$

Q3	Model Solution – 25 Marks	Marking Notes
(a)	$\dfrac{6}{\sin 17°} = \dfrac{\lvert HF\rvert}{\sin 35°}$ $\lvert HF\rvert = \dfrac{6\sin 35°}{\sin 17°} = 11{\cdot}77$ $\dfrac{11{\cdot}77}{\sin 95°} = \dfrac{x}{\sin 33°}$ $x = \dfrac{11{\cdot}77(\sin 33°)}{\sin 95°}$ $x = 6{\cdot}43$ m	**Scale 15C (0, 5, 10, 15)** *Low Partial Credit:* $\lvert\angle FHE\rvert = 17°$ $\lvert\angle GHF\rvert = 33°$ Some relevant substitution into relevant formula *High Partial Credit:* $\lvert HF\rvert$ found and stops $\lvert HE\rvert = 16{\cdot}17$ found and stops Incorrect value of $\lvert HF\rvert$ (or $\lvert HE\rvert$) used correctly to find x
(b)	$\lvert\angle BOA\rvert = 60°$ => $\lvert\angle COA\rvert = 30°$ $\sin\angle COA = \dfrac{r}{DO} = \dfrac{1}{2}$ $\Rightarrow\ \lvert DO\rvert = 2r$ $\Rightarrow\ \lvert OC\rvert = 3r$ Area $c = \pi r^2$ Area $s = \pi(3r)^2 = 9\pi r^2$ Area s : Area $c = 9 : 1 \Rightarrow k = 9$	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* 30° Area $c = \pi r^2$ *Mid Partial Credit:* $\lvert DO\rvert = 2r$ *High Partial Credit:* $\lvert OC\rvert = 3r$

Q4	Model Solution – 25 Marks	Marking Notes
(a)	Reference angle: $\frac{\pi}{6}$ 2^{nd} Quadrant: $\pi - \frac{\pi}{6} = \frac{5\pi}{6}$ $\frac{\theta}{2} = \frac{5\pi}{6} + 2n\pi$ $\theta = \frac{5\pi}{3} + 4n\pi$ $n = 0 \implies \theta = \frac{5\pi}{3} = 300°$ 4^{nd} Quadrant: $2\pi - \frac{\pi}{6} = \frac{11\pi}{6}$ $\frac{\theta}{2} = \frac{11\pi}{6} + 2n\pi$ $\theta = \frac{11\pi}{3} + 4n\pi$ $n = 0 \implies \theta = \frac{11\pi}{3} = 660°$	**Scale 15D (0, 4, 7, 11, 15)** *Low Partial Credit:* 30° or −30° Mention of 2^{nd} or 4^{th} quadrants *Mid Partial Credit* 150° or 330° or equivalent *High Partial Credit:* 150° and 330° or equivalent
(b)	Area of ΔCOA = Area of Sector − 21 $= \frac{1}{2}r^2\theta - 21 = 8{\cdot}4$ Area of ΔCOA: $\frac{1}{2}\|CO\|\|7\| \sin 1{\cdot}2 = 8{\cdot}4$ $\|CO\| = \frac{8{\cdot}4}{3{\cdot}5 \sin 1{\cdot}2} = 2{\cdot}57$ $\|BC\| = 7 - 2{\cdot}6 = 4{\cdot}4$ cm	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* Area of ΔCOA Area of Sector COA *Mid Partial Credit:* Area of ΔCOA = Area of Sector − 21 *High Partial Credit:* $\frac{1}{2}\|CO\|\|7\| \sin 1{\cdot}2 = 8{\cdot}4$ *Full credit (–1)* Distance $\|CO\|$ found and stops

Q5	Model Solution – 25 Marks	Marking Notes
(a) (i)	$$P(B\|A)=\frac{P(A\cap B)}{P(A)}$$ $$P(B\|A)=\frac{\frac{1}{2}}{\frac{3}{4}}=\frac{2}{3}$$	**Scale 15C (0, 5, 10, 15)** *Low Partial Credit:* Formula for $P(B\|A)$ *High Partial Credit:* Formula fully substituted
(a) (ii)	$$P(A\cup B)=P(A)+P(B)-P(A\cap B)$$ $$\frac{11}{12}=\frac{3}{4}+P(B)-\frac{1}{2}$$ $$\frac{11}{12}-\frac{1}{4}=P(B)=\frac{2}{3}$$ Check if: $P(A)\times P(B)=P(A\cap B)$ $$\frac{3}{4}\times\frac{2}{3}=\frac{6}{12}=\frac{1}{2}=P(A\cap B)$$ $\Rightarrow$ Independent **or** $$P(B\|A)=P(B)$$ $$\frac{2}{3}=\frac{2}{3}$$ $\Rightarrow$ Independent	**Scale 5C (0, 3, 4, 5)** *Low Partial Credit:* Condition for independent events *High Partial Credit:* $P(B)=\frac{2}{3}$ $P(A)\times P(B)=P(A\cap B)$ fully checked for any relevant value (< 1) of $P(B)$ with a valid conclusion

