Pearson

Mark Scheme (Results)

Summer 2019

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)
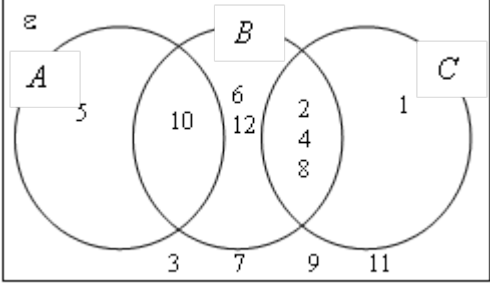   - dep – dependent

- o indep – independent
- o awrt – answer which rounds to
- o 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 there is a wrong answer indicated on the answer line 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 – please send these to review. 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.

- **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.

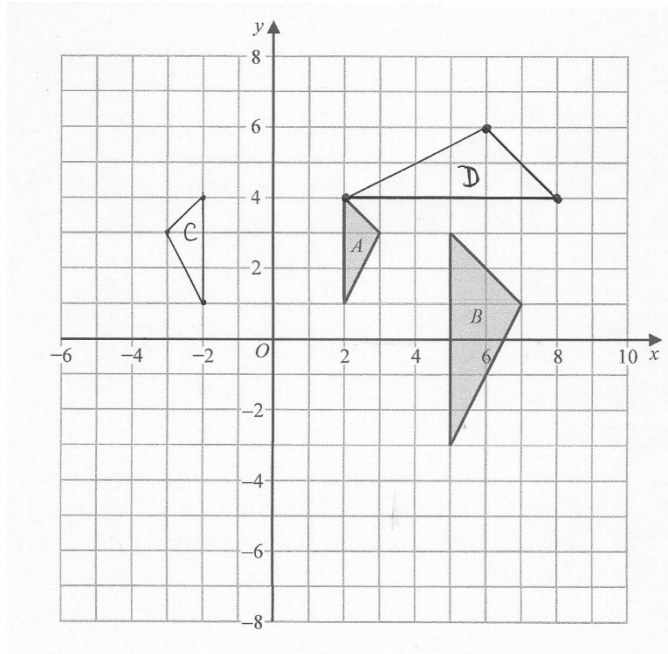| Question		Working	Answer	Mark	Notes	
1	(a)			3	B3 all 6 regions correct B2 4 or 5 regions correct B1 2 or 3 regions correct	
	(b)		{2, 4, 8}	1	B1 or ft their Venn diagram	
	(c)		{2,4,5,6,8,10,12}	1	B1 or ft their Venn diagram	With or without brackets
	(d)		{3,7,9,11}	1	B1 or ft their Venn diagram	
	(e)		7	1	B1 or ft their Venn diagram	
	(f)		5	1	B1 or ft their Venn diagram, also ft number of elements in answer to (d) + number of elements in Venn diagram in 'just *A*'	
					Total 8 marks	

Question		Working	Answer	Mark	Notes
2	(a)(i)	$6x - 2x \geq 2 - 10$ oe eg $4x \geq -8$		2	M1 allow = sign for this mark
			$x \geq -2$		A1 oe eg $[-2, \infty)$
	(a)(ii)		Shaded circle at −2 and line to right of −2	1	B1ft (if line has arrow, it can stop anywhere, without arrow it must go to at least 3 on the scale)
	(b)(i)	$8x^2 + 2x - 3 < 6x^2 - 7x - 10$		5	M1 oe correctly expanding brackets in a correct equation or inequality – allow one error (simplified or unsimplified)
		$2x^2 + 9x + 7$ (< 0) oe			A1 correct 3 term quadratic
		eg $(2x + 7)(x + 1)$ (< 0)			M1ft for a method to solve quadratic independent of previous mark, need not be expressed as inequality, condone an equality or any inequality sign. Must be solving quadratic trinomial. By factorising brackets must expand to give 2 out of 3 terms correct or fully correct substitution into fully correct formula.
		$(x =) -3.5$ $(x =) -1$			A1 correct critical values seen in this part of the question
			$-3.5 < x < -1$		A1 oe eg $x > -3.5$ (and) $x < -1$ or $-1 > x > -3.5$ or $(-3.5, -1)$ stated clearly in this part of the question
	(b)(ii)		Open circles at −3.5 and −1 and line joining circles	1	B1ft an inequality of the form $a < x < b$ where a and b are values from −5 to 5 Allow a single line joining open circles.
	(c)		$-2 \leq x < -1$	1	B1 for the correct answer oe eg $-1 > x \geq -2$ or $x < -1$ (and) $x \geq -2$ or $[-2, -1)$ even if b(i) does not have the correct answer displayed **or** ft dep on M1 in both (a) and (b) and answers for (b)(i) in the form $a < x < b$ and answer in (a)(i) an answer which overlaps the answer in (b)(i)
					Total 10 marks

