Mark Scheme (Results)

Summer 2022

Pearson Edexcel International GCSE
In Mathematics A (4MA1)
Paper 1HR

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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 question 6, 14, 21, 24 and 25, the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method					
Q	**Working**	**Answer**	**Mark**	**Notes**	
1 (a)		0.45	1	B1	oe eg $\frac{9}{20}, \frac{45}{100}, 45\%$
(b)	eg 1 – (0.25 + 0.2 + 0.2) (= 0.35) **or** 1 – ("0.45" + 0.2) (= 0.35) **or** $300\times(0.25+0.2+0.2)(=195)$		3	M1	allow use of their "0.45" from part (a), check the table
	eg 300 × "0.35" **or** $300-"195"$			M1	for a complete method
		105		A1	cao (award $\frac{105}{300}$ M2 only)
					Total 4 marks

2 (a)	eg 6 × 2.4 + 5 × 3.5		2	M1	
		31.9		A1	oe
(b)	(W =) 5.9n **or** (W =) 5.9(n – 1) + 2.4 **or** (W =) 2.4n + 3.5(n − 1)		2	M1	for 2.4n + 3.5n or 5.9n seen
		5.9n – 3.5		A1	oe but must be in simplest form eg –3.5 + 5.9n
					Total 4 marks

3	5×12 (= 60) **or** $\frac{15+7-2+23+x}{5} = 12$ oe **or** $\frac{x+"43"}{5} = 12$		3	M1	for a method to find the total of the 5 numbers **or** setting up an equation in x "43" comes from 15 + 7 – 2 + 23
	x + 15 + 7 – 2 + 23 = "60" **or** x + "43" = "60" **or** "60" – (15 + 7 – 2 + 23)			M1	for forming an equation with their 60 **or** for a complete calculation to find the value of x "43" comes from 15 + 7 – 2 + 23
		17		A1	
					Total 3 marks

4	eg 0.45×180 (= 81) oe **OR** $\frac{15}{180}\left(=\frac{1}{12}\text{ or }0.0833...\right)$ **OR** $\frac{15}{180}\times 100\left(=8.3(33...)\%\right)$		4	M1	for a method to find the number of students studying German **OR** the number of students studying French as a fraction or decimal of the total students **OR** a method to find the percentage of students studying French 81 may be seen as part of an equation
	eg 180 – 15 – "81" (= 84) **or** "81" + 15 (= 96) **OR** $1-\left(\frac{1}{12}+\frac{45}{100}\right)=\left(\frac{7}{15}\text{ or }0.466...\right)$ **or** $\frac{1}{12}+\frac{45}{100}=\left(\frac{8}{15}\text{ or }0.533...\right)$ **OR** 100 – ("8.3" + 45) (= 46.6(66…) or 46.7%) **or** "8.3" + 45 (= 53.3(33…) or 53.3%)			M1	for a method to find the number of students studying Italian/Spanish **or** French/German **OR** a method to find the fraction or decimal of students studying Italian/Spanish **or** French/German **OR** a method to find the percentage of students studying Italian/Spanish **or** French/German 84 or 96 may be seen as part of an equation
	eg $\frac{"84"}{180-"84"}(\times 100)\left(=\frac{7}{8}\text{ or }0.875\right)$ **or** $\frac{"84"}{"96"}(\times 100)\left(=\frac{7}{8}\text{ or }0.875\right)$ **or** $"\frac{7}{15}"\div"\frac{8}{15}"\left(=\frac{7}{8}\text{ or }0.875\right)$ **or** $\frac{"46.6"}{"53.3"}(\times 100)(=0.872...)$			M1	for a complete method to find the fraction or decimal or percentage of Italian/Spanish to French/German
		87.5		A1	accept 87.2 – 87.7
					Total 4 marks

5	(a)		$3c^4+12c^3$	2	B2	for $3c^4+12c^3$ (B1 for $3c^4$ or $12c^3$)
	(b)(i)			2	M1	for $(x\pm9)(x\pm1)$ **or** for $(x+a)(x+b)$ with $ab=-9$ or $a+b=8$
			$(x+9)(x-1)$		A1	for correct factors
	(ii)		$-9,\ 1$	1	B1	ft dep on factorising in the form $(x+p)(x+q)$
						Total 5 marks

