# Mark Scheme (Results)

## June 2016

## Pearson Edexcel International GCSE Mathematics B (4MB0) 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
    - 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.
  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  If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.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.

| International GCSE Maths | | | | |
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| | | | | |
| **Q** | **Working** | **Answer** | **Mark** | **Notes** |
| **1** a | $x^2 - 2\times 3\times y = 9 - 6y$ | | 3 | M1 Can be embedded in a matrix equation (This also applies to the second equation). |
| | | $x = 3$ | | A1 |
| | | $x = -3$ | | A1 |
| b | $y - 2x = 5$ | | 3 | M1 |
| | | $y = 11$ $(5 + 2\times "3")$ | | A1 ft |
| | | $y = -1$ $(5 - 2\times "-3")$ | | A1 ft |
| | | | | **Total 6 marks** |

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| **2** | a | $r_{Removed} = \frac{8}{20} \times 6$ $\left(\frac{8}{20} = \frac{r}{6}\right)$ (o.e.)<br><br>Alt: (Using half the vertex angle)<br>$r = 8 \times \tan(16.7)$ | | | M1 | |
| | | | $r_{Removed} = 2.4$ (cm) (awrt) | | A1 | |
| | b | $(V =) \frac{1}{3}\pi \times 6^2 \times 20 - \frac{1}{3}\pi \times "2.4"^2 \times 8$ (oe) | | | M1 | |
| | | | $= 706$ or 705 ($cm^3$) (cao) | | A1 | |
| | c | Time (sec) = $\frac{"706"}{54}$ | | | M1 | |
| | | | Time (sec) = 13 (cao) | | A1 | |
| | | | | | | **Total 6 marks** |

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| **3** a | $\left(\frac{dy}{dx}=\right)6x^2-8x$ (1 term correct) | | 4 | M1 |
| | Fully correct | | | A1 |
| | $6x^2-8x=0$ | $x=\frac{4}{3}$ (cc) | | M1 (dep)<br>A1 |
| | OR<br>$6\times\left(\frac{4}{3}\right)^2-8\left(\frac{4}{3}\right)$ | 0 (cc) | | M1 (dep)<br>A1 |
| b | calculating<br>$\frac{dy}{dx}(x=1,\text{say})=-2$ and $\frac{dy}{dx}(x=2,\text{say})=+8$<br>(ie evaluating $\frac{dy}{dx}$ on either side of the stationary point)<br>**Note**: **any** value to the left of 4/3 (must be > 0)<br>**any** value to the right of 4/3<br>Noting the change in sign of $\frac{dy}{dx}$ from negative to positive as $x\uparrow$ through the stationary point | | | M1<br><br>M1 (dep) |

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| | OR<br>Calculating f(4/3) = 2.63..(or better) (Accept 71/27)<br>Calculating<br>$f\left(x=1,\text{say}\right)=3$ and $f\left(x=2,\text{say}\right)=5$<br>**and** noting that **both** values are greater than f(4/3) | | | M1 **any** value to the left of 4/3 (must be > 0)<br>**any** value to the right of 4/3<br><br>M1 (dep) |
| | **OR** (not in syllabus)<br>$\frac{d^2y}{dx^2}=12x-8$<br>$"\frac{d^2y}{dx^2}"(x=\frac{4}{3})>0$ | | | M1<br><br>M1 (dep) |
| | | Minimum (cc) | | A1 |
| | | | | **Total 5 marks** |

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| **4** | a | Vans = 240 | | 1 | B1 |
| | b | One of Lorries: $\frac{1}{5}\times(600-"240")$<br>**OR**<br>Cars: $\frac{4}{5}\times(600-"240")$ seen (oe) | | 3 | M1 |
| | | | Lorries = 72<br>**OR**<br>Cars = 288 | | A1 |
| | | | Cars = $(600-"240")-"72"$<br>OR<br>Lorries = $(600-"240")-"288"$ | | A1 ft |
| | c | Cars sold = "288" + $\frac{1}{9}\times"288"(=320)$ (oe)<br>**and** Lorries sold = $\frac{87.5}{100}\times"72"(=63)$ (oe) | | 3 | M1 Accept 12.5% increase or decrease here (i.e. 63 or 81) |
| | | % increase = $\frac{("320"+"63"+"240")-600}{600}\times100$ (oe)<br>(3.833…) | | | M1 (dep) |

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| | OR<br>Increase in cars sold = $\frac{1}{9}\times"288"(=32)$<br><br>**and** **(**decrease) in lorries sold = $\frac{12.5}{100}\times"72"(=9)$ | | | M1 |
| | $\frac{"32"-"9"}{600}\times100$ | | | M1 (dep) |
| | | 4% | | A1 |
| | | | | **Total 7 marks** |

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| **5** | ai | $xy=1+x$<br>*OR*<br>$y=\frac{1}{x}+1$<br>*OR*<br>$xy=y+1$ | | 4 | M1 | |
| | | $x(y-1)=1$<br>OR<br>$y-1=\frac{1}{x}$<br>OR<br>$y(x-1)=1$ | | | M1 (dep) | |
| | | $f^{-1}: x \mapsto \frac{1}{x-1}$ | | | A1 | For the letter 'y', accept any other letter |
| | aii | | ($x=$)1<br>**OR**<br>$x \neq 1$<br>**OR**<br>"not 1" | | B1 ft | Cand's (a)(i) must be a fraction with a linear denominator and ft is on the cand's denominator |
| | b | $\frac{2}{x}+3=4\times"\frac{1}{x-1}"$ | | 5 | M1 | Correctly removing at least two **different** denominators in $x$<br>This M mark is **independent** of the previous M mark. |
| | | $2(x-1)+3x(x-1)=4x$ (oe) | | | M1 | |
| | | | $3x^2-5x-2$ (= 0) | | A1 | |

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| | | $(3x+1)(x-2)$<br>attempt to factorise their trinomial quadratic<br>OR<br>fully correct substitution into a correctly quoted formula<br>OR<br>Completing the square method as far as:<br>$\left(x-\frac{5}{6}\right)^2=\frac{2}{3}+\left(\frac{5}{6}\right)^2$ | | | M1 | |
| | | | $-\frac{1}{3}$ $(-0.333$ awrt$)$, $2$ | | A1 | |
| | | | | | | **Total 9 marks** |

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| **6** | a | | Triangle *A* drawn and labelled | 1 | B1 | |
| | b | $\begin{pmatrix}-1 & 1\\ 2 & -1\end{pmatrix}\begin{pmatrix}1 & 2 & -1\\ 1 & 3 & 2\end{pmatrix}$ | | 3 | M1 | Method can be implied from the resultant 2 x 3 matrix or the triangle itself |
| | | | Triangle *B* is $(0,\ 1),(1,\ 1),(3,\ -4)$<br>Triangle *B* drawn and labelled. | | A2<br>(-1eeoo) | |
| | c | $\begin{pmatrix}2 & 1\\ -1 & -1\end{pmatrix}$"$\begin{pmatrix}0 & 1 & 3\\ 1 & 1 & -4\end{pmatrix}$" | | 3 | M1 | |
| | | | Triangle *C* is (1, -1), (3, -2), (2, 1)<br>Triangle *C* drawn and labelled | | A2 ft<br>(-1eeoo) | The coordinates can be implied from a 2 x 3 matrix seen or from the triangle itself.<br>If the ft is to be applied we **must** see an attempt at the matrix multiplication |
| | d | | Rotation | 3 | B1 | |
| | | | about origin or (0, 0) | | B1 | |
| | | | (anticlockwise) 270° or clockwise 90° or –90° | | B1 | A combined transformation earns no marks<br>No marks (or penalties) for the appearance of a matrix here. |
| | | | | | | **Total 9 marks** |

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| **7** | a | | 0.25 (oe) | | B1 |
| | | | 0.7, 0.3 (oe) | | B1 |
| | | | 0.6, 0.4 (oe) | | B1 |
| | bi | "0.25" × "0.4" | | | M1 |
| | | | 0.1 , $\frac{1}{10}$ | | A1 |
| | bii | One of 0.75 × "0.3" and "0.25" × "0.4"<br>OR<br>0.75 × "0.7" + "0.25" × "0.6" | | | M1 |
| | | 0.75 ×"0.3" + "0.25"× "0.4"<br><br>OR<br><br>1 – (0.75 × "0.7" + "0.25" × "0.6") | | | M1 (dep) For "0.25" × "0.4" accept "0.1" |
| | | | 0.325, $\frac{13}{40}$ | | A1 |
| | c | $\frac{\text{a probability}}{\text{"0.325"}}$ | | | M1 |
| | | $\frac{\text{"0.1"}}{\text{"0.325"}}$ | | | M1 (dep) "0.325"= 0.75 × "0.7" + "0.25" × "0.6" |
| | | | awrt 0.31, $\frac{4}{13}$ | | A1 Condone percentages as probabilities. |
| | | | | | **Total 11 marks** |

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| **8** | $t = ab + adx$<br>OR<br>$\frac{t}{a} = b + dx$ | | | M1 |
| | $t - ab = adx$ (o.e.)<br>OR<br>$\frac{t}{a} - b = dx$ (o.e.) | | | M1<br>(dep) |
| | | $x = \frac{t - ab}{ad}$, $x = \frac{t}{ad} - \frac{b}{d}$ ,<br>$x = \frac{\left(\frac{t}{a} - b\right)}{d}$ (o.e) | | A1 Do not isw<br>Accept also $x = \frac{-t + ab}{-ad}$ and<br>$x = \frac{\left(\frac{t - ab}{a}\right)}{d}$<br>Do not accept $\frac{t - ab}{\frac{a}{d}}$ (the order of operation **must** be clear)<br>$x = \ldots$**must** be on the answer line for the final A mark |
| | | | | **Total 3 marks** |

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| **9** | $BD^2 = 10^2 + 4^2 - 2\times10\times4\times\cos(20)$ | | 3 | M1 |
| | $BD = \sqrt{\left(10^2 + 4^2 - 2\times10\times4\times\cos(20)\right)} \quad \left(=\sqrt{40.8...}\right)$ | | | M1 (dep) |
| | | $BD$ = 6.3894 cm → **6.39** | | A1 |
| `b | In $\Delta ABD$, $\dfrac{10}{\sin\angle ADB} = \dfrac{"6.3894"}{\sin 20}$<br>OR<br>$10^2 = 4^2 + "6.389"^2 - 2\times4\times"6.389"\times\cos\angle ADB$ | | 4 | M1 |
| | $\angle ADB = \sin^{-1}\left(\dfrac{10\times\sin 20}{"6.3894"}\right) \quad (\angle ADB = 147.636)$<br>OR<br>$\therefore \angle ADB = \cos^{-1}\left(\dfrac{4^2 + "6.389"^2 - 10^2}{2\times4\times"6.389"}\right) \quad (\angle ADB = 147.636)$ | | | M1 (dep) |
| | $\therefore \angle BDC = 180 - "147.636"$ | | | M1 (dep) |
| | | $\therefore \angle BDC = 32.3637$ →**32.4°** | | A1 |
| | OR<br>$\dfrac{4}{\sin\angle ABD} = \dfrac{"6.3894"}{\sin 20}$<br>$\sin\angle ABD = \dfrac{4\times\sin 20}{"6.3894"} \quad (\angle ABD = 12.3637...)$<br>$\therefore \angle BDC = 20 + "12.3637..."$ | $\therefore \angle BDC = 32.3637$ →**32.4°** | | M1<br>M1 (dep)<br>M1 (dep)<br>A1 |

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| c | $\Delta ABC = 18 = \frac{1}{2} \times 10 \times "(4 + CD)" \times \sin 20$<br><br>OR<br><br>$\Delta ABD = \frac{1}{2} \times 4 \times 10 \times \sin 20$ (=6.8404)<br><br>$\therefore \Delta BCD = 18 - "6.8404"$ (=11.1596) | | 3 | M1 |
| | $\therefore CD = \frac{18}{\frac{1}{2} \times 10 \times \sin 20} - 4$ (oe)<br><br>OR<br><br>$(\therefore "11.1596" = \frac{1}{2} \times "6.3894" \times CD \times \sin "32.3637")$<br><br>$CD = \frac{"11.1596"}{\frac{1}{2} \times "6.3894" \times \sin "32.3637"}$ | | | M1<br>(dep) |

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| | | $\therefore CD = 6.5186,\ \ 6.5257$ cm<br>**→6.52, 6.53** | | $CD$ = 6.5186 using 6.39 and 32.4° and $CD$ = 6.5257 using 6.3894 and 32.3637°<br>If the incorrect obtuse angle has been penalised in part (b), Condone sin(147.636...) in this part of the question. |
| | | | | **Total 12 marks** |

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| **10** | ai | | $\overrightarrow{AB} = 2\mathbf{b} - \mathbf{a}$ | 5 | B1 | |
| | aii | | $\overrightarrow{BC} = -\ \mathbf{b}$ | | B1 | |
| | aiii | | $\overrightarrow{AF} = \frac{2}{3}"\overrightarrow{AB}" = \frac{2}{3}$("2**b** – **a**") (o.e.) | | B1 ft | |
| | aiv | $\overrightarrow{FC} = \frac{1}{3}"(2\mathbf{b}-\mathbf{a})" + "-\mathbf{b}"$ **OR** $-\frac{2}{3}"(2\mathbf{b}-\mathbf{a})" - \mathbf{a} + \mathbf{b}$ | | | M1 | |
| | | | $\overrightarrow{FC} = -\frac{1}{3}(\mathbf{a}+\mathbf{b})$ (o.e.) | | A1 | |
| | b | | $\overrightarrow{FE} = -\frac{\lambda}{3}"(\mathbf{a}+\mathbf{b})"$ | 1 | B1 ft | |
| | c | $\overrightarrow{OE} = \mathbf{a} + "\frac{2}{3}(2\mathbf{b}-\mathbf{a})" + "\left(-\frac{\lambda}{3}(\mathbf{a}+\mathbf{b})\right)"$ $\left(= \overrightarrow{OA} + \overrightarrow{AF} + \overrightarrow{FE}\right)$ OR $\overrightarrow{OE} = \overrightarrow{OC} + \overrightarrow{CE} = \mathbf{b} + (\lambda - 1)"\left(-\frac{1}{3}(\mathbf{a}+\mathbf{b})\right)"$ $\left[FE = FC + CE \therefore CE = FE - FC = (\lambda - 1)FC\right]$ (o.e.) | | 2 | M1 | |
| | | | $\overrightarrow{OE} = \mathbf{a}\left(\frac{1}{3} - \frac{\lambda}{3}\right) + \mathbf{b}\left(\frac{4}{3} - \frac{\lambda}{3}\right)$ (o.e.) | | A1 | Accept $\frac{1}{3}\mathbf{a} - \frac{1}{3}\lambda\mathbf{a} + \frac{4}{3}\mathbf{b} - \frac{1}{3}\lambda\mathbf{b}$ |
| | d | $\mu"(2\mathbf{b}-\mathbf{a})" = "\mathbf{a}\left(\frac{1}{3} - \frac{\lambda}{3}\right) + \mathbf{b}\left(\frac{4}{3} - \frac{\lambda}{3}\right)"$ | | 6 | M1 | |

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| | Equating components one pair of components | | | M1 (dep) | |
| | | of **a**: $-\mu = \frac{1}{3} - \frac{\lambda}{3}$ | | A1 | |
| | | of **b**: $2\mu = \frac{4}{3} - \frac{\lambda}{3}$ | | A1 | |
| | | $\lambda = 2$ | | A1 | |
| | | $\mu = \frac{1}{3}$ | | A1 | |
| e | | Congruent, similar triangles or same area<br>$OCE \cong CFB$, $OCE$ □ $CFB$<br>Stating at least 3 pairs of sides and/or 3 pairs of angles are equal | 1 | B1 | |
| | | | | | **Total 15 marks** |

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| **11** | a | | –0.28, 3.28 (awrt) | 2 | B1<br>B1 | |
| | b | | –1 mark for<br>straight line segments<br>each point missed<br>each missed segment<br>each point not plotted<br>each point incorrectly plotted<br>tramlines<br>very poor curve | 3 | B3 | Accuracy for both plotting and drawing is $\pm\frac{1}{2}ss$<br>ft from their table values<br>Only penalise straight line segments in the range $-0.5 < x < 1$ and/or $1 < x < 1.5$ |
| | c | | –0.3 , 1.3 | 2 | B1<br>B1 | For -0.3 accept any value in the range $-0.3 \rightarrow -0.2$<br>For 1.3 accept any value in the range $1.2 \rightarrow 1.3$ |
| | d | | $x < -0.7$<br>$x > 0.4$<br>$x < 1.9$ | 3 | B1<br>ft<br>B1<br>ft<br>B1<br>ft | $0.4 < x < 1.9$ **only** stated scores B0, B1, B1<br>Accept weak inequalities<br>If none of the B marks are earned, award B1, B0, B0 if and only if all 3 critical values are stated and are correct ($\pm$ small square) |

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| e | $\left(-2x^3+3x^2+2x\right)+\left(-\frac{1}{2}x-2\right)=0$<br><br>$\therefore\left(-2x^3+3x^2+2x\right)=\frac{1}{2}x+2$ (oe, allow 1 sign slip)) | | 6 | M1 | |
| | $y="\frac{1}{2}x+2"$ drawn and going through (0, 2) or (2, 3) extrapolating if necessary | | | M1 (dep) | Accuracy of the line $\pm\frac{1}{2}$ ss of the two given points |
| | | Line going through (0, 2) **and** (2, 3)extrapolating where necessary **and** intersecting candidate's $y=-2x^3+3x^2+2x$ **three** times | | A1 | 2nd M can imply the first M |
| | | –0.8 ,<br>0.8 ,<br>1.6 | | A1 ft<br>A1 ft<br>A1 ft | |
| | | | | | **Total 16 marks** |

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