Question		Working	Answer	Mark	Notes
3	(a)	$\dfrac{3}{15}, \dfrac{7}{15}$		3	B1 oe
		$\dfrac{4}{14}, \dfrac{3}{14}, \dfrac{7}{14}, \quad \dfrac{5}{14}, \dfrac{2}{14}, \dfrac{7}{14}, \quad \dfrac{5}{14}, \dfrac{3}{14}, \dfrac{6}{14}$ [NB: may have been cancelled]			B2 for all remaining branches correct, B1 for 5,6, 7 or 8 correct (where necessary decimals must be 2dp or better truncated or rounded 0.285..., 0.214...,0.5, 0.357..., 0.5, 0.357..., 0.214..., 0.428...)
	(b)	$\dfrac{7}{15} \times \dfrac{6}{14}$		2	M1ft their tree diagram for white, white Ft dep on probabilities between 0 and 1
			$\dfrac{1}{5}$		A1 oe cao
	(c)	$\dfrac{5}{15} \times \dfrac{3}{14} + \dfrac{5}{15} \times \dfrac{7}{14} + \dfrac{3}{15} \times \dfrac{5}{14} + \dfrac{3}{15} \times \dfrac{7}{14} +$ $\dfrac{7}{15} \times \dfrac{5}{14} + \dfrac{7}{15} \times \dfrac{3}{14}$ or $\dfrac{5}{15} \times \dfrac{10}{14} + \dfrac{3}{15} \times \dfrac{12}{14} + \dfrac{7}{15} \times \dfrac{8}{14}$ oe $1 - \dfrac{5}{15} \times \dfrac{4}{14} - \dfrac{3}{15} \times \dfrac{2}{14} - "\dfrac{1}{5}"$ oe		3	M2ft for a fully correct method ft dep on probabilities between 0 and 1 M1ft for at least 2 correct products (or one product of eg O, O' or for 1 minus at least one product for 2 of the same colour (ft the answer to (b))
			$\dfrac{71}{105}$		A1 oe allow decimals of 0.68 or better and 68% or better (0.67619...)
					Total 8 marks

Question		Working	Answer	Mark	Notes	
4	(a)	$\dfrac{336}{4200} \times 100$		2	M1	
			8(%)		A1	
	(b)	$\dfrac{4}{9} \times 630$		2	M1	
			($)280		A1	
	(c)	$546 \div 112$		3	M1	M2 for $\dfrac{546}{1.12}$
		$(546 \div 112) \times 100$			M1	
			($)487.5(0)		A1	
	(d)	$4200 - (336 + 504 + 546 + 630)(=2184)$		3	M1	
		"2184 × 0.125 oe eg 2184 × $\dfrac{12.5}{100}$			M1 a correct calculation to find 12.5% of "2184" "2184" must come from correct working	
			($)273		A1	
	(e)	$\dfrac{504}{4200} \times 360$		2	M1	
			43.2(°)		A1 allow 43° if working seen	
	(f)	$\dfrac{114}{360} \times 4200$ oe		2	M1	
			($)1330		A1	
					Total 14 marks	