6	$\frac{8}{3}(+)\frac{15}{4}$ **or** $(2)\frac{8}{12}(+)(3)\frac{9}{12}$ **or** $(2)\frac{8a}{12a}(+)(3)\frac{9a}{12a}$		3	M1	for correct improper fractions **or** fractional part of numbers written correctly over a common denominator
	eg $\frac{8\times4+15\times3}{3\times4}$ **or** $\frac{32}{12}+\frac{45}{12}$ **or** $\frac{32a}{12a}+\frac{45a}{12a}$ **or** $2\frac{8}{12}+3\frac{9}{12}=5\frac{17}{12}$ oe			M1	for correct fractions with a common denominator of 12 or a multiple of 12
	$\frac{32}{12}+\frac{45}{12}=\frac{77}{12}=6\frac{5}{12}$ **or** $5\frac{17}{12}=6\frac{5}{12}$ **or** if shows $6\frac{5}{12}=\frac{77}{12}$ at the beginning then show that the addition comes to $\frac{77}{12}$	Shown		A1	dep on M2 for a correct answer from fully correct working **or** shows that RHS = $\frac{77}{12}$ **and** fully correct working shows LHS = $\frac{77}{12}$
					Total 3 marks

7	eg (V=) $\pi \times \left(\frac{18}{2}\right)^2 \times 3.5$ (= 890.(64…) or $\frac{567}{2}\pi$)		3	M1	correct method to calculate volume
	eg (7.04 × 1000) ÷ "890.64"			M1	correct method to calculate density (if volume is incorrect, their value can be used if clearly labelled) accept use of 7.04 or an incorrect conversion from kg to g for mass
		7.9		A1	accept 7.9 − 7.92
					Total 3 marks

8	18000×0.15 (= 2700) oe **or** 18000×0.85 (= 15 300) oe		3	M1	for finding 15% or 85% of 18 000	M2 for 18000×0.85^4 oe **or** 18000×0.85^5 (= 7986.(69…)) oe
	eg 18000×0.85^4 oe **or** "15300" $\times 0.85 \times 0.85 \times 0.85$ oe **or** "15300" $\times 0.85$ (= 13005) oe **and** "13005" $\times 0.85$ (= 11054.25) oe **and** "11054.25" $\times 0.85$ oe			M1	(dep) for a complete method	
		9396		A1	awrt 9396	
					If no marks awarded, award SCB1 for **or** 18000×0.85^2 (= 13 005) oe **or** 18000×0.85^3 (= 11 054.(25)) oe **or** 18 000 × 0.4 (= 7200) oe **or** 18 000 × 1.15 (= 20700) oe **or** 18 000 × 1.15^4 (= 31482.(1125)) oe	
						Total 3 marks

9	$-4x \le 11-3$ **or** $-4x \le 8$ **or** $-x \le 2$ **or** $3-11 \le 4x$ **or** $-8 \le 4x$		2	M1	allow equals sign or condone incorrect inequality sign for M1 only
		$x \ge -2$		A1	allow $-2 \le x$ SCB1 for x and -2 with an incorrect sign between them or -2 as an answer
					Total 2 marks

10	$3 \div 2$ (=1.5 or $\frac{3}{2}$) **or** eg $\frac{5--1}{4(-0)}$ **or** $c = -1$		3	M1	for correct method to find gradient or the correct value of c for gradient, may see a correct calculation **or** $\frac{3}{2}$ oe **or** $1.5x$ (+ c) oe for value of c, allow $c = -1$, $y = -1$, (L =) $mx - 1$ oe
	$y =$ "1.5"x (+ c) **or** $y = mx - 1$ **or** eg $y - 5 = m(x - 4)$			M1	for use of $y = mx + c$ with either m or c correct (NB: $m \neq 0$) **or** for (L =) $1.5x - 1$ oe
		$y = \frac{3}{2}x - 1$		A1	oe eg $y = 1.5x - 1$
					Total 3 marks

