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Mark Scheme (Results)

January 2013

International GCSE Mathematics B
4MB0 Paper 02

PEARSON

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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**
    - o M marks: method marks
    - o A marks: accuracy marks
    - o B marks: unconditional accuracy marks (independent of M marks)

- **Abbreviations**
    - o cao – correct answer only
    - o ft – follow through
    - o isw – ignore subsequent working
    - o SC - special case
    - o oe – or equivalent (and appropriate)
    - o dep – dependent
    - o indep – independent
    - 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.

  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.

- **Follow through marks**

  Follow through marks which involve a single stage calculation can be awarded without working since you can check the answer yourself, but if ambiguous do not award.

  Follow through marks which involve more than one stage of calculation can only be awarded on sight of the relevant working, even if it appears obvious that there is only one way you could get the answer given.

- **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.

- **Probability**

  Probability answers must be given a fractions, percentages or decimals. If a candidate gives a decimal equivalent to a probability, this should be written to at least 2 decimal places (unless tenths).

  Incorrect notation should lose the accuracy marks, but be awarded any implied method marks.

  If a probability answer is given on the answer line using both incorrect and correct notation, award the marks.

  If a probability fraction is given then cancelled incorrectly, ignore the incorrectly cancelled answer.

- **Linear equations**

  Full marks can be gained if the solution alone is given on the answer line, or otherwise unambiguously indicated in working (without contradiction elsewhere). Where the correct solution only is shown substituted, but not identified as the solution, the accuracy mark is lost but any method marks can be awarded.

- **Parts of questions**

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

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Paper 2

1. $\varnothing$ OR {}, {a}, {b}, {c}, {a, b}, {a, c}, {b, c}, {a, b, c}

    B3 (-1 eeoo) 3   **3**

NB: (1) Condone missing brackets

(2) Ignore repetitions

(3) Accept $\{\varnothing\}$

(4) In ePEN, deduct the marks starting with the first mark box, so, eg, 7 correct subsets would score 0 1 1 in that order.

Total 3 marks

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2. (a)Salt: $\dfrac{2}{5}\times 150$ OR Sugar: $\dfrac{3}{5}\times 150$ (o.e)   M1

    Salt: 60 grams   A1
    Sugar: 90 grams   A1   3

NB: order of award of A marks for ePEN is as the answers appear above

(b) "90"+30 : "60"+10

OR   Sugar = "90"+30 and Salt = ""60"+10   B1 ft

120: 70   OR   12 : 7   OR   4 : 2.33   OR

1.71 : 1 (cao)   B1   2   **5**

Total 5 marks

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3. (a) "6+3"×6 = 8×CB (CB = 6.75)   M1

    8 - "6$\dfrac{3}{4}$"   M1 (DEP)

    AB = 1.25 cm   (cao)   A1   3

    (b) $\dfrac{8}{6} = \dfrac{EA}{2}$ or $\dfrac{9}{"6.75"} = \dfrac{EA}{2}$ M1

OR   Cosine Rule on ΔBCD and ΔACE :

$\left(\angle ECA = \cos^{-1}\left(\dfrac{6^2 + "6.75"^2 - 2^2}{2\times 6\times "6.75"} \right) = 16.752^o \right)$

$EA = \sqrt{(6+3)^2 + 8^2 - 2\times(6+3)\times 8\times \cos"16.752"}$ $(=\sqrt{7.111})$

complete method for EA M1

EA = awrt 2.67 cm, $\tfrac{8}{3}$ cm, $2\tfrac{2}{3}$ cm   A1   2   **5**

Total 5 marks

4. (a) $\dfrac{l_{\mathrm{model}}}{10} = \dfrac{1}{20}$ (o.e)   M1

0.5 m   OR $\dfrac{1}{2}$ m   OR $\dfrac{10}{20}$ m   A1   2

(b) $C_{bus} = \dfrac{30}{1000} \times 20^3$ (o.e)   M1

OR   using (a) Q $l_{Bus} : l_{model} = 10 : \text{"0.5"}$

$C_{bus} = \dfrac{30}{1000} \times \left(\dfrac{10}{0.5}\right)^3$ M1

240 l (cao)   A1   2

(c) 64 seats   B1   1   **5**

Total 5 marks

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5. (a) $x^3 + 8x^2 + 14x$ M1
(correct expansion leading to 2 of above 3 terms)
$x^3 + 8x^2 + 14x - 8$ (cao)   A1   2
(b) "2 terms correct"   M1
$3x^2 + 16x + 14$ A1 ft   2
(c) "$3x^2 + 16x + 14$"$= 2 - 4x$ M1
$3x^2 + 20x + 12$ (cao)   A1
$(3x + 2)(x + 6)$ (factorising a 3 term quadratic)
                    M1

