Mark Scheme (Results)

January 2021

Pearson Edexcel International GCSE
In Mathematics B (4MB1)
Paper 02

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme.

  Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

- **Types of mark**
  - M marks: method marks
  - A marks: accuracy marks
  - B marks: unconditional accuracy marks (independent of M marks)
- **Abbreviations**
  - cao – correct answer only
  - ft – follow through
  - isw – ignore subsequent working
  - SC - special case
  - oe – or equivalent (and appropriate)
  - dep – dependent
  - indep – independent

- awrt – answer which rounds to
- eeoo – each error or omission

- **No working**

  If no working is shown then correct answers normally score full marks
  If no working is shown then incorrect (even though nearly correct) answers score no marks.

- **With working**

  If the final answer is wrong always check the working in the body of the script (and on any diagrams), and award any marks appropriate from the mark scheme.
  If it is clear from the working that the “correct” answer has been obtained from incorrect working, award 0 marks.
  If a candidate misreads a number from the question. Eg. Uses 252 instead of 255; method marks may be awarded provided the question has not been simplified. Examiners should send any instance of a suspected misread to review.
  If there is a choice of methods shown, then award the lowest mark, unless the subsequent working makes clear the method that has been used.
  If there is no answer achieved then check the working for any marks appropriate from the mark scheme.

- **Ignoring subsequent work**

  It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: eg. Incorrect cancelling of a fraction that would otherwise be correct.
  It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect eg algebra.
  Transcription errors occur when candidates present a correct answer in working, and write it incorrectly on the answer line; mark the correct answer.

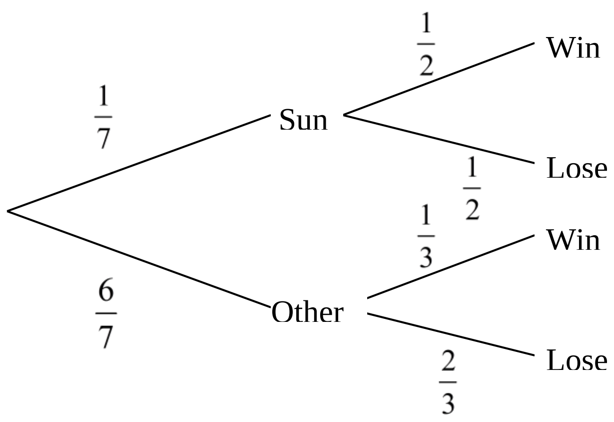
- **Parts of questions**

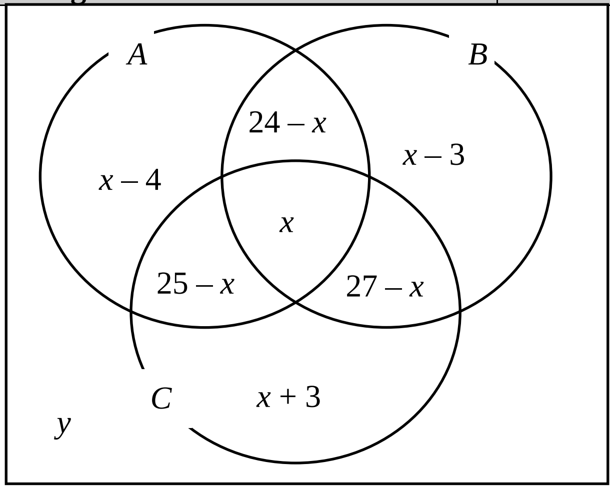
  Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded to another.

