Pearson Edexcel

Mark Scheme (Results)

January 2019

Pearson Edexcel International GCSE
Mathematics B (4MB0)
Paper 02R

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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**
  - 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 always check the working in the body of the script 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. Eg. 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 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 are multiple attempts shown, then all attempts should be marked and the highest score on a single attempt should be awarded.

- **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 shows that the candidate did not understand the demand of the question.

- **Linear equations**

  Full marks can be gained if the solution alone is given, 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.

Question	Working	Mark	Notes
1 (a)	$\begin{pmatrix} -4 & -2 \\ 14 & 18 \end{pmatrix}$	2	B2 (-1eeoo)
(b)	$\begin{pmatrix} 5 & 3 & 2 \\ 11 & 11 & 0 \\ 17 & 19 & -2 \end{pmatrix}$	2	B2(-1eeoo)
2	$14.0\times10^{147}+55.0\times10^{149}$ (removing denominators) OR $\dfrac{140.0\times10^{-76}+550.0\times10^{-74}}{10.0\times10^{-223}}$ (combining fractions) $0.014\times10^{150}+5.5\times10^{150}$ (oe, equal indices) OR $\dfrac{5.514\times10^{-73}}{1.0\times10^{-223}}$ 5.514×10^{150} **NB: No** working seen scores **no** marks.	3	M1 M1 (DEP) A1

Question	Working	Mark	Notes
3 (a)	$y = \frac{k}{x^2}$ (oe)	1	B1
(b)	$\frac{dy}{dx} = -\frac{2k}{x^3}$ **NB:** ft on **differentiation** of "x^{-m}" in their (a)		B1 (ft)
	$-\frac{5}{32} = "-\frac{2k}{4^3}"$ **NB:** DEP on using cand's identified "derivative" of their (a)		M1
	$k = 5, \frac{5\times 4^3}{32\times 2}$ (oe) **NB:** DEP on above M1 and B1		M1 (DEP) (Really A1)
	$\frac{45}{4} = \frac{"5"}{x^2}$ **NB:** DEP on subst their "*k*" into their "(a)"		M1 (DEP)
	$x = \pm\frac{2}{3}, \quad \pm 0.67$ or better	5	A1

Question	Working	Mark	Notes
4 (a)	$5(3)^3 + 2(3)^2 + k(3) + 36 = 0$ (oe, eg 135 + 18 + 3*k* + 36 = 0)		M1
	$k = -63$ (cso)	2	A1
	(**OR**: Long Division: 36 + 3(51+ *k*) = 0 (oe) (M1))		
	(**OR:** $5(3)^3 + 2(3)^2 + (-63)(3) + 36 = 0$ **and** correctly evaluated so that 0 = 0) (M1) (A1))		
(b)	$(ax^3 + (b-3a)x^2 + (c-3b)x - 3c = 5x^3 + 2x^2 - 63x + 36$ (expanding))		
	***a* = 5**		B1
	$-3c = 36$		M1
	$c = -12$	5	A1
	$b - 3\times$"a" $= 2$ OR "c" $- 3b =$ "-63" (equating correct coefs and Subst)		M1 (DEP)
	b = 17		A1
	(**OR**: Long Division: $5x^2 + 17x$.....		M1
	$5x^2 + 17x - 12$ (Complete and correct method)		(M1(DEP))
	a = 5		(B1)
	b = 17		(A1)
	$c = -12$		(A1)

Question	Working	Mark	Notes
5 (a)	$20\,000 \times (\$0.80 - \$0.65)$ (oe)		M1
	\$3000	2	A1
(b)	CP: $\$0.65 \times 0.8$ (oe) (= **\$0.52**)		M1
	SP: $\$0.80 \times 0.875$ (oe) (=**\$0.70**)		M1
	$\therefore n \times (\$"0.70" - \$"0.52") = 4500$ (oe)		M1 (DEP)
	$\therefore n = \dfrac{4500}{("\$0.80 \times 0.875" - "\$0.65 \times 0.8")}$		M1 (DEP)
	NB: Dependent on correct methods for both CP and SP.		
	n = 25 000 (cao)	5	A1