Question		Working	Answer	Mark	Notes	
5	(a)		Enlargement,	3	B1 Enlargement, enlarge, enlarged	If more than one transformation is mentioned then no marks can be scored as asked for a single transformation
			Scale factor 2,		B1 Scale factor 2 (allow SF 2)	
			centre of enlargement (−1, 5)		B1 (centre of enlargement) (−1, 5)	
	(b)		Correct reflection (−2, 1),(−2, 4),(−3, 3)	1	B1	
	(c)	$\begin{pmatrix} 0 & 2 \\ -2 & 0 \end{pmatrix}\begin{pmatrix} -2 & -2 & -3 \\ 1 & 4 & 3 \end{pmatrix}$ $= \begin{pmatrix} 2 & 8 & 6 \\ 4 & 4 & 6 \end{pmatrix}$		3	M2 for at least 4 correct entries in the matrix containing the coordinates or for at least 2 correct coordinates listed or plotted. If not M2 then M1 for a correct matrix product with all coordinates in the matrix and multiplied firstly by the transformation matrix.	
			(2, 4), (8, 4), (6, 6)		A1 for a fully correct triangle plotted on grid	
	(d)	$\begin{pmatrix} 0 & 2 \\ -2 & 0 \end{pmatrix}\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$ **or** 2a + b = 2. 2a + 4b = 8, 3a + 3b = 6, 2c + d = 4 2c + 4d = 4. 3c + 3d = 6 oe		3	M1 for both matrices (either order) with intention to multiply or for any 2 correct entries in matrix **N** or for at least 2 correct equations from list	
			$\begin{pmatrix} 0 & 2 \\ 2 & 0 \end{pmatrix}$		A2 award A1 for 3 correct entries (A marks assume M mark is gained)	
					Total 10 marks	

Questions 5b & 5c

Question		Working	Answer	Mark	Notes
6	(a)	$(MR=)\sqrt{6^2+12^2}\,(=\sqrt{180}=6\sqrt{5}=13.4...)$		3	M1
		$\tan VMR = \dfrac{5}{"\sqrt{180}"}$			M1 oe ft their MR as long as clear intention to be MR eg labelled or shown on diagram
			20.4(°)		A1 allow 20.4 – 20.5
	(b)	(height of triangle =) $\dfrac{6}{\tan(70°)}$ $(=2.18...)$		4	M1oe eg 6tan20(=2.18...)
		$PU^2 = ("2.18..."+5)^2 + \left("\sqrt{180}"\right)^2$ **or** eg $UM = \sqrt{12^2+("2.18..."+5)^2}\,(=13.985...)$			M1 ft their MR as long as clear intention to be MR "2.18" must come from correct working
		$PU = \sqrt{("2.18..."+5)^2+("\sqrt{180}")^2}$ **or** $PU = \sqrt{"13.985..."^2+6^2}$			M1 ft their MR as long as clear intention to be MR "2.18" must come from correct working
			15.2 (cm)		A1 15.2 – 15.3
					Total 7 marks

Question		Working	Answer	Mark	Notes
7	(a)	−2.5, 5, −5.5		2	B2 all correct, B1 for 2 correct
	(b)			2	M1 for at least 6 points plotted correctly ft table
					A1 a fully correct graph where all points have been plotted correctly (clear intention to go through all the correct points and join them with a curve)
	(c)		5.1	1	B1ft their graph (must be 1 dp and not part of a coordinate)
	(d)		$-1.7 \leq x \leq 1.2$	2	B2ft oe eg $1.2 \geq x \geq -1.7$ or $[-1.7, 1.2]$ ft from their graph and not from calculation (allow 2 dp but readings must be correct from their graph) (B1 for one end of inequality correct (eg could be $x \geq -1.7$)) Allow < or ≤ etc
	(e)			3	M1 for $y = 0.5x + 2$ stated or shown in working, eg $5 - 0.5x - x^2 = 2 + 0.5x$
					M1 for drawing $y = 0.5x + 2$ accurately going through the points (−2, 1), (0, 2), (2, 3) (or would if extended)
			−2.3, 1.3		A1ft from their graph - both values dependent on M2 awarded Must not be given as part of a coordinate
					Total 10 marks

