Mark Scheme (Results)

January 2022

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

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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.

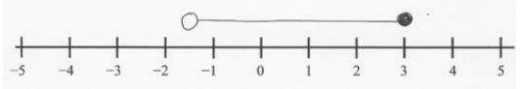
  It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect eg algebra.

  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.

Ques	Working	Answer	Mark	Notes
1 (a)		4	1	B1
(b)		1.5	1	B1 oe
(c)	g(4) = 3		2	M1
		27		A1
				Total 4 marks

2 (a)	$-4 - 6 < 3x + 2x$ or $3x + 2x \leqslant 21 - 6$ oe		3	M1 oe
	one of $-2 < x$ or $x \leqslant 3$ oe			M1 oe
		$-2 < x \leqslant 3$		A1 oe
(b)	$4x^2 - 8x - 21 (= 0)$ $(2x - 7)(2x + 3) (= 0)$		3	M1 oe rearranged and attempt to solve quadratic
	(critical values) 3.5 and -1.5			M1 NB working not required
		$-1.5 < x < 3.5$		A1
(c)			2	B2 completely correct (ft their values from (a) and (b) so long as possible on the number line) (B1 for a line between -1.5 and 3 with incorrect shading of dots or one end shaded correctly)
				Total 8 marks

3 (a)			3	B1 for LH branches $\frac{7}{15}(0.46...), \frac{3}{15}$ oe(0.2)
				B2 for all remaining branches (B1 for 5, 6, 7, 8 branches) $\frac{8}{20}$ oe (0.4), $\frac{9}{20}$ (0.45), $\frac{3}{20}$ (0.15) repeated 3 times
(b)			3	M1ft their tree diagram for any two correct products for method used
	$1-(\frac{5}{15}\times\frac{8}{20}+\frac{7}{15}\times\frac{9}{20}+\frac{3}{15}\times\frac{3}{20})$ oe or $\frac{5}{15}\times(\frac{9}{20}+\frac{3}{20})+\frac{7}{15}\times(\frac{8}{20}+\frac{3}{20})+\frac{3}{15}\times(\frac{8}{20}+\frac{9}{20})$ oe			M1ft their tree diagram for a fully correct method
		$\frac{47}{75}$		A1 oe (0.626...)
(c)	$\frac{3}{15}\times\frac{3}{20}\times x=\frac{19}{1000}$ oe eg 0.2 × 0.15 × x = 0.019		3	M1ft their tree diagram
	$x=\frac{19}{1000}\times"\frac{300}{9}"(=\frac{19}{30})$ oe x = 0.019 ÷ 0.03 (0.633...)			M1ft their tree diagram
		30		A1
				Total 9 marks

4	(a)	$\begin{pmatrix} 8 & 6 \\ -14 & 10 \end{pmatrix} - \begin{pmatrix} 11 & -3 \\ 10 & -5 \end{pmatrix}$ oe		3	M1
		$\begin{pmatrix} -3 & 9 \\ -24 & 15 \end{pmatrix}$			A1
			$\begin{pmatrix} -1 & 3 \\ -8 & 5 \end{pmatrix}$		A1 (award 2 marks for 3 out of 4 terms of this matrix correct)
	(b)		$\begin{pmatrix} -5 & 27 \\ -63 & 4 \end{pmatrix}$	2	B2 correct (B1 for 3 correct values in a matrix of correct order)
	(c)		$-\frac{1}{25}\begin{pmatrix} -5 & 3 \\ -10 & 11 \end{pmatrix}$ oe	2	B2 correct (B1 for a correct method to find the determinant and 2 other values correct or 4 correct values in matrix and one mistake in determinant)
	(d)		$\begin{pmatrix} -22 & 45 \\ -42 & -11 \\ 23 & 7 \end{pmatrix}$	2	B2 correct (B1 for 3, 4 or 5 correct values in a matrix of correct order)
					Total 9 marks

