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Mark Scheme (Results)

Summer 2015

Pearson Edexcel International GCSE Mathematics B (4MB0) 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
  - eeoo – each error or omission
  - awrt –answer which rounds to

- **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.
  Any case of suspected misread loses A (and B) marks on that part, but can gain the M marks.
  If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.
  If there is a choice of methods shown, then no marks should be awarded, unless the answer on the answer line makes clear the method that has been used.
  If there is no answer on the answer line then check the working for an obvious answer.
- **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 in another.

Question		Working		Answer	Mark	Notes
1	(a)	$1.20\times$£1400 - €1230			2	M1
				(€)450		A1
	(b)	"€450" $\times\frac{75}{100}$ (=€337.50)	$\frac{\text{"€450"}}{1.2}$ (=£375.00)		3	M1 oe
		$\frac{\text{"337.50"}}{1.20}$	$\frac{75}{100}\times$"375.00"			M1 dep
				(£)281.25		A1
						Total 5 marks

Question		Working	Answer	Mark	Notes
2	(a)		$p + m = 100$	1	B1
	(b)		$p - m = 22$	1	B1 oe
	(c)	**Note:** A correct attempt to eliminate either m or p from their equations.		3	M1
			$p = 61$ **or** $m = 39$ **or** $"p"+"m" = 100$		A1
			$p = 61$ **and** $m = 39$		A1
					Total 5 marks

Question	Working	Answer	Mark	Notes
3	$2(x-2)-3x=5x(x-2)$ **Note:** removing denominators allowing one arithmetic slip			M1
		$5x^2-9x+4(=0)$ (o.e.)		A1
	$(5x-4)\,(x-1)\;=\;0$ **Notes:** attempt to factorise/solve *their* trinomial quadratic **OR** a correct substitution of *their* values into a correctly quoted formula **OR** Completing the square, *for their* trinomial quadratic,as far as: $(x-\frac{9}{10})^2-\frac{81}{100}=\frac{-4}{5}$ (o.e.)		5	M1
		$x\;=\;\frac{4}{5}$ (0.8), 1		A1, A1
				Total 5 marks

Q	Working	Answer	Mark	Notes
4 (a)	$EC = \sqrt{(17)^2 - 5^2}$ **Note:** For a trig method, we need to see both stages for M to be earned i.e. $\sin \angle FEC = 5/17$ followed by $EC = 17 \times \cos(17.1046...)$		2	M1
		EC = 16.2 (cm) (cao)		A1
(b)	$10 \times (10 + 7 + FB) = "16.248"^2$ **OR** $10 \times (BE) = "16.248"^2$		2	M1
		Accept awrt 9.24 , 9.37→9.41		A1
(c)	$7 \times "9.4" = 5 \times FA$ (o.e.)		2	M1
		Accept awrt 12.9 →13.2		A1
				Total 6 marks

Question	Working		Answer	Mark	Notes
5 (a)	$\text{gf}(x) = 2(2+(5x-6))$ $(=10x-8)$	$\text{f}(-1) = -11$		2	M1
			$\text{gf}(-1) = -18$		A1
(b)	$y+6=5x$	$x=5y-6$ (o.e.)		2	M1
	Note: For A mark, the inverse must be in the stated form		$\text{f}^{-1} : x \mapsto \frac{x+6}{5}$ (o.e.)		A1
(c)	$\text{fg}(x) = 5(2(2+x))-6$			4	M1 oe
	$"14+10x" = 3(4+2x)$				M1 dep
	$4x=-2$ (o.e.) **Note:** The correct equation with x's gathered and numeric terms gathered. The two terms may be on the same side of the equality				M1 dep
			$x = -\frac{1}{2}$ (o.e.)		A1
					Total 8 marks

Question	Working	Answer	Mark	Notes
6 (a)	$\pi \times 20^2 \times 10$		2	M1
	Note: isw	4000π (cm^3)		A1 cao
(b)	**Note:** Allow a value substituted for π in this part.			
	Vol of spheres = $30 \times \frac{4}{3}\pi r^3$		6	M1
	Note: $40\pi r^3$ could be implied by subsequent method marks [could even be implied by $40r^3$ where π has been cancelled]	$= 40\pi r^3$		A1
	Total volume = $"4000\pi"$ + $"40\pi r^3"$ ($12566.3\ldots + 125.663r^3$) / Increase in volume = $20^2 \times \pi \times 6.4$ (2560π) ($8042.47\ldots$)			M1
	$"4000\pi"$ + $"40\pi r^3"$ = $\pi \times 20^2 \times 16.4$ (6560π) / $"40\pi r^3" = 20^2 \times \pi \times 6.4$ (2560π)			M1 dep
	$r^3 = 164 - 100$ (or better)			M1 dep
	OR			**OR**
	Vol of spheres + water = $20 \times 20 \times \pi \times 16.4$			(M1)
	6560π ($20608.8\ldots$) **Note:** 26240π if $r = 40$ used			(A1)
	$6560\pi - "4000\pi"$ (2560π, $8042.47\ldots$)			(M1)

