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Mark Scheme (Results)

January 2016

Pearson Edexcel International GCSE Mathematics B (4MB0) Paper 2

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January 2016
Publications Code UG043280

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
  - ee(oo) – each error (or omission)
  - awrt –answer which rounds to
  - cc – correct conclusion

- **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.

1. $y = \dfrac{1-2x+x^2-x^2}{x}$ (expanding, combining fractions)

OR

$xy = 1-2x+x^2-x^2$ (expanding, combining fractions) M1

$xy = 1-2x$ (removing "any denominator and x^2") M1 (DEP)

$x(y+2) = 1$ **OR** $xy + 2x = 1$ (collecting "terms in x") M1 (DEP)

[**OR** $y = \dfrac{1}{x} - 2 + x - x$ (expanding, dividing by x) (o.e.) (M1)

$y = \dfrac{1}{x} - 2$ (M1(DEP))

$\dfrac{1}{x} = y + 2$ (M1(DEP))]

NB: Allow a total of 1 sign error in the 3 M marks

$x = \dfrac{1}{y+2}$ A1 **4**

Total 4 marks

2. (a) $\frac{1}{7}\begin{pmatrix} -1 & 2 \\ -5 & 3 \end{pmatrix}$ (o.e.) B2 (-1 eeoo) 2

NB(1): If $\frac{1}{7}$ is wrong, this counts as one error.

BUT ft the adjoint matrix using *their* $\frac{1}{7}$

NB(2): Deduct errors starting from the second B box on ePEN.

(b) $"\frac{1}{7}\begin{pmatrix} -1 & 2 \\ -5 & 3 \end{pmatrix}"\begin{pmatrix} 3 & -2 \\ 5 & -1 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = "\frac{1}{7}\begin{pmatrix} -1 & 2 \\ -5 & 3 \end{pmatrix}"\begin{pmatrix} 4 \\ 9 \end{pmatrix}$ (o.e.) M1

$\begin{pmatrix} x \\ y \end{pmatrix} = "\frac{1}{7}\begin{pmatrix} 14 \\ 7 \end{pmatrix}"$ A1ft

$x = 2$ A1

$y = 1$ A1 4 **6**

[**OR** $\begin{matrix} 3x - 2y = 4 \\ 5x - \ y = 9 \end{matrix}$ (no slips, o.e.) (M1)

Correct equation in x **or** y seen. (A1)]

Total 6 marks

3. (a) Profit = (£0.68-£0.56) x 40 000 M1

(£)4800 A1 2

(b) No of articles bought = 1.25 x 40 000 (oe) (= 50 000) M1

Each article cost = $1.125 \times £0.56 \ (= £0.63)$ (oe)

M1(INDEP)

$(\therefore$ Total profit = "£4800"+£200=$((2015\ SP) - "£0.63") \times "50000")$

2015 SP = $\frac{"£4800" + £200}{"50000"} + "£0.63"$ (oe) M1 (DEP)

[**OR**

(Total selling price = (“£4800”+£200) +”50 000”×”63p” (= £36 500))

$\frac{"£36500"}{"50000"}$ (M1 (DEP))]

NB: M1DEP is dependent on the award of BOTH previous M marks

2015 SP = (£)0.73 OR 73p A1 4 **6**

Total 6 marks

4. (a) $DE^2 = 5^2 + 8^2 - 2\times5\times8\times\cos 60$ M1

$DE = \sqrt{89 - 80\times\cos 60}$ M1 (DEP)

DE = 7 cm A1 3

(b) $\dfrac{"7"}{10.5} = \dfrac{5}{5+BD}$ M1

NB: Accept x for BD

BD = 2.5 A1 2

(c) Area of ΔABC = $\left(\dfrac{10.5}{"7"}\right)^2 \times 17.3$ (o.e.) $(=38.925)$ M1

[**OR** $\left(\dfrac{"7"}{10.5} = \dfrac{8}{AC} \quad \therefore AC = 12 \text{ cm}\right)$

