Mark Scheme (Results)

January 2019

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

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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
  - csa – correct solution 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
  - awrt – answer rounding to
- **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	Answer	Mark	Notes
1 (a)	180×8	1440 g (cao)	2	M1 A1
(b)	0.84×180 OR $(180 - 180 \times 0.16)$	151 kg, 151.2 kg	2	M1 A1

Question	Working	Answer	Mark	Notes
2	$(3x - 2)(x - 1) = (x + 5)(x + 7)$ **OR** $(3x - 2)(x - 1) - (x + 5)(x + 7)$		7	M1 Missing brackets can only be condoned if the related expansions are correct
	$3x^2 - 5x + 2 = x^2 + 12x + 35$ **OR** $3x^2 - 5x + 2 - (x^2 + 12x + 35)$ (oe)			M1 (DEP) one term can be incorrect
	$2x^2 - 17x - 33$ (= 0)	cao		A1
	$x = \dfrac{17 \pm \sqrt{(-17)^2 - 4 \times 2 \times (-33)}}{2 \times 2}$ (no errors on candidates' quadratic)			M1 (INDEP) for solving their **trinomial** quadratic equation
				SC M1(INDEP) for factorisation of their **trinomial** quadratic producing 2 of the 3 terms of their quadratic
	$\sqrt{"553"}$ (= 23.515….) (candidate must have a seen +ve discriminant)			M1 (DEP) on previous M1 and can only be implied by seen correct answer(s).
		$x = 10.1$ $x = -1.63$		A1 A1 Both cao
	NB: Some correct working must be seen for obtaining the quadratic and only then can the following M1(INDEP) M1(DEP) be obtained if their answers correspond to their quadratic.			

Question	Working	Answer	Mark	Notes
3 (a)		$\frac{-1}{2}\begin{pmatrix}1 & 2\\ 4 & 6\end{pmatrix}$ (oe)	2	B2 (−1 eeoo) **NB:** Allow ISW
(b)	"$\frac{-1}{2}\begin{pmatrix}1 & 2\\ 4 & 6\end{pmatrix}$"$\begin{pmatrix}6 & -2\\ -4 & 1\end{pmatrix}\begin{pmatrix}x\\ y\end{pmatrix}$="$\frac{-1}{2}\begin{pmatrix}1 & 2\\ 4 & 6\end{pmatrix}$"$\begin{pmatrix}5\\ -3\end{pmatrix}$ (oe)		4	M1
	$\begin{pmatrix}x\\ y\end{pmatrix}$ = "$\frac{-1}{2}\begin{pmatrix}-1\\ 2\end{pmatrix}$" (oe), ie 2x1 matrix	$x = 0.5$ $y = -1$		M1 (DEP) A1 A1
	OR			
	$6x - 2y = 5$ (no slips, oe) $-4x + y = -3$ Correct equation in x or y seen (Allow 1 alg/numeric slip)	$x = 0.5$ $y = -1$		(M1) (M1 DEP) (A1) (A1) **SC:** $\begin{pmatrix}0.5\\ -1\end{pmatrix}$ collects A1 A1

Question		Working	Answer	Mark	Notes
4	(a)	$p \times 2 + q = -1$ (oe) $p \times 5 + q = 11$ (oe)		2	B1 B1
	(b)	Rearranging their equations so coefficient of p is the same in both equations **OR** isolating p or q then adding or subtracting equations **OR** substitute expressions for p or q to obtain q or p		3	M1 (No slips)
			$p = 4$ $q = -9$		A1 A1
	(c)	"$4(4x - 9) - 9$"	ff : $x \mapsto 16x - 45$	2	M1 A1 ft **NB:** (Answer must be in correct form)
	(d)	"$4x - 9$" = "$16x - 45$" **OR** x = "$4x - 9$"	$x = 3$ (cao)	2	M1 A1