11	$(AB^2 =)\ 7.5^2 - 6^2\ (=\ 20.25)$ **or** eg $(BAC =)\sin^{-1}\left(\frac{6}{7.5}\right)(=53.1...)$ **or** $\cos(BCA) = \frac{6}{7.5}(=0.8)$		6	M1	for a correct first step to find *AB* **or** a complete method to find angle *BAC* **or** a correct first step to find angle *BCA*
	$(AB =)\ \sqrt{7.5^2 - 6^2}\ (=4.5)$ **or** $(AB =)\frac{6}{\tan"53.1"}(=4.5...)$ **or** $(AB =)7.5\cos"53.1"(=4.5...)$ **or** $(BCA =)\cos^{-1}\left(\frac{6}{7.5}\right)(=36.8...)$			M1	for a complete method to find *AB* **or** angle *BCA*
	(Area *ABC* =) $\frac{1}{2}\times 6\times"4.5"$ (= 13.5) **or** $(\text{Area } ABC =)\frac{1}{2}\times 6\times 7.5\times\sin("36.8")(=13.47...\text{ or } 13.5)$			M1	ft [their labelled *AB*] or [their labelled *BCA*] eg for $\frac{1}{2}\times 6\times$[their labelled *AB*] **or** $\frac{1}{2}\times 6\times 7.5\times\sin$[their labelled *BCA*]
	(Area *DAC* =) 31.5 – "13.5" (= 18) **or** "13.5" + 0.5 × 7.5 × *AD* = 31.5 oe			M1	ft (dep on previous M1) allow 31.5 – [their area]
	(*AD* =) ("18" ÷ 7.5) ÷ 0.5 oe			M1	for a complete method to find *AD*, dependent on correct working
		4.8		A1	accept 4.78 – 4.81
					Total 6 marks

12	(a)		$3^2\times 5\times 7$	1	B1	accept 3 × 3 × 5 × 7 oe or 315
	(b)		$3^{11}\times 5^7\times 7^5$	2	B2	fully correct answer (allow $x = 11$, $y = 7$, $z = 5$) (B1 for an answer in the form $3^p\times 5^q\times 7^r$ where one or two of *p*, *q* or *r* are correct)
						Total 3 marks

13	12 (−) 3		2	M1	for both values unambiguously identified
		9		A1	
					Total 2 marks

14	**Elimination** eg $9x-15y=75$ $20x+15y=70$ + $(29x=145)$ or $12x-20y=100$ $12x+9y=42$ − $(-29y=58)$	**Substitution** eg $4\left(\frac{25+5y}{3}\right)+3y=14$ or $4x+3\left(\frac{25-3x}{-5}\right)=14$ or $3\left(\frac{14-3y}{4}\right)-5y=25$ or $3x-5\left(\frac{14-4x}{3}\right)=25$		4	M1	for a correct method to eliminate x or y: coefficients of x or y the same **and** correct operation to eliminate selected variable (condone 1 arithmetical error) **or** for correctly writing x or y in terms of the other variable and correctly substituting
					A1	dep on M1 for $x = 5$ **or** $y = -2$
	eg $3x - 5 \times$ "−2" = 25 **or** $4x + 3 \times$ "−2" = 14 **or** $3 \times$ "5" $- 5y = 25$ **or** $4 \times$ "5" $+ 3y = 14$				M1	dep on M1 for substitution of found variable **or** repeating the steps in first M1 for the second variable
		$x = 5$ $y = -2$			A1	cao, dep on M1 a correct answer without working scores no marks
						Total 4 marks

15	$PRS = 90$ **or** $PQS = 90$ **or** $PSR = 180 - 136$ (= 44)		3	M1	may be seen on diagram. Must be labelled on diagram or identified using 3 letter notation.
	$RPS = 180 - 90 -$ "44" oe **or** $RQS = 136 - 90$ (= 46)			M1	for a complete method
		46		A1	
					Total 3 marks