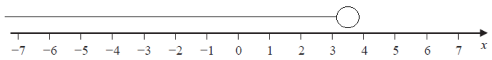
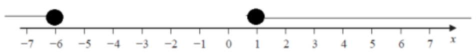
Question		Working	Answer	Mark	Notes
1	(a)	$\frac{9}{5}c = f - 32$ **or** $9c = 5f - 160$ **or** $\frac{c}{5} = \frac{f}{9} - \frac{32}{9}$ **oe**		3	M1 Multiplying by $\frac{9}{5}$ **or** $\times$by 9 and multiplying out brackets **or** $\div 5$ and separating
		$\frac{9}{5}c + 32 = f$ **or** $5f = 9c + 160$ **or** $\frac{f}{9} = \frac{c}{5} + \frac{32}{9}$ **oe**			M1 indep Isolating the term in *f*. Allow one error in the resulting equation eg condone $5f = 9c + 32$
			$f = \frac{9}{5}c + 32$		A1 correct formula. Allow equivalent form eg $f = \frac{9c+160}{5}$
		Alternative			
		$\frac{5}{9}f = c + \frac{160}{9}$			M1 for isolating term in f first. Condone $\frac{5}{9}f = c + \frac{32}{9}$
		$5f = 9c + 160$ **or** $\frac{f}{9} = \frac{c}{5} + \frac{160}{45}$ **or** $f = \frac{9}{5}c + \frac{160}{5}$ oe			M1 Multiplying by $\frac{9}{5}$ **or** by 9 **or** $\div 5$
			$f = \frac{9}{5}c + 32$		A1 correct formula could be in equivalent form eg $f = \frac{9c+160}{5}$
	(b)	$x = 2 \times \frac{5(x-32)}{9}$ or $y = \frac{5(2y-32)}{9}$ or $x = \frac{9}{5}\left(\frac{x}{2}\right) + 32$ or $2y = \left(\frac{9}{5}y + 32\right)$ oe		2	M1 Form a correct equation in terms of *x*(allow *f*) or *y* (allow *c*) but not both. Follow through their answer to part (a) if needed must be a linear equation in terms of *c*
			320		A1 cao
					Total 5 marks

Question		Working	Answer	Mark	Notes
2		$365 \times 24 \times 60 \times 60$ [=31536000] **or** $1.5 \times 10^8 \times 1000 \left[= 1.5 \times 10^{11} \right]$		4	M1 Convert days to seconds **or** km to m, may be seen within a calculation eg $[2 \times \pi \times] 1.5 \times 10^8 \times 1000$
		$2 \times \pi \times 1.5 \times 10^8$ or $2 \times \pi \times 1.5 \times 10^8 [\times 1000]$			M1 For a correct method to find the circumference of a circle. May be seen within a calculation. Note Circ = 942477796.1..
		$\dfrac{2 \times \pi \times 1.5 \times 10^8 \times 1000}{365 \times 24 \times 60 \times 60}$			M1 An attempt to use distance divided by time. If it is incorrect we need to see on the numerator 1.5×10^8 or 1.5×10^{11} or a number clearly derived from these and see on the denominator 365 or a number clearly derived from 365
			29 900		A1 awrt 29 900 from correct working
					Total 4 marks

Question		Working	Answer	Mark	Notes
3		States or uses $\angle SRQ$ or $\angle STQ$ = 90º		5	B1 may be implied by a correct use of Pythagoras. May be marked on diagram
		$\left[SQ^2 = \right] 40^2 + 60^2$ (= 5200)			M1 correct method to find SQ^2 or SQ
		$\left[QT^2 = \right]$ "5200" $- 50^2$ (= 2700)			M1 correct method using their SQ^2 to find QT^2 or QT
		$QT = \sqrt{900 \times 3}$			M1 indep factorise out a square number from their QT^2 Allow for factorising out a square number from one of their SQ or their QT correctly. Implied by $30\sqrt{3}$
			$30\sqrt{3}$		A1 cao All previous marks must be awarded Condone a = 30 and b = 3
					Total 5 marks

Question		Working	Answer	Mark	Notes
4	(a)			3	B1 $\frac{1}{7}$ and $\frac{6}{7}$ correctly placed B1 $\frac{1}{2}$ and $\frac{1}{2}$ correctly placed B1 $\frac{1}{3}$ and $\frac{2}{3}$ correctly placed
	(b)	$\frac{1}{2}\times 1+\frac{1}{3}\times 6$ or $\left(''\frac{1}{7}''\times''\frac{1}{2}''+''\frac{6}{7}''\times''\frac{1}{3}''\right)\times 7$		2	M1 correct method to find the expected score. Allow ft from their tree diagram if they are probabilities such that $0 < p < 1$
			2.5		A1 must be from correct working. Ignore subsequent rounding
					Total 5 marks