5 (ai)	(0, −1.5), (1, 0.5), (2, 2.5), (3, 4.5), (4, 6.5)		3	B3 for a line going through all the correct points (B2 for a correct line segment through at least 3 of the points or for all points plotted but not joined (B1 for a least 3 points correctly stated or plotted or a straight line with positive gradient going through (0, −1.5) or a straight line with the correct gradient)
(aii)		x = 2.5, y = 3.5	1	B1 ft their graph if lines cross, if lines do not cross or not drawn then award B0
(b)	eg $4(7 – 3y) + y(7 – 3y) – (7 – 3y)^2$ or $4x + x\left(\frac{7 – x}{3}\right) – x^2$		6	M1 for any correct substitution
	$28 – 12y + 7y – 3y^2 − 49 + 42y – 9y^2 = − 10$ $12x + 7x − x^2 − 3x^2 = −30$ oe			M1 for expansion of brackets after substitution (at least 4 terms correct)
	eg $12y^2 − 37y + 11 = 0$ or $4x^2 − 19x −30 = 0$ oe			M1
	For a correct method to solve their quadratic eg $(3y – 1)(4y – 11) = 0$ or $(x – 6)(4x + 5)$			M1 (for factorising, factors that give 2 out of 3 terms correct when expanded or for formula (allow one sign error) can be simplified as far as $\frac{37 \pm \sqrt{841}}{24}$ or $\frac{19 \pm \sqrt{841}}{8}$ or fully correct substitution into the formula with just one sign error)
				A1 dep on M2 for both y values or both x values
		$x = 6, y = \frac{1}{3}$ $x = -\frac{5}{4}, y = \frac{11}{4}$		A1 dep on M2 for all values, paired appropriately
				Total 10 marks

6 (a)	(−3, 3), (−4, 1), (−5, 4)		2	B2 for a fully correct triangle drawn (B1 for 2 correct points, or all correct points plotted but not joined or a ‘correct’ reflection in a vertical line)
(b)	(2, −1), (4, 0), (5, −2)		2	B2 for a fully correct triangle drawn (B1 for 2 correct points, or all correct points plotted but not joined)
(c)	(−1, −2), (−2, −4), (−3, −1)		2	B2 for a fully correct triangle drawn (B1 for 2 correct points, or all correct points plotted but not joined)
(d)	$\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}\begin{pmatrix} 1 & 2 & 3 \\ 3 & 1 & 4 \end{pmatrix}=\begin{pmatrix} 1 & 2 & 3 \\ -3 & -1 & -4 \end{pmatrix}$		2	M1 for at least 4 out of 6 correct entries in matrix for transformed shape
				A1 correctly plotted and joined shape
(e)		reflection	3	B1
		x + y = 1		B2 for correct line (B1 for a line stated in the form y = −x + c (x + y = c) or y = mx + 1(nx + y = 1))
				Total 11 marks

7 (a)	0.3 × 480 (=144) oe or 1 – 0.3 = 0.7 or $\frac{336}{480}\times 100 = 70$ oe		2	M1 allow M1 for 70% of 480	
	480 – 144 = 336 or 0.7 × 480 =336 or 100 – 70 = 30	336 shown		A1 dep on M1 or clearly showing that 336 is 70(%) and 100 – 70 = 30(%)	
(b)	336 ÷ (6 + 7 + 8) (=16)		3	M1	M2 for $\frac{6}{21}\times 336$ oe
	6 × "16"			M1	
		96		A1	
(c)	$\frac{730-680}{680}\times 100$		2	M1 fully correct method	
		7.4(%)		A1 awrt 7.4	
(d)	468 ÷ 1.04		2	M1	
		($)450		A1	
(e)	320 × 0.094 (= 30.08) or $\frac{0.57}{0.094}(=6.0638...)$ or $\frac{0.094}{0.57}(=0.1649...)$		3	M1	
	"30.08" ÷ 0.57 or 320 ÷"6.06.." or 320 × "0.1649..."			M1	
		52.77		A1	
				Total 12 marks	