Question		Working	Answer	Mark	Notes
8	(a)		1.5	1	B1
	(b)	f(4) = 7		2	M1
			$\dfrac{1}{11}$		A1
	(c)	$\dfrac{6x}{x-3}-5(=7)$ **or** $3x-5=7$		3	M1 allow $3.\dfrac{2x}{x-3}-5(=7)$
		$6x = 12x - 36$ **or** $\dfrac{2x}{x-3}=4$ or			M1 or $36 = 6x$ or $-6x = -36$ oe
			6		A1
	(d)	$y=\dfrac{2x}{x-3}$ $\qquad$ $x=\dfrac{2y}{y-3}$ $\;$ $y(x-3)=2x$ $\qquad$ $x(y-3)=2y$		3	M1
		$xy-2x=3y$ $\qquad$ $xy-2y=3x$ $\;$ $x(y-2)=3y$ $\qquad$ $y(x-2)=3x$			M1
			$h^{-1}: x \mapsto \dfrac{3x}{x-2}$		A1oe allow $h^{-1}(x)=\dfrac{3x}{x-2}$
	(e)	eg $\dfrac{1(x-3)}{(2x-3)(x-3)}+\dfrac{2x(2x-3)}{(2x-3)(x-3)}(=1)$ oe		5	M1 for writing fractions correctly over the same common denominator oe
		eg $4x^2 -5x-3 = 2x^2 -6x-3x+9$ oe			M1 correct expansion of brackets in a correct equation, allow one error
		$2x^2 + 4x - 12\ (=0)$ **or** $x^2 + 2x - 6\ (=0)$ oe			A1 correct 3 term quadratic
		eg $\dfrac{-2\pm\sqrt{2^2 -4\times1\times-6}}{2\times1}$ **or** $\dfrac{-2\pm\sqrt{4+24}}{2}$			M1ft their 3TQ correct substitution into formula or completing the square [eg $(x+1)^2 - 7\ (=0)$] oe
			$-1\pm\sqrt{7}$		A1 dep on at least M2
					Total 14 marks

Question		Working	Answer	Mark	Notes
9	(a)	Volume = 1³ : 2³ oe **or** side of square base of pyramid = $\sqrt{\dfrac{960\times3}{20}}(=12)$		3	M1 for a correct volume scale factor in any form or for a calculation to find the side of the square base of the pyramid
		$\dfrac{1}{8}\times960$ **or** $\dfrac{1}{3}\times(0.5\times"12")^2\times10$			M1 a correct calculation to find the volume of the smaller pyramid
			120 (cm³)		A1
	(b)	eg $\dfrac{960\times3}{20}+\dfrac{"120"\times3}{10}$ **or** 12^2+6^2 or $144+36$		5	M1 Award for sight of calculations for 144 and 36 or for 144 and 36 as part of a calculation for the total surface area. 12 & 6 may be found in (a)
		area of one triangular face of pyramid lge/sml $0.5\times"12"\times\sqrt{20^2+6^2}(=12\sqrt{109}=125.(28...))$ **or** $0.5\times6\times\sqrt{10^2+3^2}(=3\sqrt{109}=31.(32...))$ oe **or** height of trapezium = $\sqrt{3^2+10^2}=\sqrt{109}(=10.4...)$ oe **or**			M1 for a correct calculation for area of a triangular face of the large pyramid (NB: $\sqrt{20^2+6^2}=2\sqrt{109}=20.88...$) **or** The area of a triangular face of the small pyramid (NB: $\sqrt{10^2+3^2}=\sqrt{109}=10.44...$) **or** the height of the trapezium **(any ft figures must have come from a correct method)**
		Area of trapezoidal face of frustum = $"12\sqrt{109}"-"3\sqrt{109}"$ **or** $\dfrac{6+12}{2}\times\sqrt{109}(=9\sqrt{109}=93.9(6...))$			M1ft area of trapezoidal face of frustum **(any ft figures must have come from a correct method)**
		$4\times"9\sqrt{109}"+"12"\times"12"+"6"\times"6"$ oe			M1ft a fully correct method from fully correct working
			556 (cm²)		A1 (answers in range 555.8 – 556)
					Total 8 marks