Question		Working	Answer	Mark	Notes
5	(a)			3	B1 x and y correctly placed B1 $24 - x$, $25 - x$ and $27 - x$ correctly placed oe B1 $x - 4$, $x - 3$ and $x + 3$ correctly placed oe Allow un-simplified expressions
	(b)	$"x-4"+"24-x"+"x-3"+"25-x"+"x"$ $+"27-x"+"x+3"+"y"=100$		2	M1ft their diagram. For the sum of all regions = 100 as long as no regions are blank and the Venn diagram contains x and y
			$y = 28 - x$		A1 Allow $x + y = 28$ $x = 28 - y$
	(c)	Considering one of "$28 - x$", "$27 - x$", "$25 - x$" or "$24 - x$" $\geqslant 0$		3	M1 (allow > 0 or = 0 for this mark only) or M1 for 24 stated with no reasons. Ft Venn diagram for any region which is in the form $a - x$ where a is a positive value. Allow the use of their answer to part (b) (providing linear equation in x and y) where $y = 0$
		Consider one of "$28 - x$", "$27 - x$", "$25 - x$" or "$24 - x$" $\geqslant 0$			M1 must be considering an inequality $\geqslant 0$ **or** stating their expression must be greater than 0 **or** stating it can't be negative
			24		A1
	(d)	$\dfrac{48-27}{100}+\dfrac{55-27}{100}$		2	M1 Allow $\dfrac{"24-x"+"x-3"+"25-x"+"x+3"}{100}$ Allow with an x value from (c) if clear working shown
			$\dfrac{49}{100}$		A1 oe
					Total 10 marks

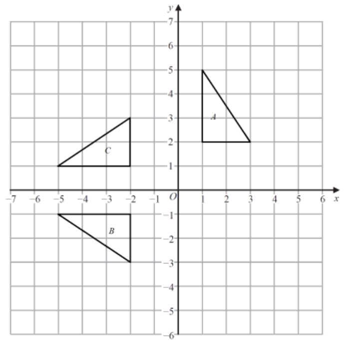
Question		Working	Answer	Mark	Notes
6	(a)(i)	$3x-7x>-9-5$ oe		2	M1 For collecting like terms together on opposite sides Allow one sign error and Allow = > < $\leqslant$ $\geqslant$
			$x<3\frac{1}{2}$		A1 oe eg. $(3.5,\infty)$
	(ii)		Open circle at $3\frac{1}{2}$ and line to left of $3\frac{1}{2}$	1	B1 ft but only if (i) is an inequality. Line should go to –7 or if it is shorter have an arrow on the end. Allow if circle between 3 and 4
	(b)(i)	$(x+6)(x-1)[\geq 0]$		3	M1 for a method to solve the correct quadratic equation. By factorisation brackets must expand to give 2 out of 3 terms correct or fully correct substitution into fully correct formula. Implied by correct critical values
		$(x=)-6$, $(x=)1$			A1 correct critical values seen in this part of the question.
			$x\leqslant-6, x\geqslant1$		A1 oe eg $(-\infty,-6]\cup[1,\infty)$ **NB** A0 for $1\leqslant x\leqslant-6$
	(ii)		Closed circle at –6 and 1 and lines to left of –6 and right of 1	1	B1 If incorrect we can ft an inequality of the form $x\leqslant a, x\geqslant b$ where $-7\leqslant a<b\leqslant7$ Line should go to –7 and 7 or if it is shorter have an arrow on the end
	(c)		$x\leqslant-6$ and $1\leqslant x<3\frac{1}{2}$	2	B2ft For both parts with correct inequality signs. B1 for $x\leqslant$"-6" or "1"$\leqslant x<$"$3\frac{1}{2}$" NB Do not allow "1"$\leqslant x$ and $x<$"$3\frac{1}{2}$" for "1"$\leqslant x<$"$3\frac{1}{2}$" SC for B1Follow through their CV's but the inequality in (a)(i) must be of the form $x<c$ and the inequality in (b)(i) must be of the form $x\leqslant a, x\geqslant b$
					Total 9 marks