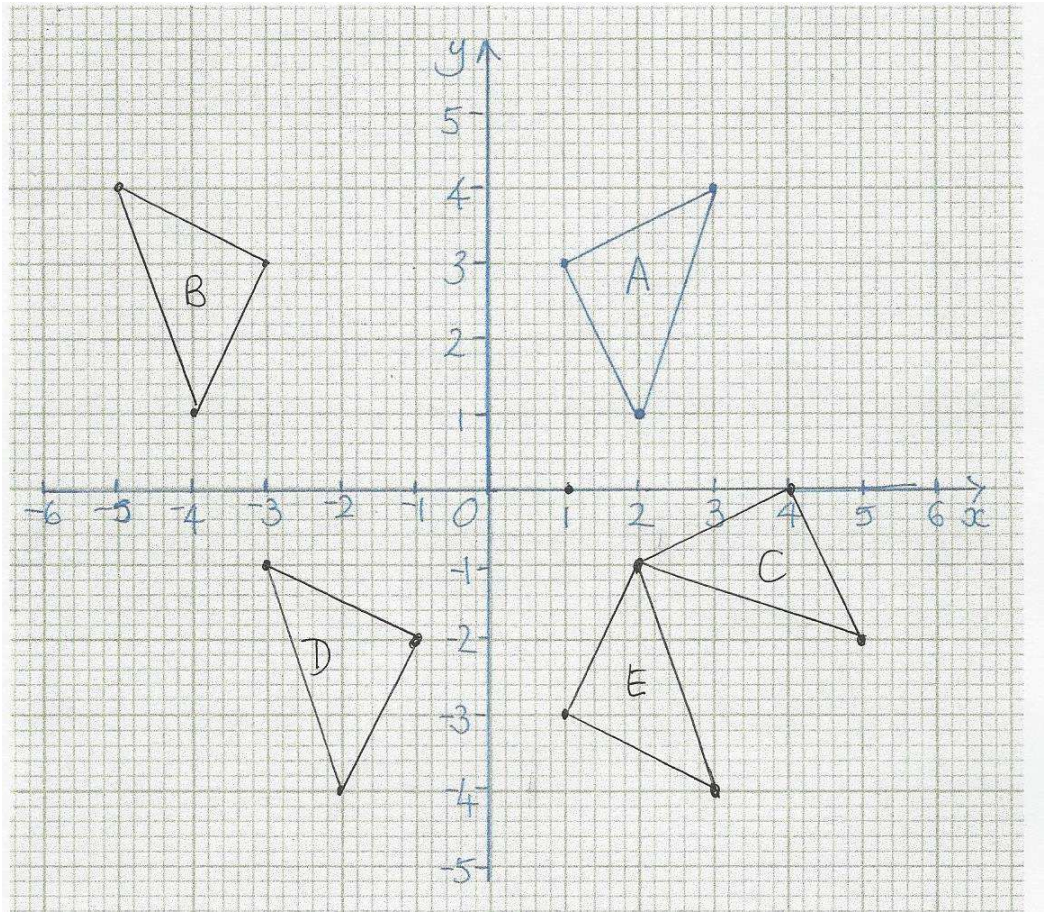
8 (a)	$2x-\frac{3}{2}=0$		4	M1
	2x = 1.5, x = 0.75	x = 0.75		A1 dep on M1
	$y=0.75^2-\frac{3}{2}\times 0.75-1$			M1
	y = −1.5625	y = −1.5625		A1 dep on M1
	Alternative method for 8 (a)			
	$(x-\frac{3}{4})^2$			M1
	$(x-\frac{3}{4})^2-\frac{9}{16}-1$			M1
		x = 0.75		A1 dep on first M1
	$-\frac{9}{16}-1=-1.5625$	y = −1.5625		A1 dep on second M1
(b)	**12.5**, 6, 1.5, −1, −1.5, 0, **3.5**, 9		3	B3 all correct (B2 for 4 or 5 correct, B1 for 2 or 3 correct)
(c)	Curve −1 for: Straight line segments, Each point missed, Each missed segment, Very poor curve Each point incorrectly plotted, Tramlines,	A correct curve	3	B3 ft (−1 eeoo) NB: accuracy for both plotting and drawing is ±0.5 ss
(d)	Line drawn or points marked on graph at y = 3		2	M1
		$-1.4 \leqslant x \leqslant 2.9$		A1 dep on M1
(e)	$x^2-\frac{3}{2}x-1=2x-0.5$ oe		3	M1 rearranging equation
	draw the line y = 2x – 0.5			M1
		−0.1, 3.6		A1 ft from correct graph (2 marks only if written