Question	Working	Answer	Mark	Notes
5 (a)(i)		$4\mathbf{a}$	1	B1
(ii)		$4\mathbf{b} - 6\mathbf{a}$	1	B1 oe
(b)	$\overrightarrow{CD} = \overrightarrow{CO} + \overrightarrow{OD} = -4\mathbf{a} + \lambda \times 4\mathbf{b}$ $\overrightarrow{AB} = -6\mathbf{a} + 4\mathbf{b} \ \ \therefore \lambda = \frac{2}{3}$ $\overrightarrow{DB} = \overrightarrow{OB} - \overrightarrow{OD} = 4\mathbf{b} - \frac{8}{3}\mathbf{b}$	$\overrightarrow{DB} = \frac{4}{3}\mathbf{b}$	4	M1 M1 (DEP) for using $\overrightarrow{CD}$ is parallel to $\overrightarrow{AB}$ M1 (DEP) complete method to find $\overrightarrow{DB}$ A1 fully correct solution
	***Alternatives for* 5(b):** **OR** $\overrightarrow{CD} = \lambda\overrightarrow{AB} = \lambda(-6\mathbf{a} + 4\mathbf{b})$ $\overrightarrow{DB} = \mu\overrightarrow{OB} = 4\mu\mathbf{b} = \overrightarrow{DC} + \overrightarrow{CA} + \overrightarrow{AB} = (6\lambda - 4)\mathbf{a} + (4 - 4\lambda)\mathbf{b}$ OR just $\overrightarrow{OD} = \overrightarrow{OC} + \overrightarrow{CD} = 4\mathbf{a} + \lambda(4\mathbf{b} - 6\mathbf{a}) = (4 - 6\lambda)\mathbf{a} + 4\lambda\mathbf{b}$ Equating coefs: $6\lambda - 4 = 0$ and $4 - 4\lambda = 4\mu$ OR just $4 - 6\lambda = 0$ $\overrightarrow{DB} = \frac{4}{3}\mathbf{b}$ **OR** $\overrightarrow{OD} = "4\mathbf{a}" + \frac{2}{3}"4\mathbf{b} - 6\mathbf{a}"$ (oe) OR $\overrightarrow{OD} = \frac{2}{3} \times 4\mathbf{b}$ $\overrightarrow{OD} = \frac{8\mathbf{b}}{3}$ $\overrightarrow{DB} = \overrightarrow{OB} - \overrightarrow{OD} = 4\mathbf{b} - "\frac{8}{3}\mathbf{b}"$			M1 M1 (dep) M1 (dep) M1 (dep) A1 M1 M1 (dep) M1 (dep)

	$\overrightarrow{DB} = \frac{4}{3}\mathbf{b}$ **NB:** Any method for $\overrightarrow{OD}$ but $\therefore \overrightarrow{DB} = \frac{1}{2}"\overrightarrow{OD}"$ scores whilst $\overrightarrow{DB} = \overrightarrow{OB} - \overrightarrow{OD} = 4\mathbf{b} - \frac{8}{3}\mathbf{b} = \frac{4}{3}\mathbf{b}$ will score M1 A1 <u>since a vector method has been used.</u> (**NB:** The question does **not** say "using **only** vector methods throughout…".) **OR** $\overrightarrow{CD} = \frac{2}{3}\overrightarrow{AB} = \frac{2}{3}"4\mathbf{b} - 6\mathbf{a}"$ (oe) $\overrightarrow{CA} = 2\mathbf{a}$ $\overrightarrow{DB} = \overrightarrow{DC} + \overrightarrow{CA} + \overrightarrow{AB} = "-\frac{2}{3}(4\mathbf{b} - 6\mathbf{a})" + 2\mathbf{a} + "4\mathbf{b} - 6\mathbf{a}"$ $\overrightarrow{DB} = \frac{4}{3}\mathbf{b}$			A1 M1M1 (dep) M0A0 M1 M1 (dep) M1 (dep) A1

Question		Working	Answer	Mark	Notes
6	(a)(i)	$3\times4t^2 - 2\times18t + 5$	$12t^2 - 36t + 5$	2	M1 at least 2 terms correct A1 cao
	(ii)	"$2\times12t - 36$" **Note:** ft from (a) (i) provided there are two terms	$24t - 36$	2	M1 at least 1 term correct A1 ft
	(b)	"$24t - 36$" > 0 **Note:** ft from (a) (ii) provided "1.5" is positive	$t > 1.5$	2	M1 Must be a linear expression which can involve = , ≥ and > A1 ft, oe,**must** be $t >$ …