	Volume of one sphere = $\frac{"2560\pi"}{30}$ $\left(\frac{256\pi}{3}\right)$ **OR** $\frac{4}{3}\pi r^3 = \frac{"2560\pi"}{30}$ $\left(\frac{256\pi}{3}\right)$	$40\pi r^3 = "2560\pi"$			(M1 dep)
	$r^3 = 64$				(M1 dep)
	Note: Ignore -4 Ignore any prior unrounded value when the answer $r = 4$ is given		$r = 4$		A1 cao
	Note: Misread (using radius = 40) loses at least the A mark in part (a) and the final A mark. All other marks (including the 2nd A mark, are available here.				
					Total 8 marks

Question	Working	Answer	Mark	Notes
7 (a)	$2.3t^2 + 14t^1 + 13$		2	M1 2 terms correct
	$6t^2 + 14t + 13$	3 terms correct (cao)		A1
(b)	$"2 \times 6t + 14"$		2	M1 1 term correct
	$12t + 14$ **Note:** ft from part (a) provided there are two terms.			A1 ft
(c)	$"6t^2 + 14t + 13" = "12t + 14"$		5	M1
		$6t^2 + 2t - 1\ (=0)$		A1 cao
	$t = \dfrac{-2 \pm \sqrt{2^2 - 4 \times 6 \times (-1)}}{2 \times 6}$ **Note:** Correct substitution of their *a*, *b* and *c* into formula (must be a trinomial quadratic but **NOT** $"6t^2 + 14t + 13"$)			M1
	Note: B mark for evaluation of their discriminant. Only ft if working seen and discriminant is not negative. **But,** an answer of $t = 0.27$ (or better) implies this ft mark. (see below)	$\sqrt{28}$ or $\sqrt{7}$		B1 ft
	Note: $t = 0.27$ or giving both positiveve & negativeve answers loses the final A mark Do not penalise -0.608 (N/A) or where the negative value is clearly eliminated. No working, but sight of $t = 0.27$ gains 4 out of 5 marks	$t = 0.274$		A1 awrt 0.274
				Total 9 marks

Question		Working	Answer	Mark	Notes
Penalise missing labels once only in the question, the first time it occurs					
8	(a)		*A* drawn and labelled	1	B1
	(b)	*B* has coordinates (3, 3), (3, 9), (7, 1)	*B* drawn and labelled	3	B3 -1eeoo
	(c)	*C* has coordinates (-3, -3), (-9, -3), (-1, -7)	*C* drawn and labelled	3	B3ft -1eeoo
	(d)	$\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$"$\begin{pmatrix} -3 & -9 & -1 \\ -3 & -3 & -7 \end{pmatrix}$"		3	M1
		D has coordinates (3, –3), (3, –9), (7, –1) **Note:** If matrix product not seen, then it can be implied from a "correct" *D*.	*D* drawn and labelled		A2 -1eeoo
	(e)	**Note:** Must be consistent with their diagram Accept $y = 0$ for x-axis	Reflection in x-axis	1	B1
					Total 11 marks

Question	Working	Answer	Mark	Notes
9 (a)	$\left[\text{Mean time} = \frac{10\times(15)+14\times(35)+90\times(50)+54\times(70)+32\times(85)}{200} \left(=\frac{11640}{200}\right)\right]$			
	Using a correct midpoint in a product		4	M1
	Attempt to use $\sum \frac{frequency \times midpoint}{200}$ **Note:** Allow for consistent use of *their* midpoint i.e. 15.5, 35.5,…. Allow UCBs or LCBs A minimum of 2 terms in numerator			M1
	Using **fully correct** $\sum \frac{frequency \times midpoint}{200}$			M1 dep
		58 minutes		A1 cao
(b)	5 bars drawn **Note:** For a height of 1/3 allow any correct line drawn between 0.3 and 0.4 inclusive Gap(s) between bars is one error only **SC:** If B0 but all correct frequency densities calculated Then B1.	Heights $\frac{1}{3}$, 1.4, 4.5, 2.7 and 3.2	5	B5 -1eeoo
(c)	$\frac{16}{20}$ Using frequency density of 4.5		4	M1
	$90\times\frac{16}{20}$ (72) $(56-40)\times 4.5$ (72)			M1 dep
	$10 + 14 + 90\times\frac{16}{20}$ (= 96 students)			M1 dep, all correct
		$\frac{96}{200}$, 0.48, 48% (o.e.)		A1
				Total 13 marks