				as coordinates)
				Total 15 marks

Ques	Working	Answer	Mark	Notes
9	$\overrightarrow{AC} = -6\mathbf{a} + 8\mathbf{b} + 3\mathbf{a} (= 8\mathbf{b} - 3\mathbf{a})$ or $\overrightarrow{CA} = -3\mathbf{a} - 8\mathbf{b} + 6\mathbf{a} (= 3\mathbf{a} - 8\mathbf{b})$		6	M1 oe
	$\overrightarrow{AP} = \frac{3}{4}(8\mathbf{b} - 3\mathbf{a})$ or $\overrightarrow{CP} = \frac{1}{4}(3\mathbf{a} - 8\mathbf{b})$			M1 oe
	$\overrightarrow{OP} = 8\mathbf{b} + 3\mathbf{a} - \frac{1}{4}(8\mathbf{b} - 3\mathbf{a})$ or $\overrightarrow{OP} = 6\mathbf{a} + \frac{3}{4}(8\mathbf{b} - 3\mathbf{a})$ $(= 6\mathbf{b} + \frac{15}{4}\mathbf{a})$			M1 oe
	$\overrightarrow{OD} = \lambda(6\mathbf{b} + \frac{15}{4}\mathbf{a})$ or $8\mathbf{b} + \mu\mathbf{a}$			M1 oe
	$\overrightarrow{OD} = 8\mathbf{b} + 5\mathbf{a}$ oe eg $\frac{4}{3}\left(\frac{15}{4}\mathbf{a} + 6\mathbf{b}\right)$			M1 oe
		$8\mathbf{b} - \mathbf{a}$		A1 oe dep on a clear vector method as required
				Total 6 marks

10 (a)		102°	1	
(b)		129°	1	
(c)	(360 – 118) ÷ 2 (=121)		5	M1 for use of correct angle
	$\frac{"121"}{360}\times\pi\times r^2-\frac{1}{2}\times r^2\times\sin("121")=70$ oe			M1 for a correct equation ($1.055..r^2 - 0.428...r^2$)
	$r^2=\frac{70}{\frac{"121"}{360}\times\pi-\frac{1}{2}\times\sin("121")}(=111.582...)$ $r=\sqrt{\frac{70}{\frac{"121"}{360}\times\pi-\frac{1}{2}\times\sin("121")}}(=10.563...)$ oe			M1 a correct rearrangement to find r^2 or r ($r=\sqrt{\frac{70}{0.627...}}$ or $r=\sqrt{111.582...}$)
	$\pi\times"10.563..."^2-70$ oe			M1 a correct method to find the unshaded area
		281		A1 (allow 280 – 283)
				Total 7 marks