Question		Working	Answer	Mark	Notes
7	(a)		65	1	B1
	(b)	5 bars drawn **Note:** Gaps between bars is one error only	Heights 3.5, 4.2, 0.8, 3, 4	5	B5 -1eeoo Penalise a maximum of one error for each bar **SC** If B0 but all correct frequency densities calculated then B1.
	(c)	$\frac{4}{15}$ **or** $\frac{11}{15}$ **or** $\frac{18}{20}$ **or** $\frac{2}{20}$ | Using frequency density of 3 or 3.5		4	M1
		$70 \times \frac{18}{20}$ (= 63) **or** $70 \times \frac{2}{20}$ (= 7) **or** $45 \times \frac{4}{15}$ (= 12) **or** $45 \times \frac{11}{15}$ (= 33) | (34 – 30) × 3 (= 12) **or** (20 – 2) × 3.5 (= 63) **or** (20 – 18) × 3.5 (= 7) $(45-34)\times 3$ (=33)			M1 (DEP)
		"7" + 21 + 4 + "12" (= 44) **or** 160 – "63" – "33" – 20 (= 44)			M1 **(**DEP)
			$\frac{44}{160}$, $\frac{11}{40}$, 0.275		A1

Question		Working	Answer	Mark	Notes
		Penalise nc ONCE only and at the first occurrer			
8	(a)	$\cos 23 = \frac{9}{OA}$ (oe)	$OA = 9.78$	2	M1 A1
	(b)	$OC^2 + 9^2 =$ "9.78"^{2} ($OC =$ 3.81965…..) | $\sin 23 = \frac{OC}{"9.78"}$ ($OC = 3.82$…..) | $\tan 23 = \frac{OC}{9}$ ($OC = 3.82$…..)		3	M1 correct first step of a method to find OC
		$\therefore AP =$ "9.78" – "3.82"			M1(DEP) complete method to find AP
		OR Secant Tangent Theorem: POQ is a diameter of the circle then $PQ = 2OC$			
		$AP(AP + 2OC) = 9^2$			(M1)
		$AP^2 + 2 \times "3.82" - 81 = 0$			(M1DEP)
			$AP = 5.95$ (Pyth.), 5.96		A1
	(c)	ΔOBP : $BP^2 =$ "3.82"^{2} + "3.82"^{2} – 2 × "3.82" × "3.82" × cos (180 – 23 – 90)		3	M1
		$BP = \sqrt{"17.783\ldots"}$ (= 4.217...)			M1 (DEP)
		OR			
		ΔABP : $BP^2 = 9^2 +$ "5.96"^{2} – 2 × 9 × "5.96" × cos 23			(M1)
		OR $\frac{BP}{\sin 67} = \frac{"OP"}{\sin 56.5}$			
		$BP = \sqrt{"17.783\ldots"}$ (= 4.217...)	$BP = 4.22$, 4.23		(M1 DEP)
		OR $BP = \frac{"OP" \times \sin 67}{\sin 56.5}$			

	OR $\frac{1}{2}\Delta OBP$: $\angle BOP = 180 - 23 - 90$ (= 67) $BP = 2 \times$ "3.82" $\times \sin\left(\frac{"67"}{2}\right)$			(M1) (M1 DEP) A1
(d)	$\frac{\sin ACP}{"5.96"} = \frac{\sin 23}{"4.22"}$ | $\angle ACP = 90 - ½ \times (180 -$ "67") **NB:** Must see a complete method for $\angle ACP$		2	M1
	OR $"5.96"^2 = "4.22"^2 + 9^2 - 2 \times "4.22" \times 9 \times \cos \angle ACP$	$\angle ACP =$ 33.3, 33.4, 33.5, 33.6		A1
(e)	$\Delta OBA = 9 \times$ "3.82" $\div 2$ OR $\frac{1}{2} \times 9 \times "OA" \times \sin 23$ (= 17.19....)		4	M1 M1
	Sector $OBP = \pi \times$ "3.82"$^2 \times \frac{67}{360}$ (= 8.53....) $\Delta OBA -$ Sector $OBP =$ "17.19" – "8.53" (= 8.658...)	8.62, 8.63, 8.64, 8.65, 8.66, 8.67		M1 (DEP) DEP on *both* M1s A1