Question		Working	Mark	Notes
Penalise labelling ONCE only.				
6	(a)	Triangle A drawn and labelled.	1	B1
	(b)	Triangle $B \left(=\begin{pmatrix}1 & 1 & 0\\ 3 & 0 & 2\end{pmatrix}\right)$	2	B2 (-1eeoo)
	(c)	Lines measuring the perpendicular distances from $x + y = 5$ (drawn or indicated) of the respective vertices of triangles A and B.		M1
		Triangle $C \left(=\begin{pmatrix}2 & 5 & 3\\ 4 & 4 & 5\end{pmatrix}\right)$ drawn and labelled.	3	A2 (-1eeoo)
		NB: If no measuring lines but triangle B is correct M1 A2 If no measuring lines but two vertices of triangle are correct M1 A1 A0		
	(d)	$\begin{pmatrix}0 & 2\\ -2 & 0\end{pmatrix}$"$\begin{pmatrix}2 & 5 & 3\\ 4 & 4 & 5\end{pmatrix}$"		M1
		Triangle $D \left(=\begin{pmatrix}8 & 8 & 10\\ -4 & -10 & -6\end{pmatrix}\right)$ drawn and labelled	3	A2 ft-(-1eeoo)
		NB: ft on their triangle C		
	(e)	$(n =)\ 4$	1	B1

Question		Working	Mark	Notes
7	(a)	$\overrightarrow{AB} = 8\mathbf{b} - 12\mathbf{a}$	1	B1
	(b)	$\overrightarrow{AP} = -\frac{1}{m} \times 12\mathbf{a}$	1	B1
	(c)	$\overrightarrow{AQ} = \frac{1}{n} \times "(8\mathbf{b} - 12\mathbf{a})"$	1	B1 ft
	(d)	In ΔAPQ $\left(\overrightarrow{PA} = \frac{12}{m}\mathbf{a}\right)$		
		$\overrightarrow{PQ} = -"\overrightarrow{AP}" + "\overrightarrow{AQ}" = "\frac{12}{m}\mathbf{a}" + "\frac{1}{n} \times (8\mathbf{b} - 12\mathbf{a})"$		M1
		$\overrightarrow{PQ} = 12\left(\frac{1}{m} - \frac{1}{n}\right)\mathbf{a} + \frac{8}{n}\mathbf{b}$ (oe but cao)	2	A1 Separate out **a** and **b** components
	(e)	Both { Components of **a** $\Rightarrow$ $3 = 12\left(\frac{1}{m} - \frac{1}{n}\right)$; Components of **b** $\Rightarrow$ $2 = \frac{8}{n}$ }		M1 Using their $\overrightarrow{PQ}$
		$n = 4$		A1 cao
		$\frac{12}{m} - \frac{12}{"4"} = 3$ (Subst their n)		M1 (DEP)
		$m = 2$	4	A1 cao
	(f)	Area of $OPQB = 20 - \frac{1}{"2"} \times \frac{1}{"4"} \times 20$		M1
		$= 17.5$ (cm^2) (cao)	2	A1