Area of ΔABC = $\frac{1}{2}\times"7.5"\times"12"\times\sin 60$ (o.e.) (= 38.971) (M1)]

Area of ΔABC = awrt 39 cm A1 2 **7**

Total 7 marks

5. (a) $f(x) > -2$ **OR** $(-2, \infty]$ **OR** $]-2, \infty]$ B1

$g(x) \leq 7$ **OR** $[-\infty, 7]$ B1 2

NB(1): Accept "y" for "f" and "g"

NB(2): Accept a curved bracket before or after infinity or minus infinity

(b) $y + 4x = 2$ **OR** $x = 2 - 4y$ M1

$f^{-1}: x \mapsto \frac{2-x}{4}$ **OR** $f^{-1}: x \mapsto \frac{1}{2} - \frac{x}{4}$ (cao) A1 2

(c) $3(2 - 4x) = 4(7 - x^2)$ M1

$4x^2 - 12x - 22 (= 0)$ (oe) A1

$\frac{+12 \pm \sqrt{(12^2 - 4 \times 4 \times (-22))}}{2 \times 4}$ (substituting) M1

$\sqrt{496} (= 4\sqrt{31})$ **OR** $\sqrt{124} (= 2\sqrt{31})$ $(\text{from } 2x^2 - 6x - 11 = 0)$

OR decimal equivalent to 3sf A1

$\therefore$ x = awrt(−1.28) A1 5 **9**

Total 9 marks

6. (a) (i) $\overrightarrow{AB} = 12\mathbf{b} - 2\mathbf{a}$ B1

(ii) $\overrightarrow{AE} = \frac{1}{4}("12\mathbf{b} - 2\mathbf{a}")$ (oe) B1 ft

(iii) $\overrightarrow{DE} = \mathbf{a} + "\frac{1}{4}(12\mathbf{b} - 2\mathbf{a})"$ M1

$\overrightarrow{DE} = \frac{1}{2}\mathbf{a} + 3\mathbf{b}$ **OR** $\frac{1}{2}(\mathbf{a} + 6\mathbf{b})$ A1 4

(b) $\overrightarrow{EF} = \frac{3}{4}"(12\mathbf{b} - 2\mathbf{a})" + m\mathbf{a}$ (oe) OR $\left(m - \frac{3}{2}\right)\mathbf{a} + 9\mathbf{b}$ B1 ft 1

(c) "Comp of **b**": $3 = n\ 9$ M1

$n = \frac{1}{3}$ (cao) A1

"Comp of **a**": $\frac{1}{2} = n\left(m - \frac{3}{2}\right)$ (oe) M1

Substituting "$n = \frac{1}{3}$" in above M1 (DEP)

$m = 3$ (cao) A1 5 **10**

NB: A1 for $n = \frac{1}{3}$ (cao) is DEP on 1st M mark

Total 10 marks

7. (a) $A = 2\left(\pi r^2 - \pi\left(\frac{r}{2}\right)^2\right) + 2\pi h\left(r + \frac{r}{2}\right)$ (oe) M1

$A = \frac{3}{2}\pi r^2 + 3\pi rh$ (cso) A1 2

(b) $30 = \pi r^2 h - \pi\left(\frac{r}{2}\right)^2 h$ M1

$h = \frac{40}{\pi r^2}$ A1 2

(c) $A = \frac{3}{2}\pi r^2 + 3\pi r"\left(\frac{40}{\pi r^2}\right)"$ M1

$A = \frac{3}{2}\pi r^2 + \frac{120}{r}$ (cso) A1 2

(d) $\left(\frac{dA}{dr} =\right) 3\pi r = \frac{120}{r^2}$ (1 "term" correct) M1