$x = -\dfrac{2}{3}$, awrt -0.667, -6 (cao)   A1   4   **8**

Total 8 marks

6. (a) 30   B1
         80   B1
         21   B1
         Total No. of students = 166   B1   4

NB: (1) Note of order of award of B marks for ePEN is as the answers appear above
       (2) "166" on its own score 4 x B1

In (b) and (c), penalise 2 sig fig answers ONCE

       (b) $\text{Prob} = \dfrac{35 + "21"}{"166"}$ M1

       $\dfrac{56}{166}$ OR $\dfrac{28}{83}$ OR   awrt 0.337   OR   33.7%   (cao)

                                                     A1   2

       (c) Adjusting new Total No. of students AND finding
       new No. of students taking > 30 mins   M1

       $\dfrac{(35+3)+("21"-5)}{"156"}$ M1 (DEP)

       $\dfrac{54}{156}$ OR $\dfrac{27}{78}$ OR $\dfrac{9}{26}$ OR   awrt 0.346   OR   34.6%

                                                     A1   3   **9**

                                                           Total 9 marks

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7.   (a) $V = 300 - [300 - (12)^2 - 2 \times 12\,]$ M1
         $V = 168$ litres   A1   2
         (b) $[300-(14)^2-28] - [300 - (15)^2-30]$ (et vice versa)
                                                     M1
         31 litres   (cao)   A1   2
         (c) $-2t - 2$ (one term correct)   M1
         $-2t - 2$ A1
         "$-2(5)-2$"   (ie $t = 5$ subst in "derive")   M1 (DEP)
         -12 (cao)   A1   4
         (d) $300 - t^2 - 2t = 0$ M1

         $\dfrac{2 \pm \sqrt{2^2 - 4 \times (-1) \times 300}}{-2}$ (o.e)   M1 (DEP)

         $+16.3$ mins   (cao)   A1   3   **11**

                                                           Total 11 marks

8. (a) (i) $\mathbf{b} - \mathbf{a}$ B1

    (ii) $\overrightarrow{DB} = \dfrac{1}{4}(\text{"}\mathbf{b} - \mathbf{a}\text{"})$ B1

    $\therefore \ \overrightarrow{OD} = \mathbf{b} - (\text{"}\mathbf{b} - \mathbf{a}\text{"})/4$ M1

OR

$\overrightarrow{AD} = \dfrac{3}{4}(\text{"}\mathbf{b} - \mathbf{a}\text{"})$ B1

$\therefore \overrightarrow{OD} = \mathbf{a} + \dfrac{3}{4}(\text{"}\mathbf{b} - \mathbf{a}\text{"})$ M1

$\overrightarrow{OD} = \dfrac{1}{4}\mathbf{a} + \dfrac{3}{4}\mathbf{b}$ **OR** $\dfrac{1}{4}(\mathbf{a} + 3\mathbf{b})$ A1   4

(b) $\overrightarrow{AC} = (\dfrac{9}{4}\mathbf{b} - \dfrac{5}{4}\mathbf{a}) - \mathbf{a}$ M1

    $= \dfrac{9}{4}(\mathbf{b} - \mathbf{a})$ **OR** $\dfrac{9}{4}\mathbf{b} - \dfrac{9}{4}\mathbf{a}$ A1   2

(c) $\overrightarrow{AB} = \dfrac{4}{9}\overrightarrow{AC}$ **OR** $\overrightarrow{BC} = \dfrac{5}{4}(\mathbf{b} - \mathbf{a})$ M1

    $\therefore AB : BC = 4 : 5$ (cao)   A1   2

NB: Do **not** allow use of vector addition for final A mark

(d) $\overrightarrow{OE} = \dfrac{1}{3}\overrightarrow{OC}$ M1

    $\therefore \overrightarrow{ED} = -\dfrac{1}{3}(\dfrac{9}{4}\mathbf{b} - \dfrac{5}{4}\mathbf{a}) + \text{"}\dfrac{1}{4}\mathbf{a} + \dfrac{3}{4}\mathbf{b}\text{"}$ M1 (DEP)

