



Mark Scheme (Results)

January 2016

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

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

January 2016

Publications Code UG043280

All the material in this publication is copyright

© Pearson Education Ltd 2016

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

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

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

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

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

Total 4 marks

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

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

BUT fit 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

$\left[\begin{array}{l} \text{OR} \end{array} \begin{array}{l} 3x - 2y = 4 \\ 5x - y = 9 \end{array} \right.$ (no slips, o.e.) (M1)

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

Total 6 marks

$$3. (a) \text{ Profit} = (£0.68 - £0.56) \times 40\,000$$

M1

$$(\pounds)4800$$

A1 2

$$(b) \text{ No of articles bought} = 1.25 \times 40\,000 \text{ (oe)} \quad (= 50\,000)$$

M1

$$\text{Each article cost} = 1.125 \times \pounds 0.56 \quad (= \pounds 0.63) \quad \text{(oe)}$$

M1(INDEP)

$$(\therefore \text{Total profit} = \pounds 4800 + \pounds 200 - ((2015 \text{ SP}) - \pounds 0.63) \times 50\,000)$$

$$2015 \text{ SP} = \frac{\pounds 4800 + \pounds 200}{50\,000} + \pounds 0.63 \text{ (oe)}$$

M1 (DEP)

[OR

$$(\text{Total selling price} = (\pounds 4800 + \pounds 200) + 50\,000 \times 63\text{p} (= \pounds 36\,500))$$

$$\frac{\pounds 36\,500}{50\,000}$$

(M1 (DEP))]

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

$$2015 \text{ SP} = (\pounds)0.73 \text{ OR } 73\text{p}$$

A1 4 6

Total 6 marks

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

M1

$$DE = \sqrt{89 - 80 \times \cos 60}$$

M1 (DEP)

$$DE = 7 \text{ cm}$$

A1 3

(b) $\frac{7}{10.5} = \frac{5}{5 + BD}$

M1

NB: Accept x for BD

$$BD = 2.5$$

A1 2

(c) Area of $\triangle ABC = \left(\frac{10.5}{7}\right)^2 \times 17.3 \text{ (o.e.) } (=38.925)$

M1

[OR $\left(\frac{7}{10.5} = \frac{8}{AC} \therefore AC = 12 \text{ cm}\right)$

$$\text{Area of } \triangle ABC = \frac{1}{2} \times 7.5 \times 12 \times \sin 60 \text{ (o.e.) } (=38.971) \quad (\text{M1})]$$

$$\text{Area of } \triangle ABC = \text{awrt } 39 \text{ cm}$$

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

OR decimal equivalent to 3sf A1

$\therefore x = \text{awrt}(-1.28)$ 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 $\mathbf{b}$ ”: $3 = n$

M1

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

A1

“Comp of $\mathbf{a}$ ”: $\frac{1}{2} = n\left(m - \frac{3}{2}\right)$ (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

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

M1

$$A = \frac{3}{2} \pi r^2 + 3\pi r h \quad (\text{cso})$$

A1 2

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

M1

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

A1 2

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

M1

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

A1 2

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

M1

(cao) – both terms correct

A1

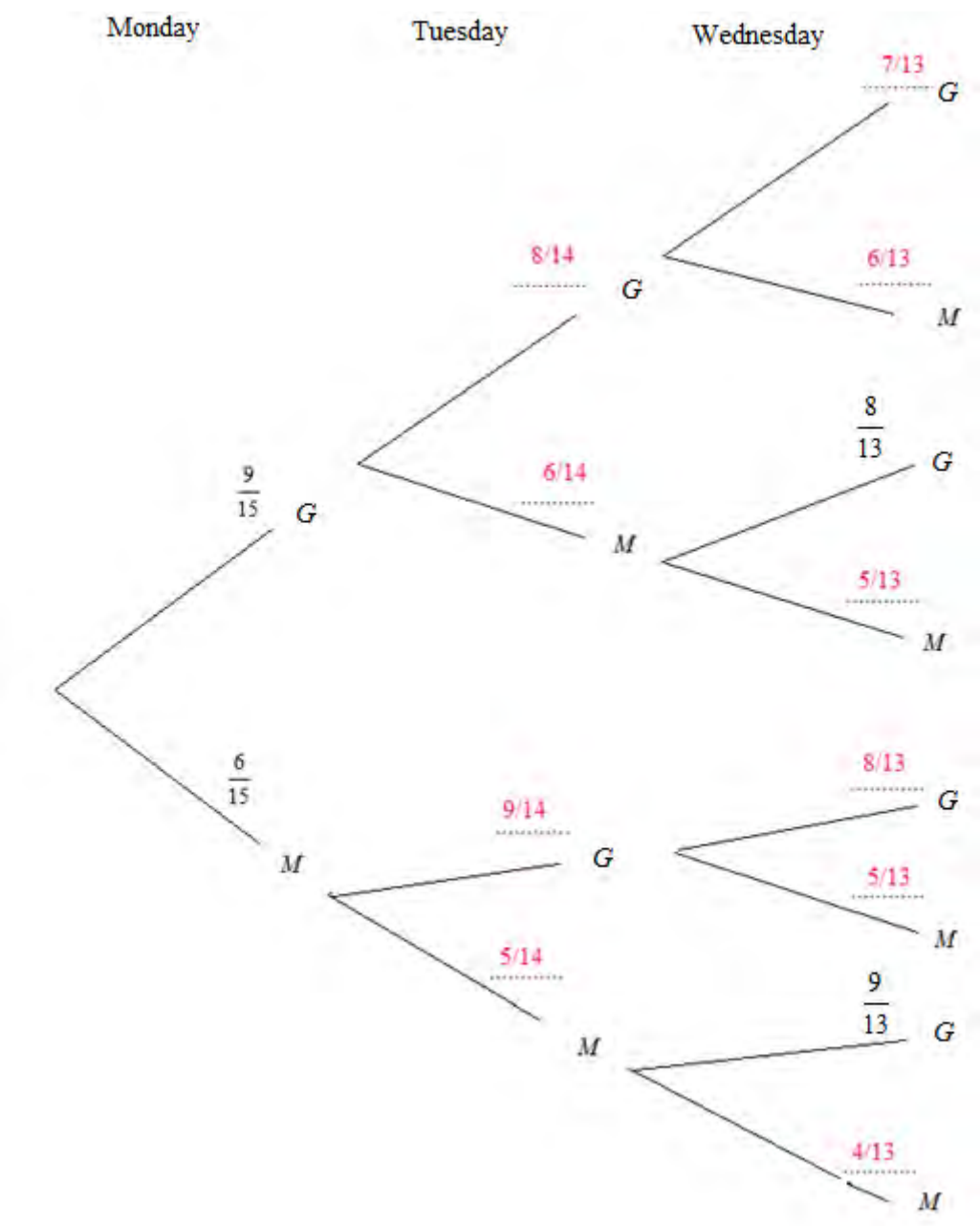
$$\left(\frac{dA}{dr} = \right) "3\pi r - \frac{120}{r^2}" = 0$$

M1 (DEP)

$$r = 2.335 \rightarrow \text{awrt } \mathbf{2.34} \text{ cm}$$

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

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

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

M1

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

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

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

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

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

NB: Answers in brackets are Casio calculator answers.**Total 11 marks**

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

(a) $\triangle ABC$ 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) $\triangle A'B'C'$ drawn B1 ft 1

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

(d) $\triangle A''B''C'' (= \begin{pmatrix} -4 & -6 & -8 \\ -4 & -6 & -2 \end{pmatrix})$ 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

$$(a) \sin 70 = \frac{8}{AD} \quad \text{M1}$$

$$AD = 8.5134 \rightarrow \mathbf{8.51} \quad \text{A1} \quad 2$$

$$(b) BD = \frac{8}{\tan 70} \quad (BD = 2.9118) \quad (\text{oe}) \quad \text{OR} \quad BD = \sqrt{("8.51")^2 - 8^2} \quad (= 2.902) \quad \text{M1}$$

$$\tan 25 = \frac{"2.9118"}{BC} \quad \text{M1 (DEP)}$$

$$[\text{OR } (\angle CDA = 135^\circ) \quad \frac{AC}{\sin 135} = \frac{"8.51"}{\sin 25} \quad (AC = 14.244) \quad (\text{M1})$$

$$\therefore BC = "14.244" - 8 \quad (\text{M1(DEP)})]$$

$$BC = 6.2443 \rightarrow \mathbf{6.24} \quad \text{OR} \quad BC = \mathbf{6.22} \quad (\text{from } BD = 2.902)$$

A1 3

$$(c) \triangle ACE: \quad \frac{9}{\sin 25} = \frac{(8 + "6.2442")}{\sin \angle AEC} \quad \text{OR} \quad \triangle ADE: \quad \frac{9}{\sin 45} = \frac{"8.5134"}{\sin \angle AEC} \quad \text{M1}$$

$$\angle AEC = \sin^{-1} \left(\frac{\sin 25 \times (8 + "6.2442")}{9} \right) \quad \text{OR} \quad = \sin^{-1} \left(\frac{"8.5134" \times \sin 45}{9} \right) \quad \text{M1 (DEP)}$$

$$\angle AEC = 41.9802^\circ \text{ OR } 41.9804^\circ \rightarrow \mathbf{42^\circ} \quad \text{A1} \quad 3$$

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

$$\triangle ABD = \frac{1}{2} \times 8 \times "2.9118" (= 11.6472) \quad \text{M1}$$

$$[\text{OR} \quad \triangle ABD = \frac{1}{2} \times 8 \times "AD" \times \sin 20^\circ \quad (\text{M1})]$$

$$\angle DAE = 180 - (45 + "42") \quad (= 93^\circ \quad (93.02^\circ)) \quad \text{M1}$$

$$\triangle ADE = \frac{1}{2} \times 9 \times "8.5134" \times \sin "93.02" \quad (= 38.26) \quad \text{M1 (DEP)}$$

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

(M1)

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

$$ABDE = \Delta ABD + \Delta ADE = "11.6472" + "38.26"$$

M1(DEP)

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

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

$$\angle CAE = 180 - (25 + "42") \quad (=113^\circ \text{ (113.02}^\circ)) \quad (\text{M1})$$

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

$$ABDE = \Delta ACE - \Delta BCD = "59.0" - "9.0911" \quad (\text{M1 (DEP)})]$$

$$ABDE = 49.91, 49.90 \rightarrow \mathbf{49.9} \quad \text{OR} \quad \mathbf{49.8} \text{ (using } BD = 2.902 \text{ and } AD = 8.51)$$

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

$\therefore$ Identifying two intersections at $x = 0.32$ and 2.89 M1 (DEP)

$0.32 < x$, $2.89 > x$ (± 1 ss = ± 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

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London WC2R 0RL
