Mark Scheme (Results)

January 2018

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.
- 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- If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.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.

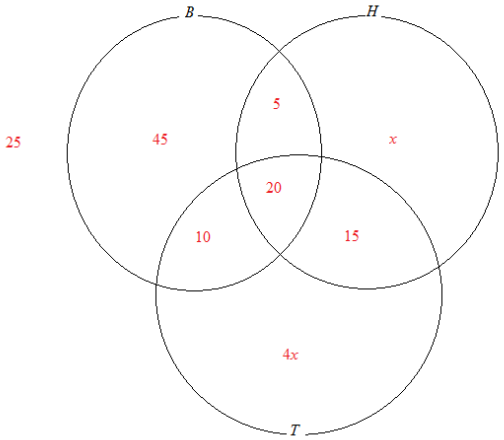
Parts of questions

- Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded in another.

Question	Scheme		Mark	Notes
1 (a)	$348\times\frac{100}{60}$ oe	($) 580	2	M1 A1
(b)	$"\$580"\times\frac{75}{100}-\$348$ OR $(0.40-0.25)\times"580"$ OR $(0.75-0.60)\times"580"$	($)87	2	M1 A1
2		$x=-14$ $y=10$	4	M1 Rearranging st coef of x or y is the same in both eqns OR isolating x or y M1 (DEP) Substituting expression (or value correctly obtained) for x or y to obtain y or x **NB:** Allow a total of 1 slip in both M marks. A1 A1

Question	Scheme	Mark	Notes
3 (a)	$576 = \dfrac{\alpha}{\left(\frac{1}{2}\right)^3}$ $\alpha = 72$ $\quad\quad$ $\therefore f = \dfrac{72}{r^3}$	3	M1 A1 A1
(b)	$f = 5 + \dfrac{1}{t} = \dfrac{"72"}{2^3}$ (= 9) (oe) $\quad\quad$ $t = \dfrac{1}{4}$	2	M1 A1

Question	Scheme		Mark	Notes
4	One of $(1,1):\quad -7+2x^2=1$ (ie 1st column) $(2,1):\quad -21-4x^2=-37$ $(3,1):\quad 35-6x^2=11$	$x=2$	6	M1 A1
	One of $(1,2):\quad 1+2\left("x"+2y\right)=1$ (ie 2nd column) $(2,2):\quad 3-4\left("x"+2y\right)=3$ $(3,2):\quad -5-6\left("x"+2y\right)=-5$	$y=-1$		M1 (DEP) A1
	One of $(1,3):\quad -"x"z-2"y"=-4$ (ie 3rd column) $(2,3):\quad -3"x"z+4"y"=-22$ $(3,3):\quad 5"x"z+6"y"=24$	$z=3$		M1 (DEP) A1

Question		Scheme		Mark	Notes
5	(a)			4	B1 25 correctly positioned B1 5, 10 and 15 correctly positioned B1 45 and 20 correctly positioned B1 4x correctly positioned in T and x correctly positioned in H
	(b)		150 = 25 + “45” + ”5” + x + “10” + 20 + “15” + 4x (oe) (ie 150 = their 8 values)	1	B1 ft
	(c)	(eg 150 = “120” + 5x (oe)) (cao)	x = 6	2	M1 Collecting “their” two x terms and equating them to “their” 7 constant values A1
	(d)	$\left(\frac{"10"+"20"}{"45"+"5"+"10"+"20"}=\right)$ $\frac{"30"}{"80"}$ (oe), "0.375", "37.5"%		1	B1 Ft **NB**: ft on their diagram