Question		Working	Answer	Mark	Notes
10		$(v =)\ 3t^2 - 14t - 5$		5	M1 all correct
		$3t^2 - 14t - 5 = 0$			M1ft for their $v = 0$
		$(3t + 1)(t - 5)$ $(t = -\frac{1}{3})\ t = 5$			M1ft method to solve quadratic equation for ft this must be a 3 term quadratic By factorising brackets must expand to give 2 out of 3 terms correct or fully correct substitution into fully correct formula or completing the square
		$t = 5$ (only)substituted into s			M1
			46(m)		A1
					Total 5 marks

Question	Working	Answer	Mark	Notes
11	$\overrightarrow{AP} = \frac{2}{3}\mathbf{b} - \frac{2}{3}\mathbf{a}$ or $\overrightarrow{PA} = \frac{2}{3}\mathbf{a} - \frac{2}{3}\mathbf{b}$ or $\overrightarrow{BP} = \frac{1}{3}\mathbf{a} - \frac{1}{3}\mathbf{b}$ or $\overrightarrow{PB} = \frac{1}{3}\mathbf{b} - \frac{1}{3}\mathbf{a}$ or $\overrightarrow{OP} = \frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b}$ or $\overrightarrow{PO} = -\frac{1}{3}\mathbf{a} - \frac{2}{3}\mathbf{b}$		6	M1oe must be labelled need not be simplified
	$\overrightarrow{OQ} = \frac{1}{4}\left(\frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b}\right) = \frac{1}{12}\mathbf{a} + \frac{1}{6}\mathbf{b}$ or $\overrightarrow{PQ} = \frac{3}{4}(-\frac{1}{3}\mathbf{a} - \frac{2}{3}\mathbf{b}) = -\frac{1}{4}\mathbf{a} - \frac{1}{2}\mathbf{b}$			M1oe or for $\overrightarrow{QO}$ **or** $\overrightarrow{QP}$ must be labelled need not be simplified
	$\overrightarrow{AQ} = \frac{1}{6}\mathbf{b} - \frac{11}{12}\mathbf{a}$ or $\overrightarrow{QA} = \frac{11}{12}\mathbf{a} - \frac{1}{6}\mathbf{b}$ **or** eg $\overrightarrow{RA} = (1-k)\mathbf{b} + \mathbf{a} - \mathbf{b}$			M1oe must be labelled, need not be simplified
	$\overrightarrow{AR} = n(\frac{1}{6}\mathbf{b} - \frac{11}{12}\mathbf{a})$ and $\overrightarrow{AR} = -\mathbf{a} + m\mathbf{b}$ or $\overrightarrow{RQ} = (\frac{1}{6} - k)\mathbf{b} + \frac{1}{12}\mathbf{a}$ & $\overrightarrow{RQ} = \mu(\mathbf{a} - k\mathbf{b})$ or $\overrightarrow{OR} = (\frac{1}{12} - \mu)\mathbf{a} + (\frac{1}{6} + \mu k)\mathbf{b}$ oe $\overrightarrow{OR} = \frac{1}{12}\mathbf{a} + \frac{1}{6}\mathbf{b} + \frac{1}{6}n\mathbf{b} - \frac{11}{12}n\mathbf{a}$ $(n = \frac{1}{11})$			M1oe or for use of the relationship between *RQ* **or** *QA* **or** *RQ* and *RA* or *AQ* and *AR* or *AQ* and *QR* or a correct statement for *OR*
	$m = \frac{2}{11}$ **or** $\overrightarrow{OR} = \frac{12}{11} \times \frac{1}{6}\mathbf{b} (= \frac{2}{11}\mathbf{b})$			M1 for a solution showing the line divided in the correct fraction eg

		eg $\mu = \dfrac{1}{12}, k = \dfrac{2}{11}$			$OR = \dfrac{2}{11}OB$ **or** $BR = \dfrac{9}{11}BO$ **or** the value of a term such as μ oe
		THERE ARE OTHER CORRECT METHODS	2 : 9		A1 correct answer from no incorrect working
					Total 6 marks