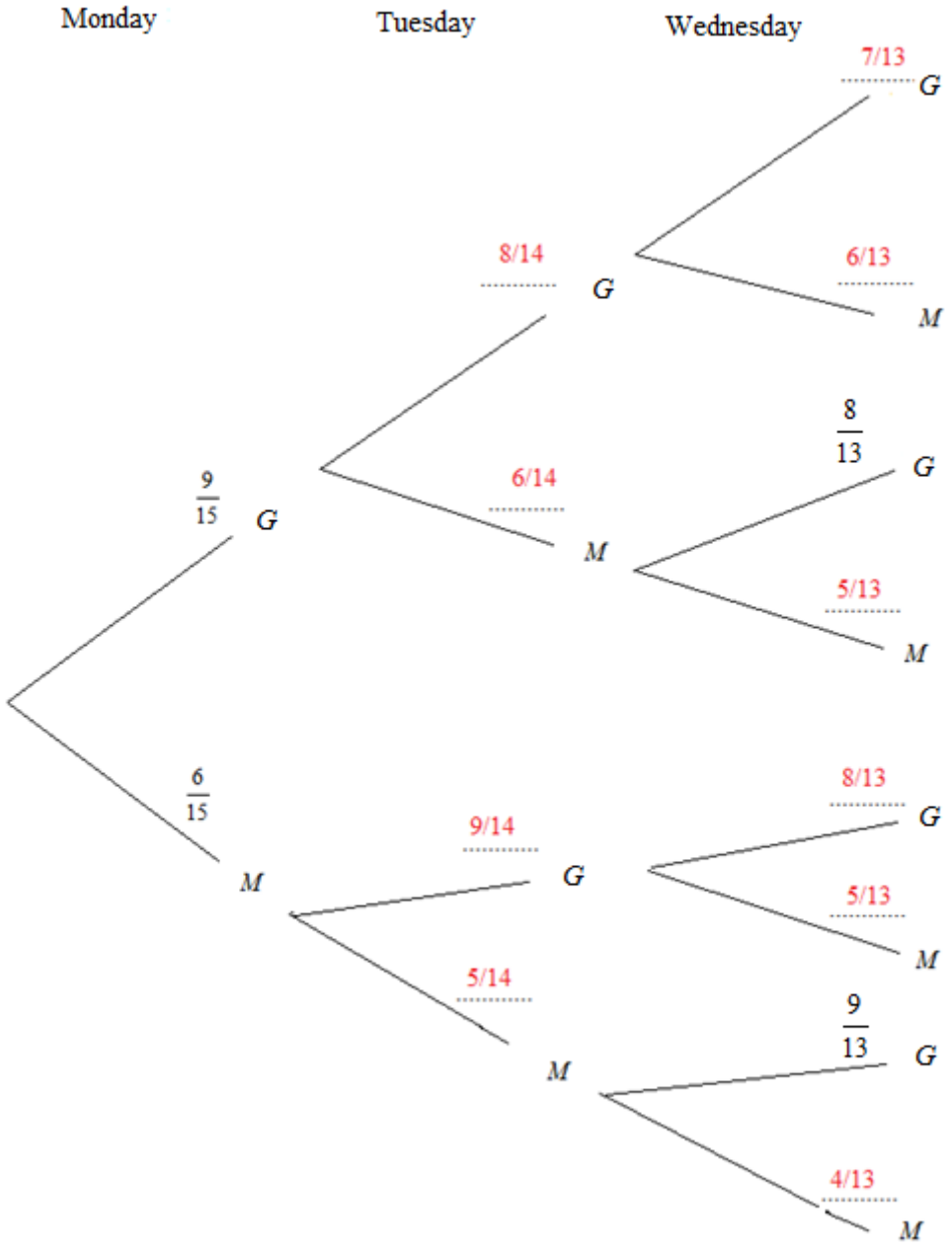
(cao) – both terms correct A1

$\left(\frac{dA}{dr} =\right)$ "$3\pi r - \frac{120}{r^2}$" = 0 M1 (DEP)

r = 2.335→awrt **2.34** cm A1 4 **10**

Total 10 marks

8. (a)