Question		Working	Answer	Mark	Notes
7		$\left(a=\dfrac{p}{\sqrt{b}}\ \textbf{or}\ ap=\dfrac{1}{\sqrt{b}}\right)$ or $\left(b=\dfrac{q}{c^3}\ \textbf{or}\ bq=\dfrac{1}{c^3}\right)$ oe		6	M1 Allow equivalent statements eg $a^2=\dfrac{p^2}{b}$ or $a^2=\dfrac{p}{b}$ Allow any letter for p or q Allow with a = 16 and/or c = 240 substituted
		$ka^2=c^3$ or $a^2=lc^3$ or $a=\dfrac{p}{\sqrt{q/c^3}}$ oe			M1 Combine correct proportionality statements. Allow any letters. Condone $a=\dfrac{k}{\sqrt{k/c^3}}$ oe Allow with a = 16 and/or c = 240 substituted
		$k16^2=240^3\left[\Rightarrow k=54000\right]$ or $16^2=l240^3\left[\Rightarrow l=\dfrac{1}{54000}\right]$ or $16=\dfrac{p}{\sqrt{q/240^3}}\left[\Rightarrow\dfrac{p}{\sqrt{q}}=\dfrac{16}{\sqrt{240^3}}\right]$ oe			M1dep on previous M mark. Substituting of 240 and 16 into their combined proportionality statement. Condone $16=\dfrac{k}{\sqrt{k/240^3}}\left[\Rightarrow\dfrac{k}{\sqrt{k}}=\dfrac{16}{\sqrt{240^3}}\right]$ oe
		$c=\sqrt[3]{"54000"\times250^2}$ or $a=\sqrt{\dfrac{135^3}{"54000"}}$			M1 dep on previous M mark. Substituting their constant into the combined proportionality statement with either a = 250 or c = 135
			$c=1500$		A1 does not need to be in the table.
			$a=6.75$		A1 does not need to be in the table. Allow ±
					NB Correct answers gains full marks.
					Total 6 marks

Question		Working	Answer	Mark	Notes
8	(a)	(x^2 =) $8^2 + 6^2$		2	M1 Correct use of Pythagoras' theorem within *ABC*
			10		A1
	(b)	$2\times\frac{1}{2}\times6\times8$		2	M1for a fully correct formula for the area.
			$48\left(\text{cm}^2\right)$		A1
	(c)	$\frac{1}{2}\times BE\times"10"=24$ oe		2	M1 A correct method to find *BE*. If a different correct method is used and they give an awrt 4.8 due to rounding values ignore the awrt 4.8 value if they then put 4.8
			BE = 4.8		A1 answer given we must see sufficient working to gain M mark. At least one line of working between first and last line eg $BE=\frac{24}{5}$ or $5BE=24$

Part(d) on following page

	(d)	**Method 1 - Show 2 of**		3	
		$\angle ACB = \angle ABE$ oe or $\angle BAC = \angle CBD$ oe or $\angle AEB = \angle BEC = 90°$ oe			M2 Show either by argument **or** calculation that 2 pairs of angles are equal or 1 pair of angles are equal and stating $\angle AEB = \angle BEC = 90$ If using lengths *AE* or *EC* the calculation must be seen for one of them. Calculation for one angle must be seen. These may be seen in part(c) M1 for showing 1 pair of angles are equal or stating $\angle AEB = \angle BEC = 90$
		Method 2			
		$\frac{BE}{AE} = \frac{4}{3}$ and $\frac{BC}{AB} = \frac{4}{3}$ and $\frac{CE}{BE} = \frac{4}{3}$ oe			M2 Show either by argument **or** calculation that at all 3 pairs of corresponding sides are in the same ratio. Need $\frac{4}{3}$ or $\frac{3}{4}$ (must be exact) If using lengths *AE* or *EC* the calculation must be seen for one of them. M1 for showing 2 pairs of corresponding sides are in the same ratio
		Method 3			
		Show two of these $\frac{BE}{AE} = \frac{4}{3}$ and $\frac{BC}{AB} = \frac{4}{3}$ and $\frac{CE}{BE} = \frac{4}{3}$ oe and the angle between them is the same			M2 Show either by argument **or** calculation that 2 pairs of corresponding sides are equal and the angle between is the same If using lengths *AE* or *EC* the calculation must be seen for one of them. M1 for showing 2 pairs of corresponding sides are in the same ratio
					NB If angles shown equal by calculation the calculation must be given as an exact value eg. $\tan\angle ACB = \frac{6}{8}$
			Both triangles are similar as 2 angles are equal or sides pair in same ratio or SAS		A1 dep on M2 being awarded. A written conclusion with their reason.
					Total 9 marks

