Mark Scheme (Results)

Summer 2022

Pearson Edexcel International GCSE
In Mathematics A (4MA1)
Paper 2H

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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
- 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. 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 there is a choice of methods shown, mark the method that leads to the answer on the answer line; where no answer is given on the answer line, award the lowest mark from the methods shown.
- If there is no answer on the answer line then check the working for an obvious answer.

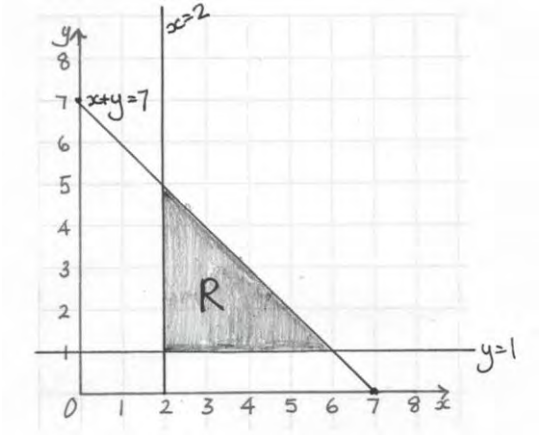
Ignoring subsequent work

- 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 to another.

International GCSE Maths				
Apart from questions 4, 10, 14a,15a, 15b, 18, 24 the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method				
Q	**Working**	**Answer**	**Mark**	**Notes**
1			3	M1 for $d = 9$ **or** $(c + d) \div 2 = 8$ (algebraically or clearly labelled integers) **or** $d - a = 4$ (algebraically or clearly labelled integers)
				M1 for at least two of $a = 5$ or $c = 7$ or $d = 9$ **or** $(c + d) \div 2 = 8$ (algebraically or clearly labelled integers) **or** or $d - a = 4$ (algebraically or clearly labelled integers)
		$a = 5$, $b = 6$, $c = 7$, $d = 9$		A1 All correct
				Total 3 marks

2	(a)(i) (ii) (iii)	 Line length 2cm + but shaded area must be enclosed for the mark in (b)		3	B1 B1 B1	$y = 1$ drawn $x = 2$ drawn $x + y = 7$ drawn Allow dashed lines or solid lines for graphs **condone lack of labels if unambiguous**
	(b)			1	B1	correct region indicated – shaded in or out – labelled **R** or clear intention to be the required region (ft only for one vertical line, one horizontal line and one line with a negative gradient)
						Total 4 marks

3	For sight of 5 hrs 24 mins = 5.4 (hrs) or $5\frac{24}{60}\left(=5\frac{2}{5}\right)$oe or 324 (mins) or 19440 (secs)		3	B1	
	$3980 \div 5.4$ or $\frac{3980}{324}\times 60$ oe			M1	For distance ÷ time that should give the correct speed in km/h. (SC allow $3980 \div 5.24$ (= 759.5…or 760) for this mark unless mark has been awarded for 324 minutes or 5.4 hours oe)
		737		A1	awrt 737 (if no working shown, 738 gets SCB2)
					Total 3 marks

4	$\frac{16}{3}(-)\frac{20}{7}$ or $(5)\frac{7}{21}(-)(2)\frac{18}{21}$		3	M1	for correct improper fractions or fractional part of numbers written correctly over a common denominator (no need for minus sign)
	$\frac{112}{21}-\frac{60}{21}$ or $5\frac{7}{21}-2\frac{18}{21}=3-\frac{11}{21}$ oe or $5\frac{7}{21}-2\frac{18}{21}=4\frac{28}{21}-2\frac{18}{21}$			M1	for correct fractions with a common denominator with minus sign or mixed numbers to the stage shown
	$\frac{112}{21}-\frac{60}{21}=\frac{52}{21}=2\frac{10}{21}$ oe or $3-\frac{11}{21}=2\frac{10}{21}$ or $5\frac{7}{21}-2\frac{18}{21}=4\frac{28}{21}-2\frac{18}{21}=2\frac{10}{21}$	Shown		A1	Dep on M2 for a correct answer from fully correct working If all 3 fractions turned into improper fractions on the first line $\frac{16}{3}-\frac{20}{7}=\frac{52}{21}$ then the student **clearly** needs to show that the LHS $=\frac{52}{21}$
					Total 3 marks