(b)		

Add	**1**	**1**	**2**	**3**
1	2	2	3	4
1	2	2	3	4
2	3	3	4	5
3	4	4	5	6

Rem.	**1**	**1**	**2**	**3**
1	2	2	0	1
1	2	2	0	1
2	0	0	1	2
3	1	1	2	0

Lee has 6 chances to win.
The others only have 5 chances
$\Longrightarrow$ It is not a fair game

Scale 5C (0, 3, 4, 5)

Low Partial Credit:
Any relevant listing of remainders/sums

High Partial Credit:
All remainders listed but no conclusion or incorrect conclusion or unsound conclusion

<table>
<tr><th>Q6</th><th>Model Solution – 25 Marks</th><th>Marking Notes</th></tr>
<tr><td>(a)</td><td>

	D	P	H/E
	$0{\cdot}3$	$0{\cdot}6$	$0{\cdot}1$
	$\times 0{\cdot}7$	$\times 0{\cdot}25$	$\times 0{\cdot}09$
VW	$0{\cdot}21$	$0{\cdot}15$	$0{\cdot}009$

$$P(VW) = 0{\cdot}21 + 0{\cdot}15 + 0{\cdot}009$$
$$= 0{\cdot}369$$

</td><td>

Scale 10D (0, 3, 5, 8, 10)

Low Partial Credit:
Any relevant probability from line 1 written

Mid Partial Credit:
Any 1 relevant probability from line 3 formulated or written

High Partial Credit:
All 3 relevant probability from line 3 formulated or written

</td></tr>
<tr><td>(b)
(i)</td><td>

$$\binom{5}{2}\left(\frac{1}{4}\right)^2\left(\frac{3}{4}\right)^3\frac{1}{4} = \frac{135}{2048}$$

</td><td>

Scale 10C (0, 4, 8, 10)

Low Partial Credit:
$\binom{5}{2}$ or $\frac{3}{4}$ or $\left(\frac{1}{4}\right)^2$ or $\left(\frac{1}{4}\right)^3$

High Partial Credit:
$\binom{5}{2}\left(\frac{1}{4}\right)^x\left(\frac{3}{4}\right)^y$ where $x, y \neq 1$

</td></tr>
<tr><td>(b)
(ii)</td><td>

P(2 or less) = P(0 pass + 1 pass + 2 pass)

P(0 pass) = $\left(\frac{1}{2}\right)^n$

P(1 pass) = $\left[\binom{n}{1}\left(\frac{1}{2}\right)^1\left(\frac{1}{2}\right)^{n-1}\right]$

P(2 pass) = $\left[\binom{n}{2}\left(\frac{1}{2}\right)^2\left(\frac{1}{2}\right)^{n-2}\right]$

P($\leq$ 2) = $\frac{1}{2^n} + \left[\frac{n}{2^n}\right] + \left[\frac{n(n-1)}{2^{n+1}}\right]$

$$= \frac{2 + 2n + n^2 - n}{2^{n+1}} = \frac{n^2 + n + 2}{2^{n+1}}$$

$$\Rightarrow a = 1, \ b = 1, \ c = 2.$$

</td><td>

Scale 5C (0, 3, 4, 5)

Low Partial Credit:
P(0 pass + 1 pass + 2 pass)

High Partial Credit:
Any two of $\left(\frac{1}{2}\right)^n$ or $\left[\binom{n}{1}\left(\frac{1}{2}\right)^1\left(\frac{1}{2}\right)^{n-1}\right]$ or $\left[\binom{n}{2}\left(\frac{1}{2}\right)^2\left(\frac{1}{2}\right)^{n-2}\right]$