Question		Scheme	Mark	Notes
6	(a)	$\frac{3}{5}$, 0.6	1	B1
	(b)	$\frac{3}{2}$ OR 1.5 OR not 3/2	1	B1
	(c)	$y(2x-3)=6$ (oe) OR $x(2y-3)=6$ (oe) $h^{-1}: x \mapsto \frac{6+3x}{2x}$, $\frac{3(2+x)}{2x}$, $\frac{3}{x}+\frac{3}{2}$, $h^{-1}=\frac{6+3x}{2x}$ (oe)	2	M1 A1
	(d)	$18x-x(2x-3)=3(2x-3)$ (removing denominators, oe, allow 1 minor slip) $2x^2-15x-9(=0)$ (oe) $x=\frac{-(-15)\pm\sqrt{\left((-15)^2-4\times2\times(-9)\right)}}{2\times2}$ **NB:** on their trinomial quadratic. –0.558 8.06		M1 A1 M1 (INDEP) A1 A1

Question		Scheme		Mark	Notes
7	(a)	$65 < t <\leq 70$ fd = 4 (8 x 1cm squares) units $70 < t \leq 80$ freq = 50 runners $80 < t \leq 95$ fd=4units $95 < t \leq 115$ fd = 4.5 units $115 < t \leq 140$ freq = 75 and fd = 3 units		5	B1 B1 B1 B1 B1 ft
	(b)		$95 < t \leq 115$	1	B1 Ft **NB:** ft on "50" for $70 < t \leq 80$
	(c)	Using a correct mid-pt At least 3 correct products $\frac{10\times62.5+20\times67.5+"50"\times75+60\times87.5+90\times105+"75"\times127.5}{305}$ $\left(=\frac{625+1350+"3750"+5250+9450+9562.5}{305}=\frac{29987.5}{305}\right)$	98 (minutes)	4	M1 M1 (DEP) M1 (DEP) A1 (cao)

Question	Scheme	Mark	Notes
8 (a) (i)	$\overrightarrow{AB} = 8\mathbf{b} - 4\mathbf{a}$	1	B1
(ii)	$\overrightarrow{PO} = -\mathbf{a}$	1	B1
(b)	$\overrightarrow{PQ} = \alpha"(8\mathbf{b} - 4\mathbf{a})" = -\mathbf{a} + \frac{8}{m}\mathbf{b} \quad \left(= \overrightarrow{PO} + \overrightarrow{OQ}\right)$ $\alpha = \frac{1}{4}$ $m = 4$	3	M1 A1 A1 **NB:** Cand. must use vectors as required by question.
(c)	$\overrightarrow{PR} = \overrightarrow{PA} + \overrightarrow{AR} = 3\mathbf{a} + \frac{1}{n}"(8\mathbf{b} - 4\mathbf{a})"$ $\overrightarrow{PR} = \left(3 - \frac{4}{n}\right)\mathbf{a} + \frac{8}{n}\mathbf{b}$, $3\mathbf{a} - \frac{4}{n}\mathbf{a} + \frac{8}{n}\mathbf{b}$, $\frac{3n\mathbf{a} - 4\mathbf{a} + 8\mathbf{b}}{n}$	2	M1 A1 **NB:** So **a** and **b** terms separated
(d)	*PR* parallel to *OB* means "comp of **a**" in $\overrightarrow{PR}$ above is zero $n = \frac{4}{3}$ (**OR** since triangles *AOB* and *ARB* are similar, $\frac{AP}{AO} = \frac{3}{4} = \frac{PR}{OB}$, Comp of **b** in (c) means that $\therefore \overrightarrow{PR} = 6\mathbf{b} = \frac{8}{n}\mathbf{b}$ (M1)**)**	2	M1 A1
(e)	Triangles *OAB* and *OPQ* are similar (oe) $\therefore \left\|\Delta OAB\right\| = 4^2 \times \left\|\Delta OPQ\right\|$ *APQB* = 150 = Triangle *OAB* □□Triangle *OPQ* $\therefore 150 = 4^2\left\|\Delta OPQ\right\| - \left\|\Delta OPQ\right\|$ (oe) $\therefore \left\|\Delta OPQ\right\| = \mathbf{10}\left(\text{cm}^2\right)$	3	M1 M1 (DEP) A1