5	28 × 12 (=336) or 5 × 12 (= 60) or 18 × 12 (= 216) or 28 × 20 (=560) or $\frac{1}{2}(CD+"18")"8"$ oe eg $72+4CD$ [numbers in " " come from correct working] **Check diagram for areas**		4	M1	For a correct method to find the area of a rectangle (may be seen as part calculation) or a correct expression for the area of the trapezium with numbers substituted. Allow for other correct methods to find area linked to this shape.
	"336" + 0.5("18"+ *CD*)"8" = 434 oe eg 4("18" + *CD*) = 98 or eg 0.5("18" + *CD*)"8" = "98" oe eg $\frac{1}{2}(18+CD)=12.25$ or $"560"-2\left(0.5(5+x)"8"\right)=434$ oe (where *x* is horizontal from *D* to perp with *AF*) [numbers in " " come from correct working]			M1	correct use of their values from correct working for an equation involving *CD* (*CD* could be labelled with any letter)
	eg $(CD=)\frac{196-144}{8}\left(=\frac{52}{8}\right)$ or $(CD=)\frac{98-72}{4}\left(=\frac{26}{4}\right)$ or $(CD=)\frac{434+152-560}{4}$ or $(CD=)2\times12.25-18$ or $98\times2(=196),\ "196"\div8(=24.5),"24.5"-18$			M1	a correct process to solve a correct equation **or** a correct process to find *CD* using **correct values**
		6.5		A1	oe
					Total 4 marks

6	$\cos 42 = \frac{x}{9.5}$ or $\tan 42 = \frac{9.5\sin 42}{x}$ or $\sin(90-42) = \frac{x}{9.5}$ or $\frac{x}{\sin(90-42)} = \frac{9.5}{\sin 90}$ or $9.5^2 - (9.5\sin 42)^2$		3	M1 a correct trig statement for x or correct Pythagoras for x^2
	$(x =)\ 9.5\cos 42$ or $(x =)\frac{9.5\sin 42}{\tan 42}$ or $(x =)9.5\sin(90-42)$ or $(x =)\frac{9.5\sin(90-42)}{\sin 90}$ or $(x =)\sqrt{9.5^2 - (9.5\sin 42)^2}$ or			M1 a fully correct calculation to find x
		7.1		A1 awrt 7.1
				Total 3 marks

7	×1000 (÷60 ÷ 60) or ÷3600 or sight of 81 000 or 1350 or 0.0225		3	M1	For one of ×1000 (eg sight of 81 000) or (÷60 ÷ 60) or ÷3600 oe
	$\frac{81\times1000}{60\times60}$ oe eg $\frac{81}{3.6}$ or $81\times\frac{5}{18}$ oe			M1	For a fully correct method with correct use of brackets eg 81000 ÷ 60 × 60 is M1 only if not recovered
		22.5		A1	or $\frac{45}{2}$ or $22\frac{1}{2}$
					Total 3 marks

8	300 ÷ (7 + 5 + 3) (= 20) **clear correct use** of 7 + 5 + 3 (= 15) eg division at the end by 15 $\left(\frac{"2.8"+"1.8"}{15}\right)$ or correct use of 15 in a fraction eg $\frac{2}{5}\times\frac{7}{15}$		5	M1	(no mark for "15" unless it is used correctly) use of 7 × 20 or 140 or 5 × 20 or 100 in further work assumes this mark
	$\frac{2}{5}\times(7\times"20")$ (=56) oe eg 0.4 ×"140" (= 56) or $\frac{2}{5}\times 7\left(=\frac{14}{5}=2.8\right)$ eg $\frac{2}{5}\times\frac{7}{15}\left(=\frac{14}{75}=0.186...\right)$			M1	finding $\frac{2}{5}$ of the number of birthday cards or $\frac{2}{5}$ of the share of 7 or $\frac{2}{5}$ of fraction of amount
	0.36 × (5 × "20")(=36)[from working] or 0.36 × 5 (= 1.8) eg $\frac{36}{100}\times\frac{5}{15}\left(=\frac{180}{1500}=0.12\right)$ oe			M1	finding 36% of anniversary cards Or 36% of the share of 5 or 36% of fraction of amount
	$\frac{"56"+"36"}{300}$ $(=\frac{92}{300})$ or eg $\left(\frac{"2.8"+"1.8"}{15}\right)$ or $\frac{\frac{14}{5}+\frac{9}{5}}{15}$ $"\frac{14}{75}"+"\frac{180}{1500}"$			M1	for any fraction from correct working that isn't simplified or 30.66..% or 0.3066...
		$\frac{23}{75}$		A1	
					Total 5 marks