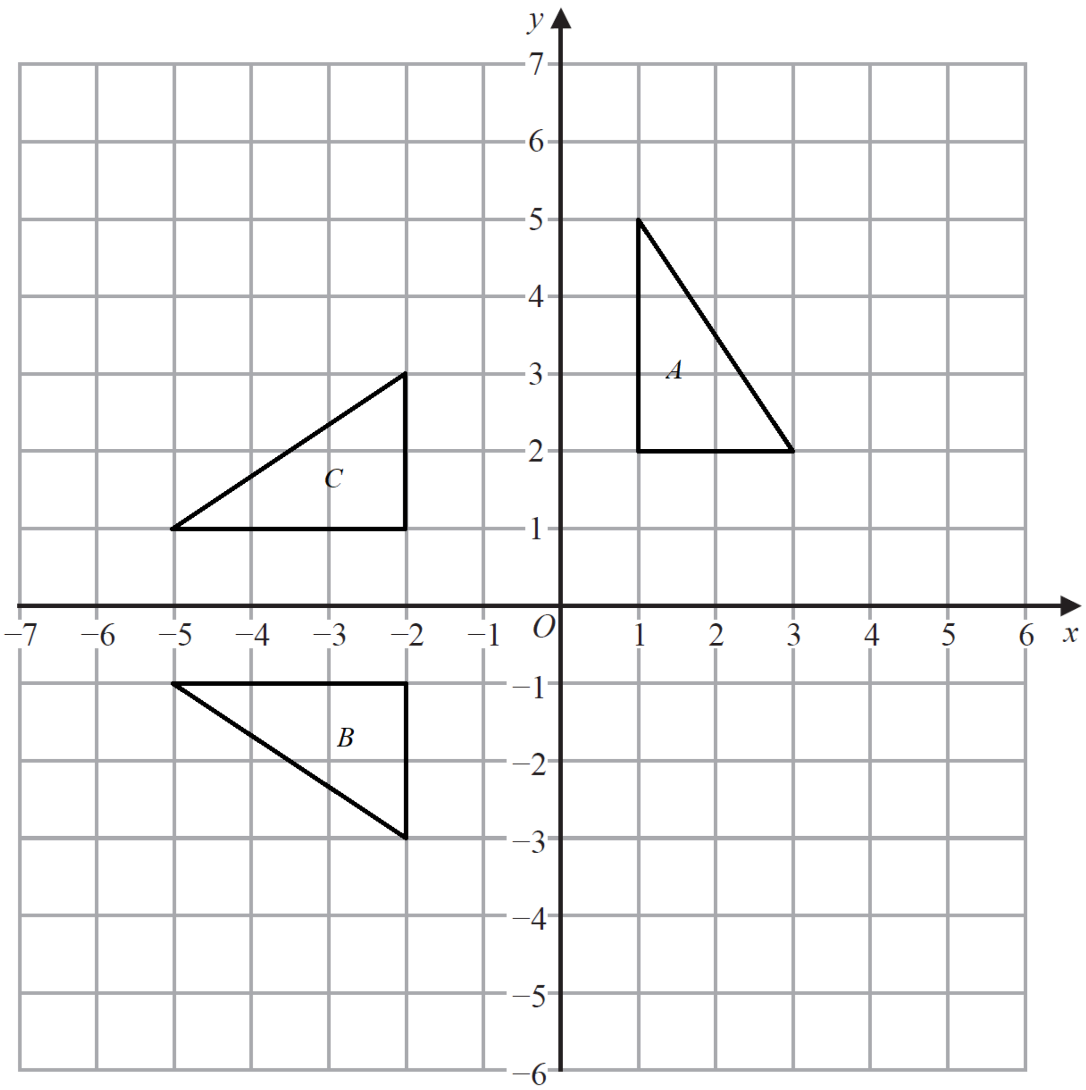
Question		Working	Answer	Mark	Notes
9					
	(a)		Points plotted joined and labelled	1	B1 throughout only penalise lack of labelling if there is any ambiguity then penalise with first B mark gained and then interpret as generously as possible.
	(b)		(–2, –1), (–5, –1) and (–2, –3) drawn, joined and labelled	2	B2ft fully correct ft their triangle *A* B1ft for 2 correct points or a reflection in either axis or the line $y = x$ or the line $y = -x$ drawn.
	(c)		$\begin{pmatrix} -2 & -5 & -2 \\ 1 & 1 & 3 \end{pmatrix}$	2	M1 Correct dimensions and at least 2 correct elements A1 Correct matrix
	(d)		(–2,1), (–5,1) and (–2,3) drawn, joined and labelled	1	B1 ft their answer to (c) if not plotted correctly
	(e)		Reflection in *x*-axis	2	Mark this part independently of their graph M1 The word Reflection and a line of reflection given (line may be incorrect) No other information pertaining to other transformations should be seen. A1 *x*-axis or $y = 0$
	(f)		$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ As reflection repeated returns any point to its original position.	2	B1 Matrix B1 Reason allow for N = $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$ only so $N^2 = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$
					Total 10 marks