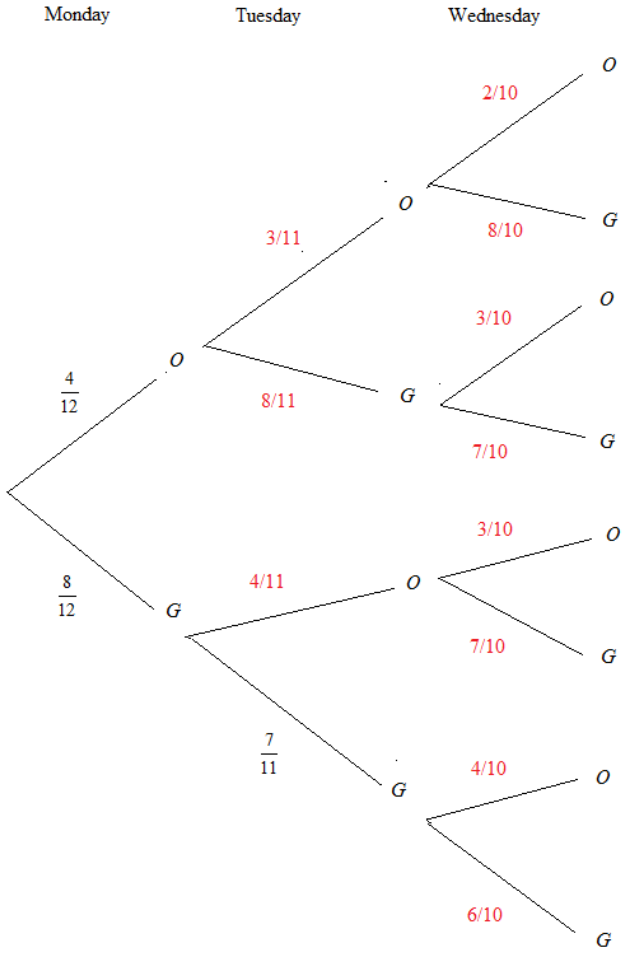
Question	Working	Mark	Notes
Penalise nc ONCE only			
8 (a)	$\triangle OAB$ is an isosceles triangles so OM is perpendicular to AB. **OR** If a radius of a circle is at right angles to a chord, then it bisects the chord (oe).	1	B1
(b)	$\cos 20 = \frac{5}{OA}$ (oe) **OR** $\left(\tan 20 = \frac{OM}{5} \quad (OM = 1.820)\right)$ $OA = \sqrt{5^2 + "1.820"^2}$		M1 Correct equation involving OA
	OA = 5.3209→ 5.32	2	A1
(c)	$\angle OAD = 90^o$		B1 Can be implied
	$\tan 40 = \frac{"OA"}{AD}$ (oe) **OR** $\frac{AD}{\sin 50} = \frac{"5.32"}{\sin 40}$ (B1) (implied) (M1)		M1
	AD = 6.3412→6.34	3	A1
(d)	$BD^2 = "AD"^2 + 10^2 - 2 \times "AD" \times 10 \times \cos("90" + 20)$		M1
	$BD^2 = 140.21... + 43.374...$		M1 (DEP)
	BD = 13.5494→ 13.5	3	A1

Question	Working	Mark	Notes
(e)	$\frac{"AD"}{\sin\angle ABD} = \frac{"BD"}{\sin("90"+20)}$ $\angle ABD = \sin^{-1}\left(\frac{"AD"\times\sin("90"+20)}{"BD"}\right)$ **OR** $10^2 = "13.5^2"+"6.34^2"-2\times"13.5"\times"6.34"\times\cos\angle ADB$ (M1) $\angle ADB = \cos^{-1}\left(\frac{"13.5^2"+"6.34^2"-10^2}{2\times"13.5"\times"6.34"}\right)$ (= 44.33°) (M1(DEP)) $\angle ABD =$ **2**5.7**,** 25.8, 25.9, 26.0, 26.1,26.2,26.3	3	M1 M1 (DEP) A1

Question	Working	Mark	Notes
9 (a)	Tuesday: $\left(\frac{3}{11}, \frac{8}{11}\right)$	4	B1
	$\frac{4}{11}$		B1
	Wednesday: $\left(\frac{2}{10}, \frac{8}{10}\right)$ and $\left(\frac{3}{10}, \frac{7}{10}\right)$		B1
	$\left(\frac{3}{10}, \frac{7}{10}\right)$ and $\left(\frac{4}{10}, \frac{6}{10}\right)$		B1
(b)(i)	$\frac{4}{12}\times"\frac{3}{11}"\times"\frac{2}{10}"$		M1
	$\frac{24}{1320}$, $\frac{1}{55}$, awrt 0.018, 1.8%	2	A1
(ii)	$1-\mathrm{P}(GGG)=1-\frac{8}{12}\times\frac{7}{11}\times"\frac{6}{10}"$		M1
	(OR P(OGG) + P(GOG) + P(GGO) + P(OOG) + P(OGO) + P(GOO) + P(OOO) $=\frac{4}{12}\times\frac{8}{11}\times\frac{7}{10}+\frac{8}{12}\times\frac{4}{11}\times\frac{7}{10}+\frac{8}{12}\times\frac{7}{11}\times\frac{4}{10}+\frac{4}{12}\times\frac{3}{11}\times\frac{8}{10}$ $+\frac{4}{12}\times\frac{8}{11}\times\frac{3}{10}+\frac{8}{12}\times\frac{4}{11}\times\frac{3}{10}+\frac{4}{12}\times\frac{3}{11}\times\frac{2}{10}$ (M1))		7 terms having 3 (8 x 7 x 4/(12x11x10) + 3(8 x 4 x 3/(12x11x10) + 4 x 3 x 2/(12x11x10)
	$\frac{984}{1320}$, $\frac{41}{55}$, awrt 0.745, 74.5%	2	A1