Question	(a)	Answer	Mark	Notes
10 (a)(i)		$\overrightarrow{AB} = 2\mathbf{b} - 6\mathbf{a}$ (o.e.)	4	B1
(ii)		$\overrightarrow{OP} = 3\mathbf{a}$		B1
(iii)	$6\mathbf{a} + "3(2\mathbf{b} - 6\mathbf{a})"$ $\quad 2\mathbf{b} + "2(2\mathbf{b} - 6\mathbf{a})"$			M1
		$\overrightarrow{OC} = 6\mathbf{b} - 12\mathbf{a}$ (o.e.)		A1
(b)	$\overrightarrow{OQ} = \frac{1}{m}"(6\mathbf{b} - 12\mathbf{a})"$		3	M1
	$\overrightarrow{PQ} = \overrightarrow{PO} + \overrightarrow{OQ} = -"3\mathbf{a}" + "\frac{1}{m}(6\mathbf{b} - 12\mathbf{a})"$			M1 dep
		$\overrightarrow{PQ} = \left(-3 - \frac{12}{m}\right)\mathbf{a} + \left(\frac{6}{m}\right)\mathbf{b}$ **OR** Accept $-3\mathbf{a} + \frac{1}{m}(6\mathbf{b} - 12\mathbf{a})$		A1
(c)	$\Delta s \begin{matrix} OAC \\ OPQ \end{matrix}$ similar Δs		3	M1
	$\frac{OP}{OA} = \frac{OQ}{OC}\left(= \frac{PQ}{AC}\right) = \frac{1}{m} = \frac{1}{2}$			M1
	OR			**OR**
	$\frac{"\left(-3 - \frac{12}{m}\right)"}{"\left(\frac{6}{m}\right)"} = "\frac{-6}{2}"$ (o.e.) **Note:** could be in ratio form			(M1) oe
	$-6 - \frac{24}{m} = -\frac{36}{m}$ (o.e.)			(M1 dep)

	OR			**OR**
	$\overrightarrow{PQ} = "\left(-3-\frac{12}{m}\right)"\mathbf{a}+"\left(\frac{6}{m}\right)"\mathbf{b} = k\overrightarrow{AB} = k\left("-6\mathbf{a}+2\mathbf{b}"\right)$			(M1) oe
	Equating coefficients of **a** and **b**			(M1 dep)
	Note: Using $\overrightarrow{PQ} = \overrightarrow{AC}$ instead of being parallel goes nowhere and commonly arrives at $m=1$			
	Note: m = 2, no incorrect working seen ⇒ full marks	$m=2$		A1
(d)	**Note**: ft from (b) and/or (c) Does not need to be simplified	$\overrightarrow{PQ} = -9\mathbf{a} + 3\mathbf{b}$	1	B1 ft
(e)	**Note:** Using /seeing $\left(\frac{1}{"m"}\right)^2$ or $\left(\frac{1}{2}\right)^2$ Do not accept m =1	$\left(\frac{1}{"m"}\right)^2$ OR $\left(\frac{1}{2}\right)^2$	3	B1 ft
	Area of $\Delta OPQ = \left(\frac{1}{"m"}\right)^2 \times 12$			M1
		Area of $PQAC = 9$ cm^2		A1
				Total 14 marks

Question	Working	Answer	Mark	Notes
11 (a)	**Note:** Accept awrt these values – do not penalise incorrect rounding in this question	–2.8 –4.6 –0.4	3	B1 B1 B1
(b)	**Notes:** ft from their table values Accuracy: ±1 small square If a point is not plotted, it can be inferred from their curve passing through (within tolerance) the required point.	Curve drawn	3	B3 -1 mark for straight line segments each point missed each missed segment each point not plotted each point incorrectly plotted tramlines very poor curve
(c)		-5.5 +/- 1 small square	1	B1 ft
(d)	Correct tangent drawn and attempting $\frac{\Delta y}{\Delta x}$ from curve **Note:** Tangent must touch curve at $x = 3$. An attempt at $\frac{\Delta y}{\Delta x}$ seen. If this M not earned, then no A mark (i.e. calculus alone earns no marks)		2	M1
		accept gradient values in the range 3.8 – 4.4		A1
(e)	$\frac{x^3}{6} - \frac{x}{4} + \frac{5}{x^2} - 4 = 0 \Leftrightarrow \frac{x^3}{6} + \frac{5}{x^2} - 8 = \frac{x}{4} - 4$ **Note:** The correct line identified (or drawn) earns method irrespective of working seen		4	M1

	Notes: Ignore missing label The line must pass through (0, -4) and (4, -3) (within tolerance) – extrapolate if necessary	drawn $y = \frac{x}{4} - 4$		A1
	Note: ft from the correct straight line and their curve (ignore values of y)	1.1 +/- 1 small square, 2.9 +/- 1 small square		A1 ft (ft dep on 1st A1) A1 ft (ft dep on 1st A1)
(f)	$\frac{x^3}{6} + \frac{5}{x^2} - 2 = 0$ rearranged as $\frac{x^3}{6} + \frac{5}{x^2} - 8 = -6$		3	M1
		$y = -6$ drawn (or implied)		A1
	OR			**OR**
	statement that $y = \frac{x^3}{6} + \frac{5}{x^2} - 2$ is obtained by moving $y = \frac{x^3}{6} + \frac{5}{x^2} - 8$ 6 units up the y-axis			(M1)
	$\therefore\ y = \frac{x^3}{6} + \frac{5}{x^2} - 2$ will not intersect the x-axis since minimum is now $y = 0.5$			(A1)
	Note: " and therefore has no solutions" Final mark can only be awarded if the previous M and A are awarded.	correct conclusion drawn		A1
				Total 16 marks

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