Pearson Edexcel

Mark Scheme (Results)

January 2020

Pearson Edexcel International GCSE
In Mathematics B (4MB1)
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 2020
Publications Code 4MB1_02R_2001_MS

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
- awrt – answer which rounds to
- 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.
  If a candidate misreads a number from the question. E.g. Uses 252 instead of 255; method marks may be awarded provided the question has not been simplified. Examiners should send any instance of a suspected misread to review. 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: e.g. 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 e.g. 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 to another.

Question		Working	Answer	Mark	Notes
1	(a)	$0.8 \times 0.9 \quad (= 0.72)$			M1 or for $\frac{20340}{0.9}$ (= 22600 - value in 2017)
		$\frac{20340}{0.8 \times 0.9}$			M1 (DEP) or for $\frac{'22600'}{0.8}$
			(£)28 250	3	A1
	(b)	$\frac{20340 - 19323}{20340} \times 100$			M1 or for $\frac{19323 - 20340}{20340} \times 100$
			5(%)	2	A1 allow -5
					Total 5 marks

2	(a)		Two of $2x + y = 2.4$ (oe) $x + 2y = 2.6$ (oe) $3x + 3y = 5$ (oe)	2	B1 (one mark for each) B1 (oe) eg $\frac{2x+y}{1+(2x+y)+(x+2y)} = \frac{2}{5}$, $\frac{x+2y}{1+(2x+y)+(x+2y)} = \frac{13}{30}$ $\frac{1}{1+(2x+y)+(x+2y)} = \frac{1}{6}$
	(b)	Isolating *x* or *y* **or** rearranging such that coefficients of *x* or *y* are the same in both equations			M1 – follow through on their linear simultaneous equations **NB:** Condone one arithmetic error
		Correctly substituting their expression for *x* or *y* to obtain *y* or *x* or correct operation to eliminate selected variable and solve for remaining variable			M1 (DEP) – e.g. obtaining an equation in *x* e.g. $15x = 11$ followed by $x = \ldots$ (but condone incorrect *x* value from their linear equation)
			$x = \frac{11}{15}$ $y = \frac{14}{15}$	3	A1
					Total 5 marks
OR	(a)		$2X + Y = 252$ $X + 2Y = 273$		**SC:** B1 for both equations
	(b)	Isolating *x* or *y* **or** rearranging such that coefficients of *x* or *y* are the same in both equations			M1 – follow through on their linear simultaneous equations **NB:** condone one arithmetic error
		Correctly substituting their expression for *x* or *y* to obtain *y* or *x* **or** correct operation to eliminate selected variable and solve			M1 (DEP) as above
		NB: 2(a) equations give $X = 77$ and $Y = 98$ which need to be divided by 105	$x = \frac{11}{15}$ $y = \frac{14}{15}$		A1

3	(a)	-2 (value of the determinant)			B1
			$\frac{1}{-2}\begin{pmatrix}4 & -2\\ -5 & 2\end{pmatrix}$	2	B1 (oe)
	(b)	$"\frac{1}{-2}\begin{pmatrix}4 & -5\\ -2 & 2\end{pmatrix}"\begin{pmatrix}2 & 2\\ 5 & 4\end{pmatrix}\begin{pmatrix}y^2-9x\\ x\end{pmatrix}$ $="\frac{1}{-2}\begin{pmatrix}4 & -5\\ -2 & 2\end{pmatrix}"\begin{pmatrix}0\\ -2\end{pmatrix}$			M1 Or $\begin{pmatrix}y^2-9x\\ x\end{pmatrix}=\begin{pmatrix}2 & 2\\ 5 & 4\end{pmatrix}^{-1}\begin{pmatrix}0\\ -2\end{pmatrix}$
		$\begin{pmatrix}y^2-9x\\ x\end{pmatrix}="\frac{1}{-2}\begin{pmatrix}4 & -2\\ -5 & 2\end{pmatrix}"\begin{pmatrix}0\\ -2\end{pmatrix}$			M1 (DEP)
		$\begin{pmatrix}y^2-9x\\ x\end{pmatrix}=\begin{pmatrix}-2\\ 2\end{pmatrix}$			A1 for $\begin{pmatrix}-2\\ 2\end{pmatrix}$
			$x=2$		A1
		$y^2-9"x"="-2"$ (substituting their value of *x*, RHS must be a constant)			M1 – dependent on both previous M marks
			$y=\pm 4$	6	A1
					Total 8 marks
OR	(b)	$2\left(y^2-9x\right)+2x=0$ $5\left(y^2-9x\right)+4x=-2$			M1 – two equations in y^2 and x A1
		$5\left(-x\right)+4x=-2$			M1 (DEP) – eliminate y^2 or x to obtain an equation in x or y^2
			$x=2$		A1
			$y=\pm 4$		A1 – so can score a maximum of 5 out of 6 if not using inverse