Question		Scheme	Mark	Notes
9	(a)	Triangle S drawn and labelled	1	B1
	(b)	Triangle T drawn and labelled $\left(\Delta T = \begin{pmatrix} 2 & 3 & 3 \\ 4 & 4 & 6 \end{pmatrix}\right)$	2	B2 (-1ee)
	(c)	Either point (-2,2) indicated **OR** At least two construction lines through (-2,2) Triangle U $\left(\Delta U = \begin{pmatrix} -6 & -7 & -7 \\ 0 & 0 & -2 \end{pmatrix}\right)$ **NB:** Award M1 A2 if (-2,2) not indicated and no construction lines but ΔU drawn correctly Award M1 A1 A0 if ΔU drawn correctly except for one Vertice.	3	M1 A2 (-1ee)
	(d)	Triangle V drawn and labelled $\left(\Delta V = \begin{pmatrix} -1 & -2 & -2 \\ -1 & -1 & -3 \end{pmatrix}\right)$ **NB:** ft on "triangle U"	2	B2) ft (-1ee
	(e)	$\begin{pmatrix} -3 & 1 \\ 1 & 1 \end{pmatrix}$"$\begin{pmatrix} -1 & -2 & -2 \\ -1 & -1 & -3 \end{pmatrix}$" Triangle W drawn and labelled $\left(\Delta W = \begin{pmatrix} 2 & 5 & 3 \\ -2 & -3 & -5 \end{pmatrix}\right)$		M1 A2 (-1ee)
	(f)	-4	1	B1
	(g)	1 : 4	1	B1

Question	Scheme	Mark	Notes
10 (a)	$\sin 25 = \frac{20}{AB}$ 47.3240→**47.3** (cm)	2	M1 A1
(b)	$\cos 20 = \frac{FC}{15}$ 14.0954→**14.1** (cm)	2	M1 A1
(c)	$AC^2 = "AB"^2 + 15^2 - 2\times "AB"\times 15\times\cos 95$ $AC = \sqrt{\left("AB"^2 + 15^2\right) - \left(2\times "AB"\times 15\times\cos 95\right)}$ **50.9** (cm)	3	M1 M1 (DEP) A1
(d)	Method 1: $ABCD = \lvert\Delta ABC\rvert + \lvert\Delta ACD\rvert$ **Scheme: Δ*ABC*:** M1 (angle for area formula), M1(area formula) **Δ*ACD*:** M1 (angle or side for area formula), M1(area formula) **A*BCD*:** M1 (adding areas) A1 $\angle ABC = 25 + (180 - 90 - 20)\quad (= 95)$ **NB:** $\angle ABC$ must be evaluated to **95** $\lvert\Delta ABC\rvert = \frac{1}{2}\times 15\times "AB"\times\sin"\angle ABC"\qquad \left(= \begin{cases} 353.6 & \text{using 4sf} \\ 353.4 & \text{using 3sf} \end{cases}\right)$	6	M1 (DEP) M1 M1 (DEP)) M1

(Point X is st AD is perpendicular to CX

$\therefore AX = 20 + "FC"$)

(M1)

$\therefore \cos\angle CAD = \dfrac{"AX"}{"AC"} \qquad \left(\angle CAD = \begin{cases} 47.94^{o} \text{ using 3sf answers} \\ 47.92^{o} \text{ using 4sf answers} \end{cases}\right)$

(M1

$\therefore \left|\Delta ACD\right| = \dfrac{1}{2} \times 40 \times "AC" \times \sin"\angle CAD" \quad \left(= \begin{cases} 755.2 & \text{using 4sf} \\ 755.8 & \text{using 3sf} \end{cases}\right)$

[OR $\therefore CX = \sqrt{"AC"^2 - "AX"^2}$

$\therefore \left|\Delta ACD\right| = \dfrac{1}{2} \times 40 \times "CX"$]