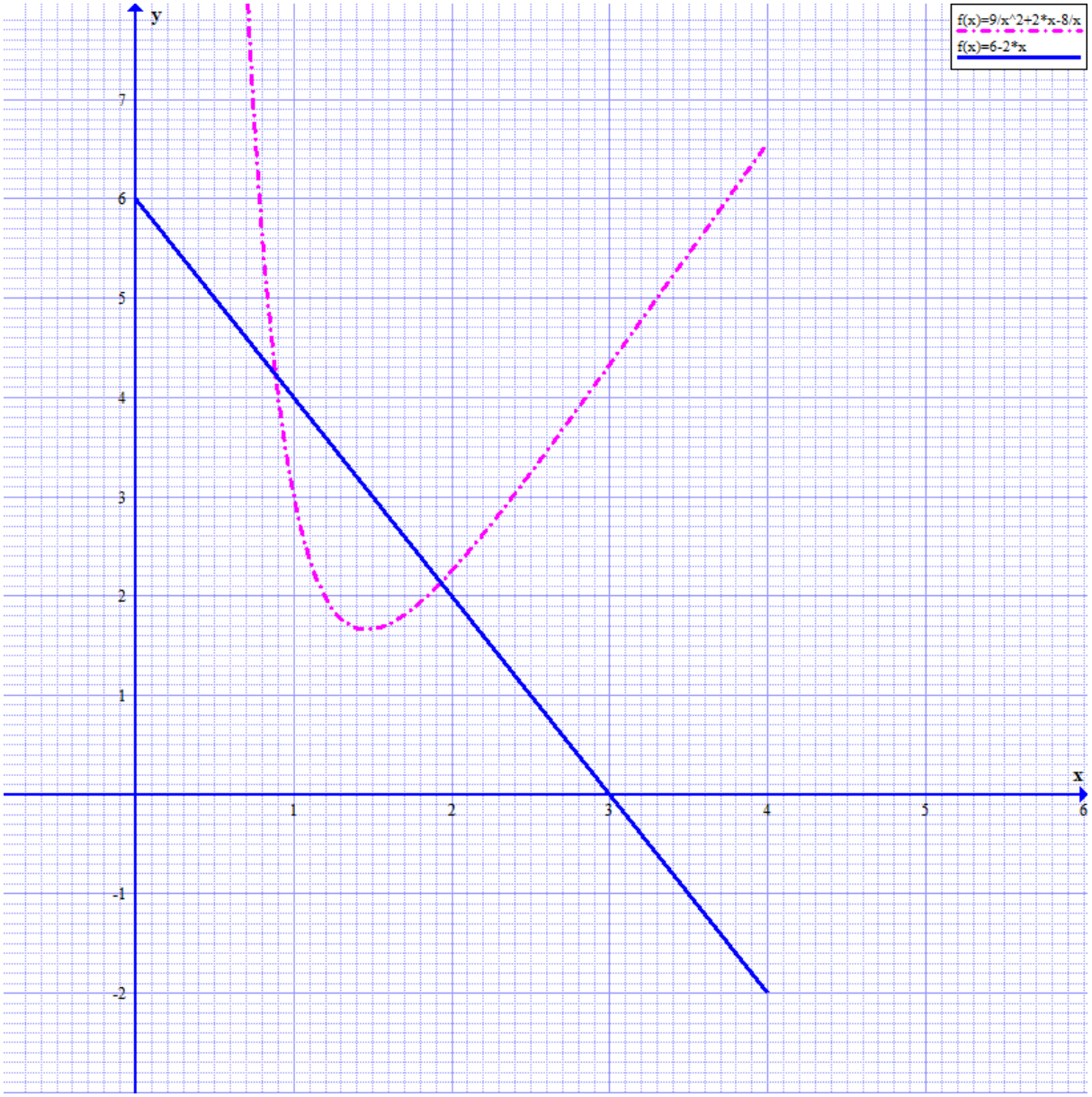
(c)	*GGG* or *OGG* or *GOG* or *GGO* (ie one suitable permutation)	2	B1
	All four: *GGG* and *OGG*, *GOG*, *GGO*		B1
(d)	$\frac{8}{12}\times\frac{7}{11}\times"\frac{6}{10}"$ + (at least one "correct" triplet of probabilities)		M1
	$\frac{8}{12}\times\frac{7}{11}\times"\frac{6}{10}"+\left(\frac{4}{12}\times"\frac{8}{11}"\times"\frac{7}{10}"+\frac{8}{12}\times"\frac{4}{11}"\times"\frac{7}{10}"+\frac{8}{12}\times\frac{7}{11}\times"\frac{4}{10}"\right)$		M1 (DEP)
	$\frac{1008}{1320}$, $\frac{42}{55}$, awrt 0.764, 76.4%	3	A1