4	(a) (i)		12.445 kg or 12 445g	1	B1 – **units not required throughout question**
	(ii)	7550 − 4995			M1
			2.555 kg or 2555g	2	A1
	(iii)	7450 − 5005			M1 (= 2.445 kg or 2445g)
			2.45 kg or 2450g	2	A1
	(b)	0.2175, 0.2225, 10.1, 9.9			M1 any one correct bound (217.5, 222.5, 10100, 9900)
		Largest number of bags = $\frac{10.1}{0.2175}$ (oe) OR $217.5\times 45(=9787.5)$			M1 – oe smallest number of bags = $\frac{9.9}{0.2225}$ or $222.5\times 45(=10012.15)$ - allow values $(10,10.1]$, $[0.2175,0.220)$, $[9.9,10)$ or $(0.220,0.2225]$ for this mark
		46.4(4…) OR 9787.5 & 9900			A1 (Dependent on both M marks) (For reference $44.49438.... < \text{bags} < 46.43678...$)
			No **and** since needs 47 bags to be sure that the jar is filled	4	B1 (Dependent on previous three marks) – B0 if UB stated as 46 (not 47) **OR** Lower bound for the weight of 45 bags is less than the lower bound for the weight of the jar
					Total 9 marks

5		Rewrite 45 as $3^2 \times 5$ (can be implied)			M1
		$45^{1-2x} = 3^{2(1-2x)} \times 5^{1-2x}$			M1 (DEP)
		$\therefore \dfrac{3^{4x} \times 5^{3x+1} \times 3^{2(1-2x)} \times 5^{1-2x}}{3^2} = 5^4$ $\Rightarrow (3x+1)+(1-2x)=4$			M1 (DEP on both previous M marks) – forming an equation using the powers of 5 only – note that $4x+3x+1+2(1-2x)+(1-2x)-2=4$ is M0
			$x=2$	4	A1 – note that the correct answer is often seen fortuitously so working must be checked carefully If no marks scored **and** correct answer stated with no working **or** if candidates confirm that $x = 2$ via substitution with no algebraic working, then award SC B1 (otherwise mark to scheme). So e.g. those that earn M1 M1 then sub. $x = 2$ and verify this value holds score 2 marks only
					Total 4 marks

6	(a)(i)		18		B1
	(ii)		−21	2	B1
	(b) (i)	$\text{hf}(x)=\dfrac{6}{x+3}$			M1
		$y(x+3)=6$ OR $x(y+3)=6$			M1 (DEP)
			$(\text{hf})^{-1}: x \mapsto \dfrac{6-3x}{x}$		A1 (must be in terms of *x*)
	(ii)		$x=0$ is excluded	4	B1 ft (oe) **NB:** ft on an inverse function (eg "*y* = …") which is of the form $\dfrac{ax+b}{cx+d}$ where *d* can be 0
	(c)	hgf(x)=$\dfrac{6}{(x+3)^2-2(x+3)+3}$			M1 Must be of the form $(\text{hgf}(x)=)\dfrac{a}{b(x+3)^2+c(x+3)+d}$
		$6=2x^2+8x+12$			M1 (DEP) – hgf(x) = 2 then removing a trinomial quadratic dominator and expansion of $(x+3)^2$ must contain 3 terms
		$2x^2+8x+6=0\Rightarrow(2x+6)(x+1)=0$ $\Rightarrow x=\ldots$			M1 (not dependent on either of the previous M marks) – solving a three term quadratic (if using formula or completing the square must lead to real roots) – requires a correct method to solve their 3TQ (that is must have $(2x+a)(x+b)$ with $ab=6$ or $2b+a=8$ for their 6 and 8) – or correct substitution into correct formula – must lead to two real values of *x*
			$x=-1$		A1 (cao)
			$x=-3$	5	A1 (cao)
					Total 11 marks