M1) (DEP))

(OR $\angle ABC = 25 + (180 - 90 - 20) \quad (= 95)$

(M1 (DEP))

NB: $\angle ABC$ must be evaluated to **95**

(M1 (DEP))

$\angle BAC = \sin^{-1}\left(\dfrac{15 \times \sin 95}{"50.9"}\right) \quad (= 17.07)$

(M1

$\left|\Delta ABC\right| = \dfrac{1}{2} \times "47.324" \times "50.9" \times \sin"\angle BAC"$

	$\angle CAD = 65 - "17.07" \quad (= 47.93)$ $\therefore \lvert\Delta ACD\rvert = \frac{1}{2} \times 40 \times "50.9" \times \sin"(65 - 17.07)"$) Finally: $\therefore ABCD = "\lvert\Delta ABC\rvert" + "\lvert\Delta ACD\rvert" \quad \left(= \begin{cases} 1108.8 & \text{using 4sf} \\ 1109.2 & \text{using 3sf} \end{cases} \right)$ *ABCD* = **1110** (cm^2)		M1 (DEP) A1
	Method 2: *ABCD* = ($\Delta ABE + \Delta BCF$) + *CFED* **Scheme: Δ*ABE* + Δ*BCF*:** M1(full method for area) ***CFED*:** M1(side or angle need to find *CX*), M1(full method for *CX*), M1(area formula for *CFED*) ***ABCD*:** M1(adding areas), A1 *ABCD* = ($\lvert\Delta ABE\rvert + \lvert\Delta BCF\rvert$) + *CFED* ($\Delta ABE + \Delta BCF$) = $\left(\frac{1}{2} \times "AB" \times 20 \times \sin 65\right) + \left(\frac{1}{2} \times "FC" \times 15 \times \sin 20\right)$ M1		M1 M1 M1 (DEP) M1 (DEP) M1 (DEP) A1

	$\left(=\begin{cases}464.852 & \text{using 3sf}\\ 465.06 & \text{using 4sf}\end{cases}\right)$ Point *X* is st *AD* is perpendicular to *CX* $\therefore AX = 20 + "FC"$ M1 $\therefore CX = \sqrt{"AC"^2 - "AX"^2}$ $\left(=\begin{cases}37.79 & \text{using 3sf}\\ 37.76 & \text{using 4sf}\end{cases}\right)$ M1 (DEP) $\left(\text{OR } \tan 25 = \frac{20}{BE}\right.$ (*BE* = 42.89) (M1) *FE* = *CX* = $"BE" - 15\sin 20$ (M1(DEP))$\left.\right)$ $\therefore CFED = \frac{1}{2} \times "CX" \times ("FC" + 20)$ $\left(=\begin{cases}644.32 & \text{using 3sf}\\ 643.71 & \text{using 4sf}\end{cases}\right)$ M1 (DEP) $\therefore$ *ABCD* = "($\Delta BCF + \Delta ABE$)" + "*CFED*" $\left(=\begin{cases}1108.8 & \text{using 4sf}\\ 1109.2 & \text{using 3sf}\end{cases}\right)$ M1 (DEP) *ABCD* = **1110** (cm^2)		
	Method 3: $\Delta ABC + \Delta ACX + \Delta CXD$ **Scheme: Δ*ABC*:** M1 (angle for area formula), M1(area formula)	6	M1 (DEP) M1 M1 M1 (DEP)