Question		Working	Answer	Mark	Notes
10	(a)(i)		$6\mathbf{a} - 6\mathbf{b}$	3	B1
	(ii)	$6\mathbf{b}+\frac{2}{3}"(6\mathbf{a}-\ 6\mathbf{b})"$ oe			M1 eg $6\mathbf{a}+\frac{1}{3}"(6\mathbf{b}-6\mathbf{a})"$
			$4\mathbf{a} + 2\mathbf{b}$		A1
	(b)	$\overrightarrow{ON}=12\mathbf{a}+\frac{1}{2}(6\mathbf{b}-12\mathbf{a})[=6\mathbf{a}+3\mathbf{b}]$ oe **or** $\overrightarrow{PN}=-\frac{2}{3}("6\mathbf{a}-6\mathbf{b}")+\frac{1}{2}(-6\mathbf{b}+12\mathbf{a})[=2\mathbf{a}+\mathbf{b}]$ **oe**		4	M1 Correct method to find $\overrightarrow{ON}$ or $\overrightarrow{PN}$ Eg $\overrightarrow{ON}=6\mathbf{b}+\frac{1}{2}(12\mathbf{a}-6\mathbf{b})$
		$\overrightarrow{ON}=6\mathbf{a}+3\mathbf{b}$ **or** $\overrightarrow{PN}=2\mathbf{a}+\mathbf{b}$			A1 Correct simplified vector $\overrightarrow{ON}$ or $\overrightarrow{PN}$
		$\overrightarrow{ON}=\frac{3}{2}\overrightarrow{OP}$ or $\overrightarrow{PN}=\frac{1}{2}\overrightarrow{OP}$ oe <u>Other ways of showing multiples include</u> Relevant vectors may be factorised, The correct scalar may be given for the two vectors used. May give a correct numerical ratio between the sides.			M1 showing 2 of $\overrightarrow{ON}$, $\overrightarrow{OP}$, $\overrightarrow{PN}$ are multiples of each other. If $\overrightarrow{ON}$ and $\overrightarrow{PN}$ found allow for $\overrightarrow{ON}=3\overrightarrow{PN}$
			$\therefore$ O, P and N are collinear		A1dep all previous marks awarded. Statement must be seen oe
	(c)	$OP^2=2^2+4^2-2\times2\times4\times\cos110$ **or** $\left(\begin{array}{l} BM^2=6^2+6^2-2\times6\times6\times\cos70\ [=47.37...] \text{ and} \\ OP^2=6^2+\left(\frac{2}{3}BM\right)^2-2\times6\times\frac{2}{3}BM\times\cos55 \end{array}\right)$		3	M1 follow through their vector $\overrightarrow{OP}$ or a correct method to find PM or BP eg Allow $BM^2=6^2+6^2-2\times6\times6\times\cos70$ and $OP^2=6^2+\left(\frac{1}{3}BM\right)^2-2\times6\times\frac{1}{3}BM\times\cos55$
		$OP=\sqrt{2^2+4^2+5.47}$ **or** $OP=\sqrt{6^2+4.58...^2-31.58...}$			M1 (NB must demonstrate correct order of operation) Allow $OP=\sqrt{6^2+2.29...^2-15.79...}$
			5.05		A1 awrt 5.05
					Total 10 marks