Graph for 9 (a)


Monday
Tuesday
Wednesday
4/12
8/12
3/11
8/11
4/11
7/11
2/10
8/10
3/10
7/10
3/10
7/10
4/10
6/10
O
G

Question	Working	Mark	Notes
10 (a)	1.86 1.87 3.24 **NB: Penalise nc ONCE only**	3	B1 B1 B1
(b)	-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: (1)** Accuracy for both plotting and drawing is $\pm\frac{1}{2}ss$ **(2)** ft on their "1.86", "1.87" and 3.24"	3	B3 ft
(c)	x = 1.46 ($\pm\frac{1}{2}ss = \pm 0.05$) **NB:** Accept 1.5 if min pt occurs exactly at "x=1.5" on their graph	1	B1 ft

Question	Working	Mark	Notes
(d)	Method 1: Starting with $\frac{9}{x^2}+2x-\frac{8}{x}=ax+b$:		
	Multiply by x^2: $9+2x^3-8x=ax^3+bx^2$ $\left(\therefore (2-a)x^3-bx^2-8x+9=0\right)$		M1
	Comparing coefs (ie one of x^3 or x^2)		M1 (DEP)
	$a=-2$		A1 (DEP on 1st M)
	$b=6$	4	A1
	(OR Method 2: Starting with $4x^3-6x^2-8x+9=0$:		
	Divide by x^2: $4x-6-\frac{8}{x}+\frac{9}{x^2}=0$ (M1) $\left(\therefore \frac{9}{x^2}-\frac{8}{x}=6-4x\right)$		
	Add $+2x$ to both sides: $\frac{9}{x^2}-\frac{8}{x}+2x=6-2x$ (M1 (DEP))		
	$a=-2$ (A1)		
	$b=6$ (A1) 4)		
(e)	Their "$y=6-2x$" going through one "correct" point		M1
	$y=6-2x$ drawn and passing through 2 correct points (cao)		A1
	0.88 (± 0.05)		A1ft DEP on M1
	1.93 (± 0.05)	4	A1ft DEP on M1
	NB: Penalise answer not to 2dp ONCE only		


f(x)=9/x^2+2*x-8/x
f(x)=6-2*x
y
x
7
6
5
4
3
2
1
-1
-2
1
2
3
4
5
6

Question	Working	Mark	Notes
	Penalise incorrect form in (c) and/or (f) ONCE only		
11 (a)	$19 = 8a + b$	2	B1
	$57 = 27a + b$		B1
(b)	Correct attempt to solve simul. equations eg $38 = 19a$		M1
	$a = 2$		A1
	$b = 3$	3	A1
(c)	$y = "2"x^3 + "3"$ OR $x = "2"y^3 + "3"$		M1
	$f^{-1} : x \mapsto \sqrt[3]{\frac{x-3}{2}}$ (cao)	2	A1
(d)	$g(2p) = \frac{2p^2}{2p - p}$		M1
	$= 2p$	2	A1

Question	Working	Mark	Notes
(e)	$\mathrm{gg}(x) = \dfrac{\left(\dfrac{p^2x}{x-p}\right)}{\dfrac{px}{x-p} - p}$		M1
	$\left(= \dfrac{\dfrac{p^2x}{x-p}}{\dfrac{px-p(x-p)}{x-p}} = \dfrac{p^2x}{x-p} \times \dfrac{x-p}{px-p(x-p)}\right)$		
	$= x$ (cso)	2	A1
(f)	$\mathrm{g}^{-1}(x) = \dfrac{px}{x-p}$ (oe)	1	B1
	(eg accept $y = \dfrac{px}{x-p}$ if (c)'s answer has been penalised.)		