9	50 000 × 1.013 (=50 650) oe Or 50 000 × 0.013 (= 650) oe (NB: accept $\left(1+\frac{1.3}{100}\right)$ for 1.013 but not (1 + 1.3%))		3	M1	For finding 101.3% or 1.3% of 50 000	M2 for 50000×1.013^4 **or** 50000×1.013^5
	"50 650" × 1.013 (=51 308.45) "51 308.45"× 1.013 (=51 975.45...) "51 975.45..."× 1.013			M1	dep for a complete method	
		52 651		A1	awrt 52 651 if no marks awarded then SCB1 for $50\ 000 \times 0.013^n$ $50\ 000 \times 0.987^4$ (= 47450…..) 50 000 × 0.052 (= 2600) 50 000 × 1.052 ((= 52600) 50000×1.013^2 (= 51308.45) 50000×1.013^3 (= 51975.45…)	
						Total 3 marks

10	eg $\begin{matrix}+\\ \end{matrix}\begin{matrix}7x+3y=3\\ 9x-3y=21\end{matrix}$ or $\begin{matrix}-\\ \end{matrix}\begin{matrix}21x+9y=9\\ 21x-7y=49\end{matrix}$ or eg $7x+3(3x-7)=3$ or $7\left(\frac{7+y}{3}\right)+3y=3$		3	M1	a correct method to eliminate x or y – multiplying one or both equations so that one variable can be eliminated (allow a total of one error in multiplication) **and** the correct operation to eliminate or for substitution of one variable into the other equation.
	If first M1 gained then they can substitute an incorrect value if from 'correct' method to gain this mark.			M1	dep on M1 for a correct method to calculate the value of other letter eg substitution or starting again with elimination
		$x = 1.5, y = -2.5$		A1	oe dep on M1
					Total 3 marks

11	(i)	$(x \pm 3)(x \pm 8)$		2	M1	or $(x + a)(x + b)$ where $ab = -24$ **or** $a + b = 5$
			$(x - 3)(x + 8)$		A1	
	(ii)		3, −8	1	B1ft	Must ft from their answer to (i) ft from their incorrect factors in the form $(x + a)(x + b)$
						Total 3 marks

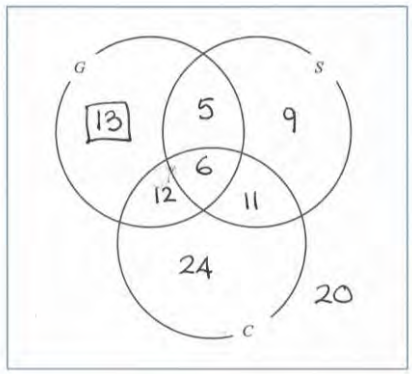
12	7×2.7 (=18.9) or 4×3.3 (= 13.2) or $\frac{3W + 4 \times 3.3}{7} = 2.7$ oe eg $3W + 13.2 = 18.9$		3	M1 For one correct product or for a correct equation for W
	$\frac{7 \times 2.7 - 4 \times 3.3}{3}$ or $\frac{"18.9" - "13.2"}{3}$ or $\frac{5.7}{3}$ or $3W = 5.7$			M1
	If you see 1.9 from correct working and they do further work to this value, award M2	1.9		A1
				Total 3 marks