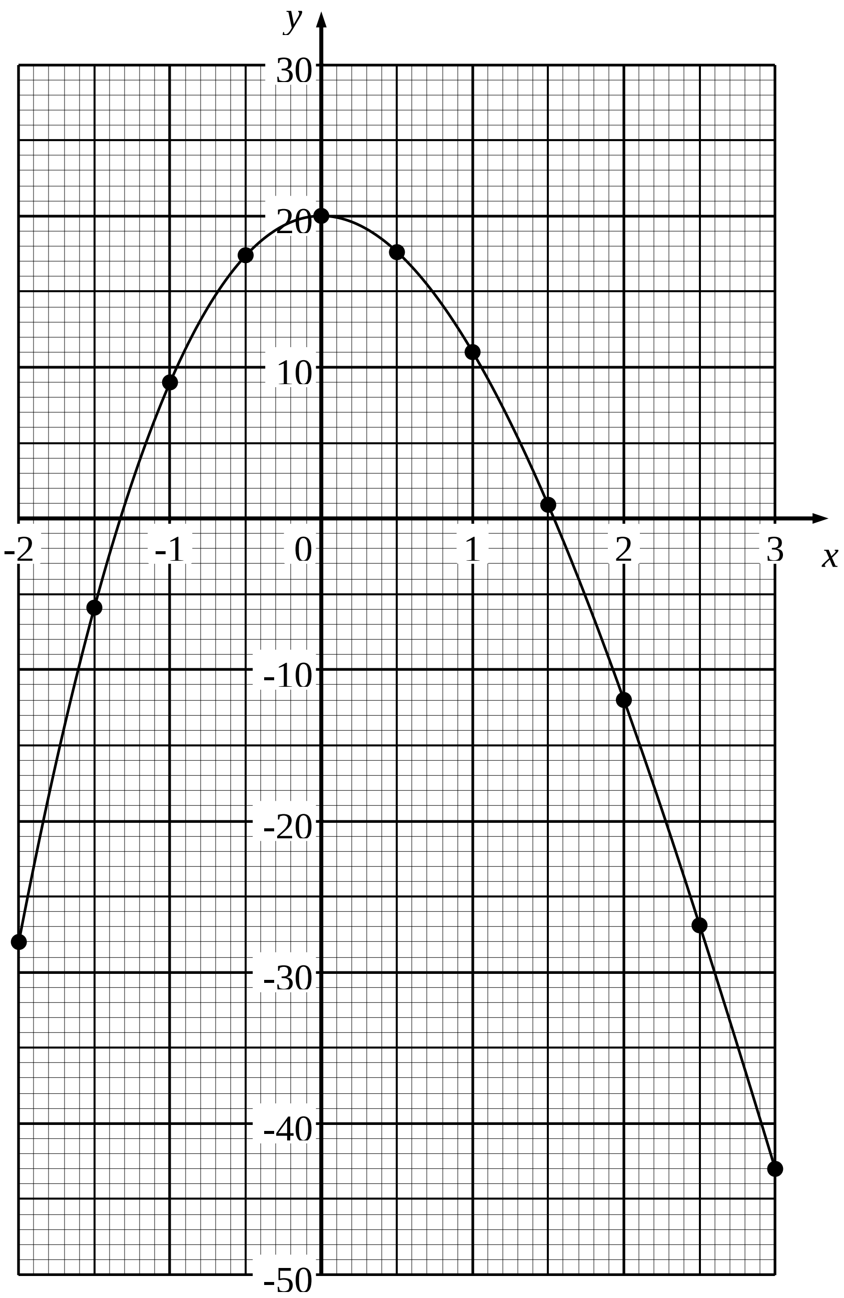
Question		Working	Answer	Mark	Notes
11	(a)		9, 17.6, –26.9	3	B3 Penalise values incorrectly rounded or truncated only once. (unrounded correct values are 9, 17.625, –26.875)
	(b)		Correct curve	3	M1 Attempts to plot the 11 points with at least 6 correct ± 1 small square. (Allow if curve goes through the points) M1 drawing a smooth curve through at least 9 of their points. Do not allow if they use straight lines. Allow ± 1 square from their point. A1 A fully correct curve. All Points plotted correctly (Allow if they have lost a mark for truncation in (a)) with a smooth curve through all the points.
	(c)	$f(x) = 0$ seen or used		3	M1
			–1.3, 1.5		A2ft Allow value either side of where their graph crosses zero or a value in between. If used calculator only allow values that correspond with their graph.
	(d)		At $x = -1.3$ $f(x)$ is increasing so represents a minimum for $g(x)$ At $x = 1.5$ $f(x)$ is decreasing so represents a maximum for $g(x)$	4	M1 Reference to gradient of $f(x)$ change of sign of $f(x)$ or 2nd derivative of $g(x)$. A1 Correct reasoning and choice for "their -1.3" Allow ft of part(c) if the method mark is awarded in (c) M1 Reference to gradient of $f(x)$ change of sign of $f(x)$ or 2nd derivative of $g(x)$. A1 Correct reasoning and choice for "their 1.5"**.** Allow ft of part(c) if the method mark is awarded in (c) **SC** If no marks awarded allow B1 for stating both "their –1.3" is a minimum **and** "their 1.5" is a maximum provided the method mark is awarded in part (c)
					Total 13 marks