7	(a)		3, 6, 9, 12, 15, 18	1	B1
	(b)		$\frac{4}{20}$ (oe), $\frac{16}{20}$ (oe)		B1
			$\frac{6}{20}$ (oe), $\frac{14}{20}$ (oe)		B1ft (the number of multiples of 3 stated in (a))
			$\frac{3}{20}$ (oe), $\frac{17}{20}$ (oe)		B1
			$\frac{5}{20}$ (oe), $\frac{15}{20}$ (oe)	4	B1
	(c)	P(Ahmed wins) = $"\frac{4}{20}"+"\frac{16}{20}"\times"\frac{14}{20}"\times"\frac{3}{20}"$			M1
			$\frac{71}{250}$, 0.284		A1 (cao)
		P(Hani wins) = $"\frac{16}{20}"\times"\frac{6}{20}"+"\frac{16}{20}"\times"\frac{14}{20}"\times"\frac{17}{20}"\times"\frac{5}{20}"$			M1
			$\frac{359}{1000}$, 0.359		A1(cao)
			Hani wins as P(Hani wins) > P(Ahmed wins), cso	5	A1 (Dependent on both previous A marks)
					Total 10 marks

8	(a)	$\frac{30}{\sin \angle ABC} = \frac{100}{\sin 70}$			M1
		$\angle ABC = \sin^{-1}\left(\frac{30 \times \sin 70}{100}\right)$			M1 (DEP)
			16.4°	3	A1 (for reference: 16.3741004…) Accept awrt to 3 sf
	(b)	$\frac{BC}{\sin\left(180 - \left("\angle ABC" + 70\right)\right)} = \frac{100}{\sin 70}$ **OR** $BC^2 = 100^2 + 30^2 - 2 \times 100 \times 30 \times \cos "\angle BAC"$			M1
		$BC = \frac{100 \times \sin\left(180 - \left("\angle ABC" + 70\right)\right)}{\sin 70}$ **OR** $BC = \sqrt{10900 - 6000 \cos "\angle BAC"}$			M1 (DEP)
			106 (cm)	3	A1 (for reference: 106.2047547…) Accept awrt to 3 sf
	(c)		20 (cm)	1	B1
	(d)	$V_{DCM} = \frac{1}{2} \times \left(\frac{1}{2} \times "BC"\right) \times \left("DC"\right) \times \sin 70$			M1
			498, 499 (cm^2)	2	A1 (for reference: 498.9991215…) Accept awrt to 3 sf
	(e)		3	1	B1
					Total 10 marks

9	(a)		Triangle *A* drawn	1	B1 vertices of *A* are $(-5,2),(-11,0),(-7,6)$
	(b)	Either lengths of sides of *B* half that of *A* (so implying a scale factor of a half) **OR** At least two construction lines through (1, 4) from *A* going past *A*			M1 – two correct points can imply this mark
		($\nabla B = (4,\ 5),\ (7,\ 6),\ (5,\ 3)$)	Triangle *B* drawn	3	A2 (-1eeoo e.g. two points correct scores A1) or A1 for a scale factor of –0.5 but not with centre (1, 4)
	(c)	Either lengths of sides of *C* same as *B* **OR** At least two construction lines through (3,1)			M1 – two correct points imply this mark
		($\Delta C = (2,\ -3),\ (-1,\ -4),\ (1,\ -1)$)	Triangle *C* drawn	3	A2 (-1eeoo e.g. two points correct scores A1)
	(d)		Enlargement		B1 – note that more than one transformation stated scores no marks in this part
			$(9,-8)$		B1
			(Scale) factor 2	3	B1
					Total 10 marks

10	(a) (i)		$\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$		B1
	(ii)	$\overrightarrow{AC} = "(\mathbf{b} - \mathbf{a})" - \frac{1}{2}\mathbf{a}$			M1
			$\overrightarrow{AC} = \mathbf{b} - \frac{3}{2}\mathbf{a}$		A1 (simplified to a single term in **a** and **b**)
	(iii)	$\overrightarrow{CD} = \frac{1}{2}\mathbf{a} - "(\mathbf{b} - \mathbf{a})" - 2\mathbf{a}$ or $-"\left(\mathbf{b} - \frac{3}{2}\mathbf{a}\right)" - 2\mathbf{a}$			M1
			$\overrightarrow{CD} = -\left(\frac{1}{2}\mathbf{a} + \mathbf{b}\right)$		A1 (simplified to a single term in **a** and **b**)
	(iv)	$\overrightarrow{AM} = -2\mathbf{a} - \frac{1}{2}"\left(-\left(\frac{1}{2}\mathbf{a} + \mathbf{b}\right)\right)"$			M1
			$\overrightarrow{AM} = -\frac{7}{4}\mathbf{a} + \frac{1}{2}\mathbf{b}$	7	A1 (simplified to a single term in **a** and **b**)