	ΔACX: M1(full method for area formula) **ΔCXD:** M1(full method for area formula) ***ABCD*:** M1 (Adding areas) A1 *ABCD =* $\underline{\lvert\Delta ABC\rvert+\lvert\Delta ACX\rvert+\lvert\Delta CXD\rvert}$ $\angle ABC=25+(180-90-20)\quad(=95)$ M1 **NB:** $\angle ABC$ must be evaluated to **95** $\lvert\Delta ABC\rvert=\frac{1}{2}\times 15\times "AB"\times\sin "\angle ABC"\qquad\left(=\begin{cases}353.6 & \text{using 4sf}\\ 353.4 & \text{using 3sf}\end{cases}\right)$ M1(DEP) (Point *X* is st *AD* is perpendicular to *CX* $\therefore AX=20+"FC"$) $\left(BE=20\tan 65=42.89\quad\text{and}\quad BF=15\sin 20=5.130\quad\therefore\ FE=37.7598\right)$ $\lvert\Delta ACX\rvert=\frac{1}{2}\times "34.095"\times "37.76"\quad(=643.718)$ M1 $(DX=20-"14.095"=5.905)$ $\lvert\Delta CXD\rvert=\frac{1}{2}\times 37.76\times 5.905\quad(=111.479)$ M1		M1 A1

	$\therefore ABCD$ = 353.4 + 643.718 + 111.479 (=111.479)	M1(DEP)		
	$ABCD$ = 1108.6→ **1110**	A1		
	Method 4: $\Delta ABE + \Delta BED + \Delta BCD$		6	M1 M1 M1 M1 (DEP) M1 (DEP) A1
	Scheme: **Δ*ABE* + Δ*BED* :** M1(area formula for Δ*ABE*), M1(Δ*ABE* = Δ*BED*)			
	Δ*BCD*: M1(full method for ∠*DBC*), M1(area formula)			
	***ABCD*:** M1 (Adding areas), A1			
	$\Delta ABE + \Delta BED + \Delta BCD$			
	(BE = 20tan65 = 42.89)			
	$\lvert\Delta ABE\rvert = \frac{1}{2} \times 20 \times "42.89"$ (= 428.9)	M1		
	and $\lvert\Delta ABE\rvert = \lvert\Delta BED\rvert$ (Congruence)	M1		
	$\angle DBE = 25 \ \therefore \ \angle DBC = 70 - 25 = 45$	M1		
	$\lvert\Delta BCD\rvert = \frac{1}{2} \times 15 \times "47.324" \times \sin "45" \quad (= 250.97)$	M1(DEP)		
	$ABCD$ = "428.9" + "428.9" + "250.97"	M1(DEP)		
	$ABCD$ = 1108.77→**1110**			

Question	Scheme	Mark	Notes
11 (a)	$3x^4-11x^3+6x^2+9x-6$ (Expanding, allow 1 slip) $\left(\text{OR}\quad 3\left(\frac{2}{3}\right)^4+a\left(\frac{2}{3}\right)^3+6\left(\frac{2}{3}\right)^2+9\left(\frac{2}{3}\right)-6=0 \qquad \text{(M1)}\right)$ cc	2	M1 A1
(b)	$\frac{dy}{dx}=3x^2-6x$ (differentiating, one term correct) $"3x^2-6x"=0$ $3x(x-2)$ (solving 2 term quadratic) (0, 3) and (2, -1) **NB:** Working must be seen	4	M1 M1 (DEP) M1 (DEP) A1
(c)	(3), [Accept $-0.38,-0.375,-0.37,-\frac{3}{8}$], (-1), [Accept $-0.13,-0.125,-0.12,-\frac{1}{8}$], 1.11 [Accept $\frac{71}{64}$] **NB** : **(1)** Do **not** award respective A1 for (b) in (c). **(2)** 2dp answers required, penalise ONCE	3	B3 (-1eeoo)

Question	Scheme	Mark	Notes
(d)	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 **NB: (1)** Accuracy for both plotting and drawing is $\pm\frac{1}{2}ss = \pm 0.05$ **(2)** Deduct errors starting with the last ePEN mark box	3	B3 (–1eeoo)
(e)	-0.88 (-0.91 to -0.85) 0.67 (Accept $\frac{2}{3}$), 1.35 (ie 1.32 to 1.38), 2.53 (ie 2.50 to 2.56)	4	B1 B1 B1 B1