Question	Working	Answer	Mark	Notes
Penalise missing labels only ONCE in the question, the first time it occurs				
9 (a)		Translation $\begin{pmatrix}6\\-2\end{pmatrix}$	2	B1 B1 **NB:** Only **ONE** transformation can be mentioned otherwise B0 B0
(b)	$\begin{pmatrix}0 & -1\\-1 & 0\end{pmatrix}\begin{pmatrix}1 & 1 & 3\\2 & 5 & 5\end{pmatrix}$ *C* has coordinates (−2, −1), (−5, −1), (−5, −3) **Note:** If matrix product not seen, then it can be implied from a correct *C*.	*C* drawn and labelled	3	M1 A2 −1eeoo
(c)	*D* has coordinates (5, 3), (5, 9), (9, 9)	*D* drawn and labelled	3	B3 -1eeoo
(d)	*E* has coordinates (2, −1), (5, −1), (5, −3)	*E* drawn and labelled	2	B2ft -1eeoo
(e)	**Note:** Must be consistent with their diagram and their triangle *E* must be a rotation of triangle *A* to achieve any marks **NB:** More than **ONE** translation given scores B0 B0 B0	Rotation 90° clockwise (−4, −2)	3	B1 Rotation B1 90° clockwise B1 (−4, −2)

Question	Working	Answer	Mark	Notes
10 (a)	$S = 2 \times \pi rl + 2\pi rh$	$S = 2\pi r(h + l)$ cso	2	M1 A1
(b)	$60 = 2\pi r(h + 4)$	$h = \frac{30}{\pi r} - 4$ cso	2	M1 A1
(c)	$V = 2 \times \frac{1}{3}\pi r^2 h + \pi r^2 h$		4	M1
	$V = 2 \times \frac{1}{3}\pi r^2\left(\frac{30}{\pi r} - 4\right) + \pi r^2\left(\frac{30}{\pi r} - 4\right)$ subst. h			M1 (DEP)
	OR			
	$V = \frac{5\pi r^2}{3}h$			
	$V = 20r - \frac{8}{3}\pi r^2 + 30r - 4\pi r^2$ eliminating r denominators			M1 (DEP)
	OR			
	$V = \frac{5\pi r^2}{3}\left(\frac{30}{\pi r} - 4\right)$ (oe) subst. h	$V = 50r - \frac{20}{3}\pi r^2$ cso		Must have completely correct algebra throughout A1
(d)	$\frac{dV}{dr} = 50 - \frac{40}{3}\pi r$		5	M1 one term correct
	$50 - \frac{40}{3}\pi r = 0$			M1 (DEP) fully correct and equating to 0
	$r = \frac{15}{4\pi}$, 1.19…			A1
	eg $50 \times "\frac{15}{4\pi}" - \frac{20}{3} \times \pi \times \left("\frac{15}{4\pi}"\right)^2$			M1 (INDEP) for substituting r in V
		$V = 29.8$		A1 awrt 29.8

Question		Working	Answer	Mark	Notes
11	(a)		−3 −4.5 27	3	B1 B1 B1
	(b)	−1 mark for straight line segments Each point missed ($\pm\frac{1}{2}$ small square) Each missed segment Each point not plotted Tramlines Very poor curve **NB:** ft on "−3", "−4.5" and "27"	Correct Curve	3	B3 ft −1 eeoo
	(c)	−5.186337289→ −5.2 ± 0.2	−5.0, −5.1, −5.2, −5.3, −5.4	1	B1 cao (−5 scores B0)
	(d)	$y = 4x - 7$ drawn correctly **Note:** line must pass through any two of (0, −7), (1, -3), (2, 1), (3, 5) and drawn between x=0.6 to x=2.2 so that the intersections in (e) can be seen.	Line	1	B1
	(e)	Values must be read off their curve and straight line from (d) **Note: (1)** Penalise equality signs (correct direction but includes the equality) **ONCE only.** **(2)** Answer for part (e) may be seen as one inequality	 awrt 0.7, 0.8 awrt 2.1 $x >$ awrt 0.7,0.8 $x <$ awrt 2.1	 4	B1 Critical pt value B1 Critical pt value B1 B1

Graph for Question 11