	(b) (i)	$\overrightarrow{ON} = \mathbf{a} + \lambda"\left(-\frac{7}{4}\mathbf{a} + \frac{1}{2}\mathbf{b}\right)"$			M1 or equivalent complete method e.g. $\overrightarrow{ON} = \overrightarrow{OD} + \overrightarrow{DC} + \overrightarrow{CB} + \overrightarrow{BA} + \overrightarrow{AN}$ in terms of **a**, **b** and λ
			$\overrightarrow{ON} = \mathbf{a}\left(1 - \frac{7\lambda}{4}\right) + \frac{\lambda}{2}\mathbf{b}$	2	A1 (two terms in **a** and one term in **b**) – note that $\overrightarrow{ON} = \mu\mathbf{b}$ is no marks in this part unless they go and find $\overrightarrow{ON}$ in terms of **a**, **b** and λ
	(ii)	Component of **a**: $1 - \frac{7}{4}\lambda = 0$			M1 or equivalent complete method e.g. $\overrightarrow{AN} = \overrightarrow{AO} + \overrightarrow{ON} = -\mathbf{a} + \mu\mathbf{b}$ and $\overrightarrow{AN} = \lambda\left("-\frac{7}{4}\mathbf{a} + \frac{1}{2}\mathbf{b}"\right)$ $\Rightarrow -\mathbf{a} + \mu\mathbf{b} = -\frac{7}{4}\lambda\mathbf{a} + \frac{1}{2}\lambda\mathbf{b}$ and compare components for **a**
			$\lambda = \frac{4}{7}$		A1
		Component of **b**: $\frac{"\lambda"}{2} = \mu$			M1 – comparing components for **b** (not dependent on previous M mark)
			$\mu = \frac{2}{7}$	4	A1
	(c)	(area of BNA = $"\frac{5}{7}" \times$ area of OAB)	10 (sq units)	1	B1
					Total 14 marks

11		**Penalise failure to round correctly ONCE only**			
	(a)		$-0.47,\quad 0.47,\quad 2.53,\quad 2.36$	3	B3 (-1eeoo)
	(b)	For reference: x / y: 0 / 0 0.5 / –0.47 1 / '–0.47' 2 / '0.47' 3 / 1.8 4 / '2.53' 4.5 / '2.36' 5 / 1.67	Curve drawn	3	B3ft (**NB:** ft on their (a) values) –1 mark for straight line segments each point missed each missed segment each point not plotted each point incorrectly plotted tramlines very poor curve **NB:** Accuracy for both plotting and drawing is $\pm\frac{1}{2}ss = 0.05$
	(c)	$-\frac{x^3}{6}+\frac{6x^2}{5}-\frac{3x}{2} > x^2-5x+3$			M1 (oe e.g. realising that the critical values are the intersection of the two curves)
			0.85 ± 0.05		A1ft (one intersection of their graphs)
			4.80 ± 0.05		A1ft (second intersection of their graphs)
			$0.85 \pm 0.05 < x < 4.80 \pm 0.05$	4	A1ft (must be using strict inequalities)

	(d)	(Accurate values for *P* and *Q* are (0.845, –0.511) and (4.796, 2.022) respectively) Gradient = $\frac{"2.022"-("-0.511")}{"4.796"-"0.845"}$ (= 0.641)			M1 Using their coordinates for *P* and *Q* (or any other points on their line)
			0.6, 0.7	2	A1
	(e)	(*a* = 0.641) ∴ e.g. $b = "-0.511" - "(d)" \times "0.845"$ e.g. $b = "2.022" - "(d)" \times "4.796"$ (oe)			M1 Using their gradient (which must be positive) and their coordinates for *P* or *Q* (or any other point on their line) to obtain a value for *b*
			$b = -1.0, -1.1$	2	A1
					Total 14 marks

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