13	(a)		7, 32, 52, 66, 74, 80	1	B1	
	(b)	*If a graph is ascending you can ft for the marks in parts (c) and (d)*		2	B2	**(use overlay)** Fully correct cf graph – points at ends of intervals and joined with curve or line segments. If not B2 then B1(ft from a table with only one arithmetic error) for 5 or 6 of their points **either** plotted correctly at ends of intervals not joined **or** plotted consistently within each interval (not at upper ends of intervals) at their correct heights and joined with smooth curve or line segments. (ignore curve/line from 0 to first plotted point)
	(c)		32-34	1	B1	Any value in range (ft their CF graph reading across at 40 or 40.5)
	(d)			3	M1	For a correct method to take readings at 18 and 65 (eg 6 and 77) even if not given values or error reading the CF scale (ft a CF graph if method shown)
		eg (77 – 6) × 0.6 oe			M1	ft dep on previous M1 for their **difference** (working must be shown if incorrect values used) ft finding 60% of their difference dep on previous M1
			42, 43, 44		A1	ft award full marks for an integer answer in the range if not from incorrect working and ft their CF graph if value outside range (but for this accuracy mark all readings must be correct) ft their graph but answer must be whole number (value rounded or truncated)
						Total 7 marks

14 (a)	$(5 – x)(2x + 3) = 10x + 15 – 2x^2 – 3x$ $(= -2x^2+7x+15)$ or $(5 – x)(x + 4) = 5x + 20 – x^2 – 4x$ $(= -x^2 + x + 20)$ or $(2x + 3)(x + 4) = 2x^2 + 8x + 3x + 12$ $(=2x^2+11x+12)$		3	M1	multiplying 2 factors only but do not award if they multiply eg $(5 – x)(2x + 3)$ **and** $(5 – x)(x + 4)$ as their method allow one error
	$(-2x^2+7x+15)(x+4)= -2x^3 -8x^2 + 7x^2 + 28x + 15x + 60$ or $(-x^2+x+20)(2x+3)= -2x^3 - 3x^2 + 2x^2 + 3x + 40x + 60$ or $(2x^2+11x+12)(5-x)= 10x^2 - 2x^3 + 55x - 11x^2 + 60 - 12x$			M1	(dep)ft for expanding by the third factor, allow one further error
		$-2x^3 – x^2 + 43x + 60$		A1	Dep on M1
	ALTERNATIVE				
	$10x^2 + 15x + 40x + 60 – 2x^3 – 3x^2 – 8x^2 – 12x$		3	M2	for a complete expansion with 8 terms present, at least 4 of which must be correct (M1 for 4 correct terms from any number of terms)
		$-2x^3 – x^2 + 43x + 60$		A1	

(b)	$g+7=\frac{c+3}{4+c}$ or $g(4+c)=c+3-7(4+c)$ or $g=\frac{c+3}{4+c}-\frac{7(4+c)}{4+c}\left(=\frac{c+3-28-7c)}{4+c}\right)$		4	M1	Adding 7 to both sides as a first step or removing fraction correctly
	eg $4g + gc + 28 + 7c = c + 3$ or $4g + gc = c + 3 – 28 – 7c$ oe			M1	removing fraction and expanding all brackets in an equation with no more than one error
	eg $gc + 7c – c = 3 – 28 − 4g$ or $28 – 3 + 4g = c – 7c − gc$			M1ft	ft dep on previous M1 - terms in c on one side and other terms on the other side in an equation
		$c=\frac{-(4g+25)}{g+6}$		A1	oe eg $c=\frac{25+4g}{-6-g}$ or $c=\frac{3-28-4g}{g+7-1}$ oe [if c = is missing allow full marks if seen in working otherwise 3 marks] (SCB2 for an answer of $c=\frac{-4-4g}{g-1}$ oe or $c=\frac{31-4g}{g-8}$ oe SCB1 in working for $4g + cg = c + 3 – 7$ oe or $4g+cg-28-7c=c+3$ oe
					Total 7 marks

15 (a)	eg $\frac{2(4x+5)-3(3-2x)}{6}(=13)$ oe or $\frac{2(4x+5)}{6}-\frac{3(3-2x)}{6}(=13)$ $2(4x + 5) -3(3 – 2x) = 13 × 3 × 2$ oe		4	M1	Writing fractions over a common denominator or removing denominator If the student has removed the denominator at this stage then a correct method must be shown or implied	Allow one error in removal of brackets
	eg $8x + 10 – 9 + 6x = 78$ oe eg $14x + 1 = 78$			M1ft	ft dep on previous M1 removing brackets and fractions correctly in an equation	
	eg $8x + 6x = 78 – 10 + 9$ oe eg $14x = 77$			M1ft	ft dep on previous M1 terms in x on one side and number terms the other	
		5.5		A1	oe eg $\frac{11}{2}$ **dep on M2**	
(b)	$(2y + 5)(y − 6)$ or $\frac{--7\pm\sqrt{(-7)^2-4\times2\times-30}}{2\times2}$ $2\left[\left(y-\frac{7}{4}\right)^2-\frac{49}{16}\right]-30(=0)$ oe		3	M1	A correct method to solve the quadratic - allow factorisation that gives 2 out of 3 terms correct when expanded or use of quadratic formula – if using formula, allow one sign error and allow if simplified as far as $\frac{7\pm\sqrt{49+240}}{4}$ or use of completing the square with one sign error as far as shown	
	$(y =) 6, (y =) −2.5$			A1	Correct critical values **dep on M1**	
		$−2.5 \leq y \leq 6$		A1	oe eg $y \geqslant -2.5$ (and) $y \leqslant 6$ or $[–2.5, 6]$ (do not penalise change of variable eg y to x) **dep on M1**	
						Total 7 marks

16 (a)		Fully correct Venn diagram	3	B1 B2	For 13 correct in *G* only For all 7 others correct (B1 for 4, 5 or 6 others correct (does not need to be complete for this))	
(b)(i)		36	1	B1ft	ft from a diagram where values are present in the required regions	If these 3 parts are given as probabilities, please mark incorrect the first time but award marks from there on if numerator is correct
(ii)		44	1	B1ft		
(iii)		35	1	B1ft		
(c)		$\frac{18}{53}$	2	B2ft	oe 0.33(96…) or 33(.96…)% ft their Venn diagram or (B1 for $\frac{18}{m}$ where $m>18$ or $\frac{n}{53}$ where $n<53$ or for 18 : 53 or other incorrect notation or B1ft their Venn diagram for $\frac{"18"}{m}$ where $m>"18"$ or $\frac{n}{"53"}$ where $n<"53"$)	
						Total 8 marks

17	$M = kh^3$ oe or $4 = k \times 0.5^3$ oe		4	M1 $k \neq 1$ and where k could be any letter	M2 for $\frac{500}{4} = \frac{h^3}{0.5^3}$ oe or 125×0.5^3 (= 15.625) oe
	$k = \frac{4}{0.5^3}$ or $k = \frac{4}{0.125}$ or $k = 32$			M1 Allow this for M2 if $M = kh^3$ is not written	
	$h = \sqrt[3]{\frac{500}{"32"}}$ or $\sqrt[3]{\frac{500 \times 0.5^3}{4}}$ or $\sqrt[3]{15.625}$ or $h = 5 \times 0.5$			M1 for a correct expression for h using correct values or a value of k from a completely correct method	
		2.5		A1 oe	
					Total 4 marks

18	7.45, 7.55, 3.415, 3.425, 1.5, 2.5		3	B1 For one correct upper or one correct lower bound Allow $7.54\dot{9}$ for 7.55, $3.424\dot{9}$ for 3.425, $2.4\dot{9}$ for 2.5	
	$(X =)\frac{2 \times 7.55 - 3.415}{1.5}$ oe eg $\frac{11.685}{1.5}$			M1 $\frac{2 \times UB_a - LB_b}{LB_f}$ where $7.5 < UB_a \leq 7.55$, $3.415 \leq LB_b < 3.42$, $1.5 \leq LB_f < 2$ (also award this mark for $\frac{7.55 - 3.415}{1.5}$ or $\frac{2(7.55 - 3.415)}{1.5}$)	
		7.79		A1 must be from correct working	
					Total 3 marks

19	$(a=)\dfrac{14}{3\times\dfrac{7}{4y-3}-7}$		3	M1	For a correct substitution
	$(a=)\dfrac{14(4y-3)}{21-7(4y-3)}$ oe eg $\dfrac{56y-42}{21-28y+21}$			M1	or for a correct but unsimplified answer in the form $\dfrac{m}{n}$ ie the denominator should be simplified to remove the fraction
		$\dfrac{4y-3}{3-2y}$		A1	oe but must be simplified
					Total 3 marks