</td></tr>
</table>

Q7	Model Solution – 55 Marks	Marking Notes
(a) (i)	$9^2 = 3{\cdot}3^2 + h^2$ $h^2 = 81 - 10{\cdot}89$ $h = 8{\cdot}37$	**Scale 10C (0, 4, 8, 10)** *Low Partial Credit:* Pythagoras formulated *High Partial Credit:* $\sqrt{9^2 - 3{\cdot}3^2}$ or equivalent
(a) (ii)	$CSA = \pi rl = \pi 3{\cdot}3(9) = 93{\cdot}31$ cm^2	**Scale 10C (0, 4, 8, 10)** *Low Partial Credit:* Formula for **CSA** with some substitution *High Partial Credit:* Formula fully substituted
(a) (iii)	Circumference of cup $= 2\pi r = 2\pi(3{\cdot}3)$ Arc length of sector $= \frac{2\pi\times 9\theta}{360°}$ $2\pi(3{\cdot}3) = \frac{2\pi \times 9\theta}{360°}$ $\theta = \frac{3{\cdot}3(360)}{9} = 132°$	**Scale 10C (0, 4, 8, 10)** *Low Partial Credit:* Formula for circumference **or** arc length with some substitution *High Partial Credit:* Both formulas fully substituted
(b)	$\frac{3{\cdot}3}{8{\cdot}37} = \frac{r}{7{\cdot}37}$ $r = 2{\cdot}905$ cm $v = \frac{1}{3}\pi(2{\cdot}905)^2 7{\cdot}37$ $65{\cdot}16$ cm^3 $65{\cdot}2$ cm^3	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* Any relevant effort to find r using similar triangles *Mid Partial Credit:* $\boldsymbol{r}$ found *High Partial Credit:* Volume formula fully substituted Note: If $r = 3{\cdot}3$ used then award MPC at most

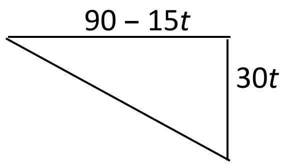
(c)	Volume of water in one second $\pi 0{\cdot}8^2(2{\cdot}5)$ $= 5{\cdot}0265$ cm^3 Time taken is $\frac{65{\cdot}2}{\pi 0{\cdot}8^2(2{\cdot}5)} = 13$	**Scale 5D (0, 2, 3, 4, 5)** *Low Partial Credit:* Any relevant effort to find volume of water *Mid Partial Credit:* $\pi 0{\cdot}8^2(2{\cdot}5)$ *High Partial Credit:* Time formula fully substituted **Note**: Accept work using candidates volume from part (b)
(d)	$\frac{3{\cdot}3}{8{\cdot}37} = \frac{r}{h}$ $r = \frac{3{\cdot}3h}{8{\cdot}37}$ $v = \frac{1}{3}\pi\left(\frac{3{\cdot}3h}{8{\cdot}37}\right)^2 h = 60$ $h^3 = \frac{60 \times 8{\cdot}37^2 \times 3}{\pi 3{\cdot}3^2}$ $h = \sqrt[3]{\frac{60 \times 8{\cdot}37^2 \times 3}{\pi 3{\cdot}3^2}} = 7{\cdot}169$ $x = 8{\cdot}37 - 7{\cdot}169 = 1{\cdot}2$	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* Effort to link r and h *Mid Partial Credit* r and h linked *High Partial Credit:* $h^3 = \frac{60 \times 8{\cdot}37^2 \times 3}{\pi 3{\cdot}3^2}$ or equivalent

Q8	Model Solution – 70 Marks	Marking Notes
(a) (i)	$$z = \frac{x - \bar{x}}{\sigma}$$ $$\frac{x - 280}{90} = 0{\cdot}68$$ $$\Rightarrow x = 341{\cdot}2$$ $$x = 342$$	**Scale 15D(0, 4, 7, 11, 15)** *Low Partial Credit:* μ or σ identified *Mid Partial Credit:* $0{\cdot}68$ *High Partial Credit:* Equation in x fully substituted and stops or continues incorrectly
(a) (ii)	Eileen's z-score $= \frac{260-280}{90} = -0{\cdot}222 = z$ 40% z-score $= -0{\cdot}25$ i.e. z score for 60% $$-0{\cdot}222 > -0{\cdot}25$$ Eileen is eligible to re-sit the test. or $$P(0{\cdot}222) = 0{\cdot}5871$$ $$1 - 0{\cdot}5871 = 0{\cdot}4129$$ 41·29%	**Scale 10D(0, 3, 5, 8, 10)** *Low Partial Credit:* μ or σ identified *Mid Partial Credit:* $\frac{260-280}{90}$ or $-0{\cdot}222$ or $-0{\cdot}25$ *High Partial Credit:* $-0{\cdot}222$ and $-0{\cdot}25$ Note: Allow $-0{\cdot}26$
(b) (i)	95% of the of the data lies in the interval $-1{\cdot}96 \leq z \leq 1{\cdot}96$	**Scale 5B (0, 2, 5)** *Partial Credit:* 95% without context