OR $\overrightarrow{EC} = \dfrac{2}{3}\overrightarrow{OC}$ M1

$\therefore \overrightarrow{ED} = \overrightarrow{EC} + \overrightarrow{CD} = \dfrac{2}{3}\left(\dfrac{9}{4}\mathbf{b} - \dfrac{5}{4}\mathbf{a}\right) + \text{"}\left(-\dfrac{3}{2}\mathbf{b} + \dfrac{3}{2}\mathbf{a}\right)\text{"}$ M1 (DEP)

    $\overrightarrow{ED} = \dfrac{8}{12}\mathbf{a}$ **OR** $\overrightarrow{ED} = \dfrac{2}{3}\mathbf{a}$ A1

OR (<u>Geometric Method</u>)

Given $\overrightarrow{AD} = \dfrac{3}{4}\overrightarrow{AB}$ and $\overrightarrow{DC} = \overrightarrow{DO} + \overrightarrow{OC} = \dfrac{3}{2}\overrightarrow{AB}$

M1

$\therefore AD : DC = 1 : 2$ A1

$\therefore \Delta s \begin{array}{l} OAC \\ EDC \end{array}$ are similar triangles   M1 (DEP)

c.c   (all methods)   A1   4   **12**

NB: Do **not** allow use of vector addition for final A mark

Total 12 marks

9.   (a) (i) $\angle ABC = 90°$ B1

       (a) (ii) $\triangle ABC = \frac{1}{2} \times 3x \times 4x$ and (cc)   B1

       (a) (iii) $S = 2 \times 6x^2 + 4xy + 3xy + 5xy$ M1

       $S = 12x^2 + 12xy$ (o.e)   A1   4

NB: A correct statement for S (eg M mark line) can collect A1 ie
simplification not necessary (allow ISW)

       (b) $144 = "12x^2 + 12xy"$ M1

       $y = \frac{12 - x^2}{x}$ correctly obtained   A1   2

       (c) $V = 6x^2 \times \frac{12 - x^2}{x}$ M1

       $V = 6x(12 - x^2)$ correctly obtained   A1   2

       (d) 35.3, 87.8, 96, 86.3   B3 (-1eeoo)   3

NB: penalise incorrect rounding **ONCE**

       (e) curve
               -1 mark for
                 straight line segments
                 each point missed $\left(\pm \frac{1}{2} ss \right)$

                 each missed segment
                 each point not plotted

                 each point incorrectly plotted $\left(\pm \frac{1}{2} ss \right)$

                 tramlines
                 very poor curve   B3   3

NB: In ePEN, deduct the errors as they appear going from $x = 0$ to $x = 3.4$

       (f) 96 ± 1 B1 ft   1   **15**

NB: A coordinate earns B0

                                                              Total 15 marks

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10. Penalise ncc ONCE only in the question.

(a) $CE^2 = 8^2 + 6^2 - 2 \times 6 \times 8 \times \cos 20^o$ M1

       $CE = \sqrt{8^2 + 6^2 - 2 \times 6 \times 8 \times \cos 20^o}$ M1 (DEP)

       $CE = 3.1288 \rightarrow$ **3.13**   A1   3

       (b) <u>Sine Rule:</u> $\dfrac{"CE"}{\sin 20} = \dfrac{6}{\sin \angle BCE}$ M1

       $\angle BCE = \sin^{-1}\left(\dfrac{6 \times \sin 20}{"CE"} \right)$ M1 (DEP)

OR <u>Cos. Rule:</u>

$6^2 = 8^2 + "3.13"^2 - 2 \times 8 \times "3.13" \times \cos \angle BCE$ M1

$\angle BCE = \cos^{-1}\left(\dfrac{8^2 + "3.13"^2 - 6^2}{2 \times 8 \times "3.13"} \right)$ M1 (DEP)

$\angle BCE = \mathbf{41.0}$ (accept 41)   A1 3

(c) $\underline{\Delta CDE}:$

$\dfrac{ED}{\sin \angle ECD(=139)} = \dfrac{"3.13"}{\sin 25}$ M1

$ED = \dfrac{"3.13"}{\sin 25} \times \sin "139"$ (=4.8561)   M1 (DEP)

OR

$\underline{\Delta BDE}:$

$\dfrac{ED}{\sin 20} = \dfrac{6}{\sin 25}$ M1

$ED = \dfrac{6 \times \sin 20}{\sin 25}$ (=4.8557)   M1 (DEP)

$ED = \mathbf{4.86}$ A1 3

(d) $\underline{\Delta ABE}:$

$\angle BEA = \angle CBE + \angle CDE = 45^{\circ}$ M1

$\dfrac{7}{\sin "\angle BEA(= 45)"} = \dfrac{6}{\sin \angle BAE}$ M1 (DEP)

$\angle BAE = \sin^{-1}\left(\dfrac{6 \times \sin "\angle BEA"}{7} \right) (= 37.31)$ M1 (DEP)

OR

$\underline{\Delta ABD}:$

$(\angle CED = 16°) \dfrac{CD}{\sin "16"} = \dfrac{"3.13"}{\sin 25}$ (CD=2.0414)

$BD = 8 + "2.0414" = 10.0414$

    (full method for BD)   M1

$\dfrac{"10.0414"}{\sin \angle BAE} = \dfrac{7}{\sin 25}$ M1 (DEP)

$\angle BAE = \sin^{-1}\left(\dfrac{"10.0414" \times \sin 25}{7} \right) (=37.318)$ M1 (DEP)

$\angle ABE = 97.69 \rightarrow \mathbf{97.7}$ A1 4

(e) *Mark Scheme:*

     M1 for all lengths and/or angles needed to calculate ΔABD
     M1 (DEP) for correct "expression" for area of ΔABD
     A1 cao for 31.1

$$\Delta CDE = \frac{1}{2} \times "3.13" \times "4.8591" \times \sin("16")$$

                                       M1

$$\Delta ABD = \Delta ABE + \Delta BCE + \Delta CDE$$
$$= \frac{1}{2} \times 7 \times 6 \times \sin"97.7" + 8.208 + \Delta CDE$$

                                       M1 (DEP)

OR

$$\Delta EBD = \frac{1}{2} \times 6 \times "4.8591" \times \sin("135")$$ ~~M1~~

$$\Delta ABD = \Delta ABE + \Delta EBD$$

                                       M1 (DEP)

$$= \frac{1}{3} \times 7 \times 6 \times \sin"97.7" + \Delta EBD$$

OR

$$BD = "10.0414" (\text{ possibly in part (d))}$$ M1

$$\Delta ABD = \frac{1}{2} \times 7 \times "10.0414" \times \sin"117.7"$$

                                       M1 (DEP)

OR

$$\frac{AE}{\sin"97.7"} = \frac{7}{\sin 45} \quad (AE = 9.810)$$
$$\therefore AD = "9.810" + "4.86" \quad (=14.67)$$

                                       M1

$$\Delta ABD = \frac{1}{2} \times 7 \times ("14.67") \times \sin"37.3"$$ M1(DEP)

$$\Delta ABD = \mathbf{31.1}$$ A1   3   **16**

                                                        Total 16 marks

11. Penalise labelling **ONCE**
    (a) ΔABC drawn and labelled.   B1   1

    (b) $\begin{pmatrix} -1 & -5 & -3 \\ 3 & 3 & 9 \end{pmatrix}$ B2 (-1 eeoo)   2

NB: Penalise the 1st error in the 1st ePEN mark box etc
    (c) $\Delta A'B'C'$ drawn and labelled   B1 ft   1

    (d) $\Delta A''B''C''$ ($=\begin{pmatrix} 1 & 1 & 3 \\ 1 & 5 & 3 \end{pmatrix}$)   matrix   B2 ft(-1 eeoo)

    $\Delta A''B''C''$ drawn and labelled   B1 ft(-1 eeoo) 3

NB: Penalise the 1st error in the 1st ePEN mark box etc
    (e) rotation, 270° OR 90° clockwise or -90° B1
    about origin   B1   2

NB: This order in ePEN
    (f) $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ B2 (-1 eeoo)   2   **11**

Total 11 marks

TOTAL FOR PAPER : 100 MARKS
END

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