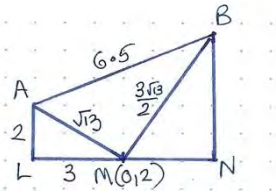
19 alt	$x=\dfrac{14+7a}{3a}$ **and** $\dfrac{14+7a}{3a}=\dfrac{7}{4y-3}$		3	M1	For rearranging 'x' to be in terms of a and equating two expressions for a
	$a(42-28y)=56y-42$ oe eg $(a=)\dfrac{56y-42}{21-28y+21}$			M1	or for a correct but unsimplified answer in the form $\dfrac{m}{n}$
		$\dfrac{4y-3}{3-2y}$		A1	oe but must be simplified
					Total 3 marks

20	eg $2d \times 2d - 4 \times \pi \times (\frac{1}{2}d)^2 (= 40)$ oe or $4r \times 4r - 4 \times \pi \times r^2 (= 40)$ oe or $x^2 - 4\pi\left(\frac{1}{4}x\right)^2 (= 40)$ oe or $w^2 - \pi\left(\frac{1}{2}w\right)^2 (= 10)$ oe		4	M1	oe a **correct** expression or a correct equation for the shaded area (must be in one unknown only) where d = diameter r = radius x = side of large square w = side of square when shape divided into 4
	$d = \sqrt{\frac{40}{4-\pi}} (= 6.826...)$ or $2d = \sqrt{\frac{160}{4-\pi}} (= 13.652\ldots)$ oe $r = \sqrt{\frac{40}{16-4\pi}} (3.413...)$ or $4r = \sqrt{\frac{640}{16-4\pi}} (= 13.652...)$ oe $x = \sqrt{\frac{40}{1-0.25\pi}} (13.652\ldots)$ or $w = \sqrt{\frac{10}{1-0.25\pi}} (= 6.826\ldots)$oe			M1	oe a correct expression for d or $2d$ or r or $4r$ or x or w
	(perimeter =) 8 × "6.826…" (8 × diameter(or side of small square when divided)) or 16 × "3.413..." (16 × radius) oe or 4 × "13.652…"(4 × side of square)			M1ft	dep on first M1 For substituting values into a calculation for the perimeter use of **their** r, d, x, w
		54.6		A1	54.4 - 54.7
					Total 4 marks

21	$\overrightarrow{OP} = 4\mathbf{a} + 2\mathbf{a} + 8\mathbf{b} (= 6\mathbf{a} + 8\mathbf{b})$ oe OR $\overrightarrow{PO} = -6\mathbf{a} - 8\mathbf{b}$ oe or $\overrightarrow{AB} = 6\mathbf{b} - 4\mathbf{a}$ oe OR $\overrightarrow{BA} = 4\mathbf{a} - 6\mathbf{b}$ oe or $\overrightarrow{BP} = 6\mathbf{a} + 2\mathbf{b}$ oe OR $\overrightarrow{PB} = -6\mathbf{a} - 2\mathbf{b}$ oe		5	M1 oe for one of $\overrightarrow{OP}$ or $\overrightarrow{PO}$ or $\overrightarrow{AB}$ or $\overrightarrow{BA}$ or $\overrightarrow{BP}$ or $\overrightarrow{PB}$ (may be seen as part of another vector calculation)
	$\overrightarrow{OQ} = 4\mathbf{a} + \lambda(6\mathbf{b} - 4\mathbf{a})$ oe OR $6\mathbf{b} + \mu(4\mathbf{a} - 6\mathbf{b})$ oe OR $x(6\mathbf{a} + 8\mathbf{b})$ oe or $\overrightarrow{BQ} = \mu(4\mathbf{a} - 6\mathbf{b})$ oe OR $-6\mathbf{b} + \lambda(6\mathbf{a} + 8\mathbf{b})$ oe OR $4\mathbf{a} - 6\mathbf{b} + x(6\mathbf{b} - 4\mathbf{a})$ oe or $\overrightarrow{AQ} = y(6\mathbf{b} - 4\mathbf{a})$ oe OR $-4\mathbf{a} + x(6\mathbf{a} + 8\mathbf{b})$ oe OR $6\mathbf{b} - 4\mathbf{a} + \mu(4\mathbf{a} - 6\mathbf{b})$ oe OR $2\mathbf{a} + 8\mathbf{b} + m(6\mathbf{a} + 8\mathbf{b})$ oe or $\overrightarrow{QP} = \lambda(6\mathbf{a} + 8\mathbf{b})$ oe OR $\mu(4\mathbf{a} - 6\mathbf{b}) + 2\mathbf{a} + 8\mathbf{b}$ oe			M1 for one of $\overrightarrow{OQ}$ or $\overrightarrow{QO}$ or $\overrightarrow{BQ}$ or $\overrightarrow{QB}$ or $\overrightarrow{AQ}$ or $\overrightarrow{QA}$ or $\overrightarrow{QP}$ or $\overrightarrow{PQ}$
				M1 for a second correct expression for the same vector OR for two correct expressions for parallel vectors eg 2 of $\overrightarrow{OQ}$, $\overrightarrow{OP}$, $\overrightarrow{QP}$ oe AND using ratios to form an equation in one variable that can lead to a solution eg $\overrightarrow{OQ} = 4\mathbf{a} + k(6\mathbf{b} - 4\mathbf{a})$ and $\overrightarrow{QP} = 2\mathbf{a} + 8\mathbf{b} - k(6\mathbf{b} - 4\mathbf{a})$ and $\frac{4-4k}{2+4k} = \frac{6k}{8-6k}$
	eg $\lambda = \frac{8}{17}$ or $\mu = \frac{9}{17}$ or $AQ:QB = \frac{4x}{3} : \frac{3x}{2}$ oe			A1 oe
		8 : 9		A1 oe
				Total 5 marks

22	(gradient AM =) $\frac{4-2}{-3-0}$ oe $(=-\frac{2}{3})$		7	M1	A correct method to find gradient of AM
	$y=\frac{3}{2}x+2$ or eg $\frac{y-2}{x}=\frac{3}{2}$ oe			M1	For the correct equation of the line passing through BD or for a correct expression involving the x and y coordinates of point B or point D
	$(x--3)^2+(y-4)^2=6.5^2$ or $(x-0)^2+(y-2)^2=6.5^2-[(-3-0)^2+(4-2)^2]$ oe eg $x^2+(y-2)^2=29.25$			M1	A correct equation in x and y to find the coordinates of B and D
	eg $x^2+6x+9+y^2-8y+16-42.25=0$ oe or $x^2+y^2-4y+4-29.25=0$ oe			M1	Brackets expanded
	eg $x^2+6x+9+\left(\frac{3}{2}x+2\right)^2-8\left(\frac{3}{2}x+2\right)+16-42.25=0$ $\left(\frac{2y-4}{3}\right)^2+y^2-4y+4-29.25=0$ oe			M1	For a correct substitution into a correct equation to get an equation in either x only or y only
	eg $\frac{13}{4}x^2=\frac{117}{4}$ or $13y^2-52y-211.25=0$ oe			M1	A fully correct simplified equation in x or in y – all brackets expanded and like terms grouped.
		(3, 6.5) (−3, −2.5)		A1	correct coordinates SCB3 for one pair of correct coordinates or both x values correct or both y values correct
					Total 7 marks