Question		Working	Answer	Mark	Notes
12	(a)	$\frac{4}{5}\times 1000(=800)$ or $\frac{1}{5}\times 1000(=200)$ oe		3	M1 Method to find the correct number of either size of doll.
		$"800"\times 1900+"200"\times 10300$			M1 Method to find total cost. Ft their number of dolls.
			3 580 000		A1
	(b)				**Working must be seen in part (b) May work in forints We will follow through their number of dolls in part(a) and their answer to part (a)**
		Cost in Euros = $"3\,580\,000"\div 327.6(=10927.96)$		8	M1 for conversion to € or forints. May be as part of Total cost. Allow 10927.96… or awrt 10928 seen.(Forints award when change to euros)
		(Total cost =) $"3\,580\,000"\div 327.6+100$ $(=11027.96)$			M1 correct method to find total cost. The 100 must be used correctly somewhere. Allow 11027.96… or awrt 11028 seen (Forints 3612760)
		$0.8\times "800"(=640)$			M1 Correct method to find 80% of the number of small dolls bought. ft the number from part(a) Allow for 640 seen. Implied by 5120 or 768 or 5888 or 13488 (Forints 1677312 or 241596.8 or 1918908.8 or 4418669)
		$\frac{7}{8}\times "200"(=175)$			M1 Correct method to find $\frac{7}{8}$ of the number of large dolls bought. ft the number from part(a) Allow for 175 seen. Implied by selling price of 7000 or 600 or 1300 or 13488 (Forints 2293200 or 196560 or 2489760 or 4418669)
		$0.6\times 8(=4.80)$ or $8-0.4\times 8(=4.80)$ $0.6\times 40(=24)$ or $6-0.4\times 40(=24)$			M1 A correct method to reduce at least one selling price by 40% Allow for 4.8 or 4.80 seen or 24 seen Implied by 768 or 600 as selling prices or 13488 (Forints 251596.8 or 196560 or 4418669)
		(Total income =) $"640"\times 8+$ $("800"-"640")\times "4.80"+"175"\times 40+$ $("200"-"175")\times "24"(=13488)$			M1 dep (on 3rd, 4th and 5th M marks) 5120 + 768 + 7000 + 600 or 13488 seen (Forints 1677312 + 251596.8 + 2293200 + 196560 or 4418669)
		$"13488"-"11027.96"$			M1dep on all previous M marks awarded (Forints 4418669 – 3612760)
			2 460.04		A1 Award full marks for awrt 2460 must be in Euros

	(c)(i)	$\frac{"2460.04"}{"11027.96"}\times 100$ or $\frac{"13488"}{"11027.96"}\times 100$		2	M1 Ft values from part (b) Allow "their 10927.96…" or " 11027.96" for their denominator
			22.3(%)		A1 awrt 22.3
	(ii)		The percentage profit would have been the same.	1	B1 indep
					Total 14 marks



y
x
O
A
B
C



y
30
20
10
-2
-1
0
1
2
3
x
-10
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Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom