Mark Scheme (Results)

January 2017

Pearson Edexcel International GCSE Mathematics B (4MB0)

Paper 02R

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 2017
Publications Code 4MB0_02R_1701_MS
All the material in this publication is copyright
© Pearson Education Ltd 2017

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

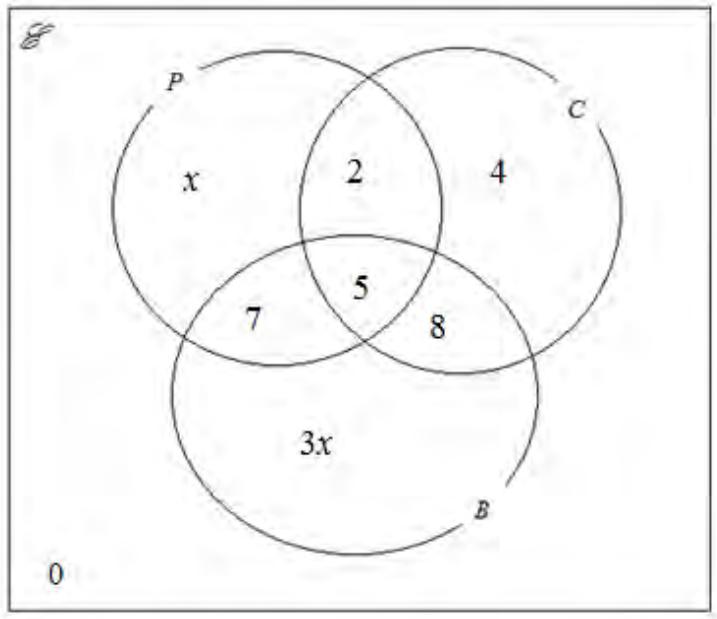
January 2017 – Paper 2R Mark Scheme

1.	$2(-2)+x=4$ $x=8$ $(3+y)(-2)+(-3)"8"=-16$ (subst) $y=-7$ **NB:** 1st M is for a correct equation **SC:** $\begin{pmatrix}(3+y)(-2)+(-3)x\\2(-2)+x\end{pmatrix}=\begin{pmatrix}-16\\4\end{pmatrix}$ scores 1st M1 (seeing one correct equation)		M1 A1 M1 dep A1	4 4

2.	$2\times(\text{base area})=\left(400\sqrt{2}\right)^2$ (oe) base area = 160000 cm^2 (oe cao) Allow ISW	$2\times(\text{side})^2=\left(400\sqrt{2}\right)^2$ (oe) side = 400 (cm) (oe cao) Allow ISW	M1 A1	
	$\frac{1}{3}\times"\left(\frac{400\sqrt{2}\times400\sqrt{2}}{2}\times\frac{1}{10^4}\right)"\times\frac{150}{10^2}$ (oe)	$\frac{1}{3}\times"\left(\frac{400\times400}{10^2\times10^2}\right)"\times\frac{150}{10^2}$ (o.e.)	M1 dep	
	8 m^3 **NB: (1)** The 1st A is for a correct side length (cm or m) or correct base area (cm^2 or m^2) **(2)** The 2nd M is for a correct volume statement using their "side" or "base area" and a correct conversion of 150 cm to m,		A1	4 4

3.	(a) $\frac{65}{100}\times 360$ (oe)	M1	
	234	A1	2
	(b) $\frac{5}{1+3+5}\times "234"$	M1	
	130	A1	2
	(c) $\frac{3}{1+3+5}\times "234"$ (78)	M1	
	"78" : "130" − 4	M1 dep	
	13 : 21	A1	3 7

4.	(a) 55 (m)	B1	1
	(b) one term correctly differentiated (ie $3t^2$ or -27)	M1	
	$3t^2 - 27$	A1	2
	(c) $"3t^2 - 27" = 0$	M1	
	$t = 3$ (cao)	A1	2
	(d) 1 (m)	B1 ft	1
	(e) $(5)^3 - 27 \times 5 + 55$ (45) **NB:** The "45" might be seen in a table	M1	
	$("55" - "1") + ("45" - "1")$	M1 dep	
	98 (m)	A1	3 9

5.	(a)  5 , 4 2, 7, 8 x , $3x$	B1, B1 B1 B1	4
	(b) correctly adding all their terms and equating to 50 6	M1 A1	2
	(c) (i) (3×"6"+8+5+7+4 = OR 50 – "6" – "2" =) 42 (ii) ("2" + "5" + "8" =) 15	B1 ft, B1 ft	2

	(d) $\frac{"6"}{"20"}$ (o.e.) ft numerator, ft denominator **SC:** Case where their Venn Diagram has 7 in place of 2, 12 in place of 7 and 13 in place of 8: (a) scores B1 B1 B0 B1 (b) should be $4x + 41 = 50$ (M1) , $x = 2.25$ (A0) (c) (i) B0, (ii) 25 B1ft (d) 3/35 **B1** B0	B1 ft, B1 ft	2	10

6.	$\frac{-5-20}{5} < x$ (o.e.) OR $x < \frac{(13-20)}{5}$ (oe)	M1	
	$\frac{-5-20}{5} < x$ AND $x < \frac{(13-20)}{5}$	M1 dep	
	$-4, -3, -2$	A2 (-1 eeoo)	4 4
	NB: (1) Use of ≤ or = correctly gains only the M marks		

7.	(a) (i) 12 (ii) 1.5 (o.e.)	B1, B1	2
	(b) $\frac{1}{3x}$	B1	1
	(c) (i) $+\frac{5}{4}$, $-\frac{5}{4}$ (o.e.)	B1, B1	
	(ii) $2\left(9x^2-3x-3x+1\right)=x$	M1	
	$18x^2-13x+2\ \ (=0)$	A1	
	attempt to solve a trinomial quadratic	M1	
	$\frac{2}{9}$, awrt 0.222	A1	
	$\frac{1}{2}$, 0.5	A1	7 10

8.	(a) (i) $\frac{1}{3}$, awrt 0.333	B1	1
	(ii) $\frac{1}{3}\times\frac{1}{2}$ $(A\to B\to A)$ or $\frac{1}{3}\times\frac{1}{3}$ $(A\to D\to A)$	M1	
	$\frac{1}{3}\times\frac{1}{2}+\frac{1}{3}\times\frac{1}{3}$	M1 dep	
	$\frac{5}{18}$ $\left(\frac{15}{54}\text{ , awrt } 0.278\right)$	A1	3
	(iii) $\frac{1}{3}\times\frac{1}{2}$ $(A\to B\to C)+\frac{1}{3}\times\frac{2}{3}$ $(A\to D\to C)$	M1	
	$\frac{7}{18}$ (awrt 0.389)	A1	
	Conclusion (with reference to part (ii)) so $\frac{7}{18}>\frac{5}{18}$ OR a statement eg P(aii) > P(aiii) (cso)	A1	3

	(b) $\frac{1}{3}\times\frac{1}{2}\times\frac{1}{3}$ or $\frac{2}{3}\times\frac{1}{3}\times\frac{1}{3}$	M1		
	$\frac{1}{3}\times\frac{1}{2}\times\frac{1}{3}$ + $\frac{2}{3}\times\frac{1}{3}\times\frac{1}{3}$ $\left(\frac{7}{54}\right)$ ($C \rightarrow B \rightarrow A \rightarrow$Exit) ($C \rightarrow D \rightarrow A \rightarrow$Exit)	M1 dep		
	$\frac{7}{54}$ or 0.129 (o.e.) seen + conclusion	A1	3	10
	NB: A sufficient conclusion would be "7/54 = 0.13"			

9.	(a) (i) $6\mathbf{c}-2\mathbf{a}$ (ii) $5\mathbf{c}$		B1, B1	
	(iii) $\overrightarrow{AN}=-2\mathbf{a}+"5\mathbf{c}"$ $\overrightarrow{OM}=\begin{cases}\overrightarrow{OA}+\overrightarrow{AM}=2\mathbf{a}+\frac{1}{2}"\left(-2\mathbf{a}+5\mathbf{c}\right)"\\ \overrightarrow{ON}+\overrightarrow{NM}="5\mathbf{c}"-\frac{1}{2}"\left(-2\mathbf{a}+5\mathbf{c}\right)"\end{cases}$	$\overrightarrow{OM}=\frac{1}{2}\left(2\mathbf{a}+"5\mathbf{c}"\right)$ (gains M2)	M1 M1 dep	
	$\mathbf{a}+\frac{5}{2}\mathbf{c}$ **NB:** $\frac{1}{2}\left(2\mathbf{a}+5\mathbf{c}\right)$ earns all 3 marks		A1	5
	(b) $\overrightarrow{PM}=\begin{cases}\overrightarrow{PO}+\overrightarrow{OM}=-\mathbf{a}+"\left(\mathbf{a}+\frac{5}{2}\mathbf{c}\right)"\\ \overrightarrow{PA}+\overrightarrow{AM}=\mathbf{a}+\frac{1}{2}"\left(-2\mathbf{a}+5\mathbf{c}\right)"\end{cases}$		M1	
	correct conclusion **NB:** Must be a conclusion based on the **directions** of $\overrightarrow{OC}$ and $\overrightarrow{PM}$ and not just on their ratio.		A1	2

	(c) area of triangle $OAN = \frac{5}{6} \times 30$ (25) area of triangle $APM = \frac{1}{2} \times \frac{1}{2} \times$ " area of triangle OAN" 6.25 , $\frac{25}{4}$ (square units) **NB:** Ignore vector division in (c), eg $\frac{\mathbf{a}}{2\mathbf{a}} = \frac{1}{2}$	M1 M1 dep A1	3 10

10.	Penalise incorrect rounding (i.e. not giving answers to 3 significant figures) **ONCE** only in the question, the first time it occurs (a) $\frac{80}{\sin\angle ACB} = \frac{110}{\sin 75}$ $\sin\angle ACB = 80 \times \frac{\sin 75}{110}$ $\angle ACB = \mathbf{44.6}$ (44.6272...) (b) $\angle ABC = 180 - (75 + 44.6)$ (60.4 , 60.3727...) Cosine Rule: $(AC^2 =)\ 80^2 + 110^2 - 2 \times 80 \times 110 \times \cos"60.4"$ $= 18500 - 8693.37$ AC = **99.0** m (98.9916…)	M1 M1 dep A1 B1 M1 M1 dep A1	3 4

	Sine Rule: $\frac{AC}{\sin"60.4"} = \frac{110}{\sin 75}$ (oe, $= \frac{80}{\sin"44.6"}$) (M1) $AC = \frac{110}{\sin 75} \times \sin"60.4"$ (oe) (M1 dep) AC = **99.0** (98.9916…), **99.1** (A1) **NB: Accept 99 for A1**		
(c)	$(AM^2 =) \begin{cases} 80^2 + 55^2 - 2 \times 80 \times 55 \times \cos"60.4" \\ "99"^2 + 55^2 - 2 \times "99" \times 55 \times \cos"44.6" \end{cases}$ $(AM^2 =) \begin{cases} 9425 - 4346.69 \\ 12826 - 7753.96 \end{cases}$ AM = $\begin{cases} \textbf{71.3}\ m\ (71.262\ldots) \\ \textbf{71.2}\ m\ (71.218\ldots) \end{cases}$	M1 M1 dep A1	3
(d)	$\frac{PA}{80} = \tan 41$ **69.5** m (69.5429…)	M1 A1	2

	(e) $QM^2 = \begin{cases} "71.3"^2 + \left("69.543"/2\right)^2 \\ "71.2"^2 + \left("69.5"/2\right)^2 \end{cases}$	M1		
	$QM = \begin{cases} \mathbf{79.3}\ (79.327...) \\ \mathbf{79.2}\ (79.227...) \end{cases}$	A1	2	
	(f) $\tan QMA = \dfrac{"69.5"/2}{"71.3"}$ (oe)	M1		
	26.0° (26.0175…) **NB: Accept 26 for A1**	A1	2	16

11.	(a) $3(-3)^3 + k(-3)^2 - 27\times -3 + 36 = 0$		
	$-81 + 9k + 81 + 36 = 0$	M1	
	correct conclusion	A1	2
	Algebraic division Method:		
	$3x^2 - 13x + 12$ (M1)		
	Statement of zero denominator (A1)		
	(b) $3x - 4 - \frac{27}{x} + \frac{36}{x^2}$ (dividing by x^2, no slips)		
	OR	M1	
	Multiply $\frac{27}{x} - \frac{36}{x^2} = px + q$ by x^2 $\Rightarrow$ $27x - 36 = px^3 + qx^2$ $\Rightarrow$ $px^3 + qx^2 - 27x + 36$		
	and comparing coefficients		
	$p = 3$, $q = -4$	A1, A1	
	OR		
	$\frac{27}{x} - \frac{36}{x^2} = 3x - 4$		
	So A1 for $3x$, A1 for -4		3
	(c) -1.4 , 4.5 , 5	B1, B1, B1	3
	Note: Accept -1.44 without penalty		

	(d) graph penalties (-1) straight line segments each point missed (± ½ small sq.) each missed segment each point not plotted each point incorrectly plotted (± ½ small sq.) tramlines very poor curve i.e. line too thick	B3 (-1 eeoo)	3
	(e) straight line, gradient = 3 AND intersecting their curve TWICE intercept on y-axis $"-4"$ OR Their $y="p"x+"q"$ going through two points on their line Going through "one point" AND intersecting their curve TWICE (M1) "two points" (A1 ft)	M1 A1 ft	2
	(f) -3 (ca0), 1.3 or 4/3 (both ±0.05), 3 (±0.05)	B1, B1, B1	3 16

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