See next page for alternative scheme

22 **Alt** 1	$(AM=)\sqrt{3^2+2^2}\ (=\sqrt{13}=3.605...)$ or $(AM^2=)3^2+2^2(=13)$		7	M1	Use of Pythagoras for point *A* to point *M*
	$(BM=)\sqrt{6.5^2-"\sqrt{13}"^2}\ (=\sqrt{29.25}=\dfrac{3\sqrt{13}}{2}5.4083...)$			M1	A correct method to find the length of *BM* or *DM*
	$(\text{SF}=)\dfrac{\sqrt{29.25}}{\sqrt{13}}=\dfrac{3}{2}$ oe **or** $MN=x$, $BN=1.5x$ (*see diag*) or $(LAM=)\sin^{-1}\dfrac{3}{\sqrt{13}}(=56.3...)$ oe **or** $(LMA=)\cos^{-1}\dfrac{3}{\sqrt{13}}(=33.6...)$ **or**			M1	A correct method to find the SF of the enlargement of the sides *AM* to *BM* or angle *LAM* OR *LMA* 
	eg $\overrightarrow{MB}_x=\dfrac{3}{2}\times2$ or $\overrightarrow{MB}_y=\dfrac{3}{2}\times3$ or $\overrightarrow{MD}_x=-\dfrac{3}{2}\times2$ or $\overrightarrow{MD}_y=-\dfrac{3}{2}\times3$ oe or $x^2+\left(1.5x\right)^2=\sqrt{29.25}^2$ **or** $MN=\sqrt{29.25}\cos56.3...(=3)$ oe **or** $BN=\sqrt{29.25}\sin56.3...(=4.5)$ oe *turn over*			M1	A correct method to find the translation of at least one component of *MB* or *MD* (need not be written in vector form) OR correct Pythagoras statement using the SF to find *x* coordinates OR 1 correct trig statement to find translations from *M*
	$\overrightarrow{MB}_x=\dfrac{3}{2}\times2$ **and** $\overrightarrow{MB}_y=\dfrac{3}{2}\times3$ **or** $\overrightarrow{MD}_x=-\dfrac{3}{2}\times2$ **and** $\overrightarrow{MD}_y=-\dfrac{3}{2}\times3$ oe **or** $x^2+2.25x^2=29.25$ **or** $MN=\dfrac{3\sqrt{13}}{2}\cos56.309...(=3)$ **and** $BN=\dfrac{3\sqrt{13}}{2}\sin56.309...(=4.5)$ oe			M1	A correct method to find the translation of both components of *MB* or *MD* (need not be written in vector form) OR correct Pythagoras statement with no brackets using the SF to find *x* coordinates OR 2 correct trig statements to find translations from *M*

	eg (0, 2) is translated $\begin{pmatrix} 3 \\ 4.5 \end{pmatrix}$ or $(0+3,\ 2+4.5)$ (= (3, 6.5)) or (0, 2) is translated $\begin{pmatrix} -3 \\ -4.5 \end{pmatrix}$ or $(0-3,\ 2-4.5)$ (= (−3, −2.5)) oe **or** $3.25x^2 = 29.25$			M1 correct method to find the coordinates of *B* or *D* or one pair of correct coordinates or a correct method to find both *x* coordinates or both *y* coordinates OR a fully correct simplified equation in *x* all brackets expanded and like terms grouped.
		(3, 6.5) (−3, −2.5)		A1 correct coordinates SCB3 for one correct coordinate or both *x* values correct or both *y* values correct
				Total 7 marks

23	(i)		(180, 0)	1	B1
	(ii)		(360, −1)	1	B1
					Total 2 marks

24	eg $\frac{2\times3\times3\times(3^{\frac{3}{2}})^{4n+6}}{2\times3\times3^{2(2n+8)}}$ or $\frac{3\times3^{\frac{3}{2}(4n+6)}}{3^{2(2n+8)}}$ $\sqrt{27}$ to be changed to a power of 3 and not $3\sqrt{3}$ unless recovered		3	M1 For **2** of: • writing 18 as 2×3^2 oe **and** 6 as 2×3 **OR** cancelling 6 & 18 fully • writing $\sqrt{27}$ as $3^{\frac{3}{2}}$ or $3\times3^{\frac{1}{2}}$ **OR** $\left(\sqrt{27}\right)^{4n+6}$ as $\left(3^3\right)^{2n+3}$ or 3^{6n+9} • writing 9 as 3^2 **OR** 9^{2n+8} as $3^{2(2n+8)}$ or 3^{4n+16}
`	eg $\frac{3\times3^{6n+9}}{3^{4n+16}}$ or $\frac{3^{6n+10}}{3^{4n+16}}$ or $\frac{3\times3^{1.5(4n+6)}}{3^{2(2n+8)}}$ or $\frac{3^2\times3^{6n+9}}{3\times3^{4n+16}}$ or $\frac{3^{6n+11}}{3^{4n+17}}$ oe or eg $3^{6n+11}=3^x\times3^{4n+17}$ oe			M1 For a correct expression or equation using only powers of 3 (powers of 3 but not necessarily a single power)
		$2n-6$		A1 oe eg $2(n-3)$ dep on M1
				Total 3 marks

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