11 (a)	$(l=)\sqrt{(3r)^2+r^2}\ (=r\sqrt{10})$		4	M1 a correct expression for l
	$\pi\times r\times r\sqrt{10}+\pi r^2=4\pi\times10^2$ oe eg $r^2\sqrt{10}+r^2=400$			M1 a correct equation involving r
	eg $r^2=\dfrac{400\pi}{\pi\sqrt{10}+\pi}$ or $r=\sqrt{\dfrac{400}{\sqrt{10}+1}}$ oe			M1 a correct rearrangement for r^2 or r
		9.8		A1
(b)	(height =)15cos20 (= 14.095...) oe		5	M1
	(side of base =)15sin20 (= 5.13...)oe eg $\sqrt{15^2-"14.095"^2}$ (= 5.13) $0.5\times\sqrt{15^2+15^2-2\times15\times15\times\cos40}$ (=5.13) Or AD = $\sqrt{15^2+15^2-2\times15\times15\times\cos40}$(=10.26...)			M1
	(area of base =) $6\times\dfrac{1}{2}\times("5.13...")^2\times\sin(60)$ oe (=68.38...)			M1
	$(\text{volume}=)\dfrac{1}{3}\times6\times\dfrac{1}{2}("5.13...")^2\times\sin(60)\times"14.095..."$ oe			M1
		321(cm^3)		A1 awrt 321
				Total 9 marks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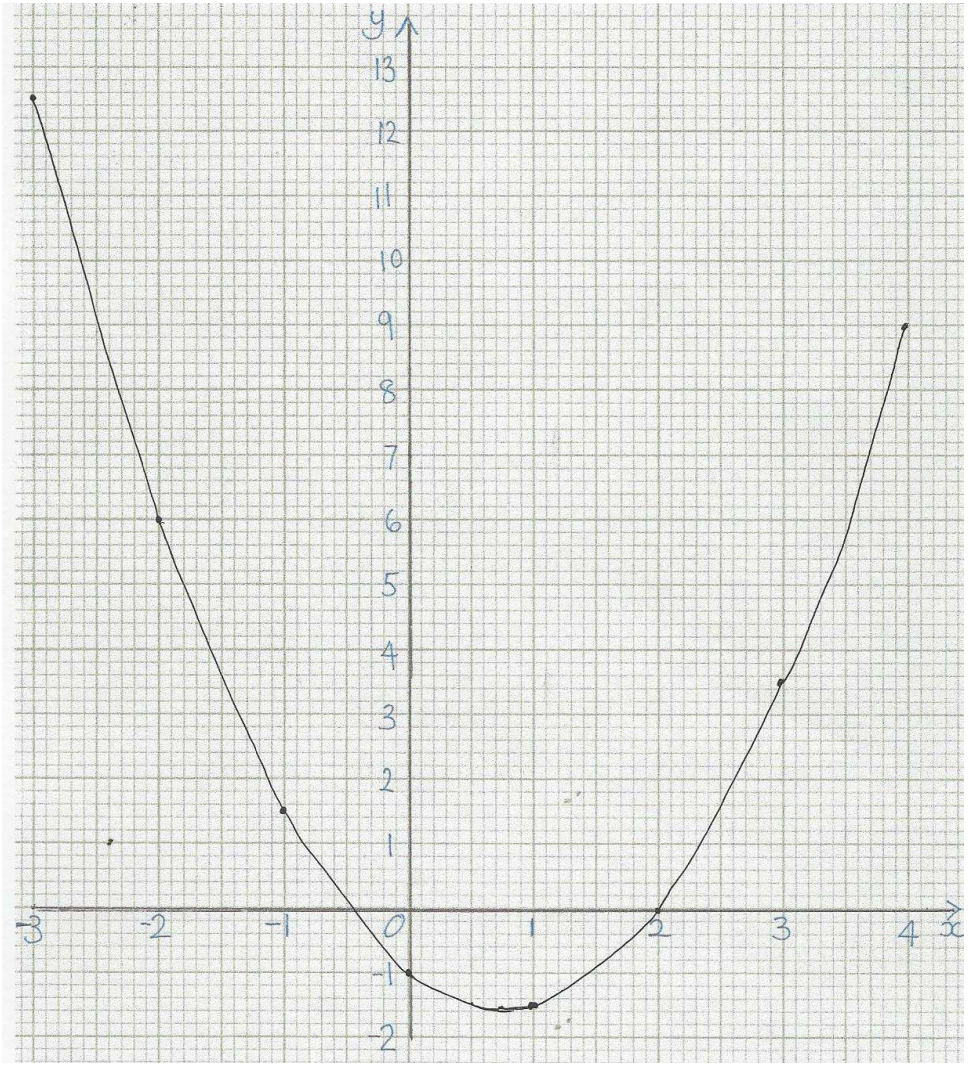
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