B4(-1 each incorrect pair) 4

NB: Deduct marks for incorrect pairs starting from the last mark box

(b)(i) $\frac{9}{15}\times"\frac{8}{14}"\times"\frac{7}{13}"$ M1

$\frac{504}{2730}$, $\left(\frac{12}{65}\right)$, 0.18 or better A1

(ii) $1 - P(GGG) = 1 - \frac{9}{15} \times "\frac{8}{14}" \times "\frac{7}{13}"$ (oe, must have 7 correct triplet products) M1

$\frac{2226}{2730}, \left(\frac{53}{65}\right)$, 0.82 or better A1

(iii) P = P(GGG)+P(GGM)+P(GMG)+P(MGG)

$= \frac{9}{15} \times "\frac{8}{14}" \times "\frac{7}{13}" + \frac{9}{15} \times "\frac{8}{14}" \times "\frac{6}{13}" + \frac{9}{15} \times "\frac{6}{14}" \times "\frac{8}{13}" + \frac{6}{15} \times "\frac{9}{14}" \times "\frac{8}{13}"$

Any two "probability triplets" added M1

All four "probability triplets" added M1 (DEP)

NB: Apply the method marks to 1 − the complement of the above

$= \frac{1800}{2730}, \left(\frac{60}{91}\right)$, 0.66 or better A1 7 **11**

NB: Answers in brackets are Casio calculator answers.

Total 11 marks

9. Penalise incorrect labelling ONCE only, the first time it occurs.

(a) ΔABC drawn — B1 — 1

(b) $\begin{pmatrix} 4 & 6 & 8 \\ 0 & 0 & 3 \end{pmatrix}$ — B2 (-1eeoo) — 2

NB: If vectors or coordinates given, this is deemed as one error

(c) $\Delta\ A'B'C'$ drawn — B1 ft — 1

NB: ft on *their* matrix in (b)

(d) $\Delta A''B''C''$ (= $\begin{pmatrix} -4 & -6 & -8 \\ -4 & -6 & -2 \end{pmatrix}$) drawn and labelled — B3 (-1eeoo) — 3

SC: If B0 scored from diagram, check whether $\begin{pmatrix} -1 & 0 \\ -1 & 2 \end{pmatrix}$"$\begin{pmatrix} 4 & 6 & 8 \\ 0 & 0 & 3 \end{pmatrix}$" is seen in body of script. If so, award B1 B0 B0

(e) Enlargement — M1

Centre origin — A1

Scale factor −2 — A1 — 3(-1eeoo)

NB(1): cao and note above order of award of marks in ePEN boxes

NB(2): we must see "enlargement" only for M1.

(f) $\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$ — B1 — 1 — **11**

Total 11 marks

10. Penalise ncc ONCE only

(a) $\sin 70 = \dfrac{8}{AD}$ M1

AD = 8.5134-> **8.51** A1 2

(b) $BD = \dfrac{8}{\tan 70}$ (BD = 2.9118) (oe) **OR** $BD = \sqrt{\left("8.51"^2 - 8^2\right)}$ $\left(= 2.902\right)$

M1

$\tan 25 = \dfrac{"2.9118"}{BC}$ M1 (DEP)

[**OR** ($\angle CDA = 135^o$) $\dfrac{AC}{\sin 135} = \dfrac{"8.51"}{\sin 25}$ (AC = 14.244) (M1)

$\therefore BC = "14.244" - 8$ (M1(DEP))]

BC = 6.2443->**6.24** **OR** BC = **6.22** (from BD = 2.902)

A1 3

(c) ΔACE: $\dfrac{9}{\sin 25} = \dfrac{\left(8 + "6.2442"\right)}{\sin \angle AEC}$ OR ΔADE: $\dfrac{9}{\sin 45} = \dfrac{"8.5134"}{\sin \angle AEC}$