(b) (ii)	$$1{\cdot}96\sqrt{\frac{\hat{p}(1-\hat{p})}{2500}} = 0{\cdot}01568$$ $$=> \hat{p}(1-\hat{p}) = 2500\left(\frac{0{\cdot}01568^2}{1{\cdot}96^2}\right)$$ $$\Rightarrow\ \hat{p}^2 - \hat{p} + \frac{4}{25} = 0$$ $$\hat{p} = \frac{1 \pm \sqrt{1-4\left(\frac{4}{25}\right)}}{2} = \frac{1 \pm \frac{3}{5}}{2}$$ $$\hat{p} = \frac{4}{5} \text{ or } \frac{1}{5}$$ $\frac{1}{5}$ outside the range $$\Rightarrow\ \hat{p} = \frac{4}{5}$$	**Scale 10D(0, 3, 5, 8, 10)** *Low Partial Credit:* $\sqrt{\frac{\hat{p}(1-\hat{p})}{2500}}$ or equivalent written *Mid Partial Credit:* Formula fully substituted *High Partial Credit:* Quadratic in form $a\hat{p}^2 + b\hat{p} + c = 0$
(c)	H_0: Mean weight of bags has not changed H_1: Mean weight of bags has changed $$z = \frac{\bar{x}-\mu}{\frac{\sigma}{\sqrt{n}}} = \frac{13{\cdot}1 - 12}{\frac{4{\cdot}5}{\sqrt{80}}} = 2{\cdot}186$$ $$2{\cdot}186 > 1{\cdot}96$$ Mean weight of the bags has changed	**Scale 10C (0, 4, 8, 10)** *Low Partial Credit:* CI formulated with some correct substitution $1{\cdot}96$ H_0 or H_1 *High Partial Credit:* z score fully substituted

(d)	$P(\text{weight} > 3000)$ $= P(\text{Average of those on bus} > \frac{3000}{40})$ $P(\bar{x} > 75) = 1 - P(\bar{x} < 75)$ $z = \frac{75-73}{\frac{12}{\sqrt{40}}}$ $= 1{\cdot}054$ This gives a proportion of $0{\cdot}8531$. $1 - 0{\cdot}8531 = 0{\cdot}1469$ $= 14{\cdot}69\%$ This is the probability that the bus with 40 passengers will be above the maximum weight allowance.	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* $\frac{3000}{40}$ μ or σ identified *Mid Partial Credit:* z formula fully substituted *High Partial Credit:* $1{\cdot}054$

(e)	Median is 12·5 $\Longrightarrow$ D + E = 25 LQ is 7·5 $\Longrightarrow$ B + C = 15 IQR is 12 and 12 + 7·5=19·5 $\Longrightarrow$The upper quartile = 19·5 F + G = 39 G = 23 so F = 39 − 23 = 16 Now B + C + D + E + F+G = 79 The total is 8 x 13·5 = 108 So A + H = 108 − 79 = 29 H − A = 21 (range) A = 4 and H = 25 D + E = 25 so D = 11, E = 14 (cannot be 12 and 13 also cannot be 10 and 15) B + C = 15 so B = 6, C = 9 (cannot be 7 and 8 also cannot be 5 and 10) The list is: A: 4, B: 6, C: 9, D: 11, E: 14, F: 16, G: 23, H: 25	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* One unknown number given One relevant equation written *Mid Partial Credit* Three unknown numbers given Three relevant equations written *High Partial Credit:* Five unknown numbers given Five relevant equations written

Q9	Model Solution – 25 Marks	Marking Notes
(a)	$d = \sqrt{\left(90 - \frac{15}{2}\right)^2 + \left(\frac{30}{2}\right)^2}$ $d = \sqrt{(82{\cdot}5)^2 + (15)^2}$ $d = 83{\cdot}85$ km	**Scale 15C (0, 5, 10, 15)** *Low Partial Credit:* $\frac{15}{2}$ or $\frac{30}{2}$ Indication of Pythagoras *High Partial Credit:* Pythagoras fully substituted
(b)	 $s^2 = (90 - 15t)^2 + (30t)^2$ $s^2 = 8100 - 2700t + 225t^2 + 900t^2$ $s^2 = 1125t^2 - 2700t + 8100$ $s = (1125t^2 - 2700t + 8100)^{\frac{1}{2}}$	**Scale 5C (0, 3, 4, 5)** *Low Partial Credit:* 90 – 15t or 30t *High Partial Credit:* Pythagoras fully substituted
(c)	$s = (1125t^2 - 2700t + 8100)^{\frac{1}{2}}$ $\frac{ds}{dt} = \frac{(2250t - 2700)}{2\sqrt{1125t^2 - 2700t + 8100}}$ $\Rightarrow 2250t - 2700 = 0$ $t = \frac{2700}{2250} = 1{\cdot}2$ hours $s = (1125t^2 - 2700t + 8100)^{\frac{1}{2}}$ $s = (1125(1{\cdot}2)^2 - 2700(1{\cdot}2) + 8100)^{\frac{1}{2}}$ $s = 80{\cdot}4984 \approx 80{\cdot}5$ km	**Scale 5D(0, 2, 3, 4, 5)** *Low Partial Credit:* Any correct differntiation *Mid Partial Credit:* Value of t found *High Partial Credit:* Formula for s fully substituted Incorrect value of t (found through calculus) substituted and worked correctly. **Note**: No calculus ⇒ 0 credit

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