M1

$\angle AEC = \sin^{-1}\left(\dfrac{\sin 25 \times \left(8 + "6.2442"\right)}{9}\right)$ OR $= \sin^{-1}\left(\dfrac{"8.5134" \times \sin 45}{9}\right)$

M1 (DEP)

$\angle AEC$ = 41.9802° OR 41.9804° →**42°** A1 3

(d) $ABDE = \Delta ABD + \Delta ADE$ route:

$\Delta ABD = \dfrac{1}{2} \times 8 \times "2.9118"$ (=11.6472) M1

[**OR** $\Delta ABD = \dfrac{1}{2} \times 8 \times "AD" \times \sin 20^o$ (M1)]

$\angle DAE = 180 - \left(45 + "42"\right)$ $\left(= 93^o\ (93.02^o)\right)$ M1

$\Delta ADE = \dfrac{1}{2} \times 9 \times "8.5134" \times \sin "93.02"$ (=38.26) M1 (DEP)

[**OR** $DE = \sqrt{\left("8.513"^2 + 9^2 - 2 \times "8.513" \times 9 \times \cos 93.02\right)} = \begin{cases} 12.71 \\ 12.67\ (3sf) \end{cases}$

(M1)

$$\Delta ADE = \frac{1}{2}\times 9\times \begin{Bmatrix} "12.71" \\ "12.67" \end{Bmatrix} \times \sin \begin{Bmatrix} "41.98" \\ "42" \end{Bmatrix} = \begin{Bmatrix} 38.26 \\ 38.15 \end{Bmatrix} \quad \text{(M1(DEP))}\Big]$$

$ABDE = \Delta ABD + \Delta ADE =$ "11.6472" + "38.26" M1(DEP)

[OR $ABDE = \Delta ACE - \Delta BCD$ route:

$\Delta BCD = \frac{1}{2}\times "2.9118" \times "6.2443"$ (=9.0911) (M1)

$\angle CAE = 180 - (25 + "42")$ $\left(= 113^{o}\ (113.02^{o})\right)$ (M1)

$\Delta ACE = \frac{1}{2}\times 9\times (8 + "6.2443")\times \sin "113.02"$ (=59.0) (M1(DEP))

$ABDE = \Delta ACE - \Delta BCD =$ "59.0"-"9.0911" (M1 (DEP))**]**

$ABDE$ = 49.91, 49.90->**49.9** **OR** **49.8** (using BD =2.902 and AD = 8.51)
A1 5 **13**

Total 13 marks

11. (a) −10 (or better), −22 (or better), −9.4 (or better) B1, B1, B1 3

(b) Curve

-1 mark for straight line segments

each point missed

each missed segment

each point not plotted

each point incorrectly plotted

tramlines

very poor curve B3 (-1eeoo) 3

NB: Accuracy for both plotting and drawing is $\pm\frac{1}{2}ss$

(c) $y = 5x - 8$ drawn correctly B1 1

NB: line must pass through any two of (0, −8), (1, −3), (2, 2) or (3, 7), extrapolating where necessary.

(d) Rearranging $3x^3 - x^2 - 25x + 8 < 0$ to $3x^3 - x^2 - 20x < 5x - 8$ ` M1

∴ Identifying two intersections at x ="0.32" and "2.89" M1 (DEP)

$0.32 < x$, $2.89 > x$ ($\pm 1ss = \pm 0.05$ for ft)

One correct range statement A1 ft

2nd correct range statement A1 ft 4

NB: (1) $0.32 < x < 2.89$ collects A1, A1

(2) Penalise incorrect inequality signs (correct direction but includes the equality) **once only,** the first time it occurs for an "A" mark.

(3) Award full mark if correct range (ft) given with no algebra seen

(e) $y = -25$ drawn M1

cc A1 2 **13**

NB: $y = -25$ **not** drawn but see statement like "$y = -25$ does not intersect $y = 3x^3 - x^2 - 20x$ collects M1, A0

Total 13 marks

TOTAL 100 MARKS

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