16 (a)	$(3x-1)(x+2)=3x^2+6x-x-2(=3x^2+5x-2)$ **or** $(3x-1)(3x+1)=9x^2+3x-3x-1(=9x^2-1)$ **or** $(x+2)(3x+1)=3x^2+x+6x+2(=3x^2+7x+2)$		3	M1	for a correct intention to multiply all 3 factors by multiplying 2 factors only, allow one error
	$[(3x^2+5x-2)(3x+1)=]\ 9x^3+15x^2-6x+3x^2+5x-2$ **or** $[(9x^2-1)(x+2)=]\ 9x^3+18x^2-x-2$ **or** $[(3x^2+7x+2)(3x-1)=]\ 9x^3+21x^2+6x-3x^2-7x-2$			M1	(dep)ft for expanding by the third factor, allow one error
		$9x^3+18x^2-x-2$		A1	
	ALTERNATIVE				
	$9x^3+3x^2+18x^2+6x-3x^2-x-6x-2$		3	M2	for a complete expansion with 8 terms present, at least 4 of which must be correct
		$9x^3+18x^2-x-2$		A1	
(b)	$\left(\frac{8xy^2}{2x^5}\right)^2$ **or** $\left(\frac{x^4}{4y^2}\right)^{-2}$ **or** $\left(\frac{4x^{10}}{64x^2y^4}\right)^{-1}$		3	M1	for one of reciprocating or simplifying or squaring
	$\left(\frac{4y^2}{x^4}\right)^2$ **or** $\left(\frac{x^8}{16y^4}\right)^{-1}$ **or** $\frac{64x^2y^4}{4x^{10}}$ **or** $\frac{\frac{1}{4}x^{-10}}{\frac{1}{64}x^{-2}y^{-4}}$			M1	for two of reciprocating or simplifying or squaring
		$\frac{16y^4}{x^8}$		A1	accept $16y^4x^{-8}$ or $\frac{16}{y^{-4}x^8}$ or $\frac{16x^{-8}}{y^{-4}}$ oe
	ALTERNATIVE				
			3	M2	for 2 correct terms (M1 for 1 correct term)
		$\frac{16y^4}{x^8}$		A1	accept $16y^4x^{-8}$ or $\frac{16}{y^{-4}x^8}$ or $\frac{16x^{-8}}{y^{-4}}$ oe
					Total 6 marks

17	(area PQS =) $\frac{1}{2}\times 6.1\times 3.8\times \sin P = 9$ **or** (area $PQRS$ =) $6.1\times 3.8\times \sin P = 18$	$\frac{1}{2}\times 6.1\times SX = 9$ **or** $(SX =)\frac{9}{\frac{1}{2}\times 6.1}(=2.95...)$ **or** $6.1\times SX = 18$ **or** $(SX =)18\div 6.1(=2.95...)$		5	M1	correct equation for the area of the triangle or parallelogram **or** a calculation to find the height of the parallelogram (where X is the point vertically below S on PQ)
	eg (sin P =) $\frac{9}{\frac{1}{2}\times 6.1\times 3.8}\left(=0.776... \text{ or } \frac{900}{1159}\right)$ **or** (sin P =) $\frac{18}{6.1\times 3.8}\left(=0.776... \text{ or } \frac{900}{1159}\right)$	$(PX^2 =)3.8^2-"2.95..."^2(=5.73...)$ **or** $(PX =)\sqrt{3.8^2-"2.95..."^2}(=2.39...)$			M1	correct expression for sin P **OR** for start of Pythagoras method to find length of PX (where X is the point vertically below S on PQ)
	$(P =)\ \sin^{-1}"0.776..."\ (=50.9...)$	$(QX =)6.1-\sqrt{"5.73"}(=3.70...)$ **or** $(QX =)6.1-"2.39"(=3.70...)$			M1	for complete method to find angle P **OR** for method to find length of QX
	$(QS^2 =)3.8^2+6.1^2-2\times 3.8\times 6.1\times\cos("50.9")\ (=22.4...)$ **or** $(QS =)\sqrt{3.8^2+6.1^2-2\times 3.8\times 6.1\times\cos("50.9")}$	$(QS^2 =)"2.95..."^2+"3.70..."^2(=22.4...)$ **or** $(QS =)\sqrt{"2.95..."^2+"3.70..."^2}$			M1	correct expression for QS^2 (or QS)
			4.74		A1	accept 4.73 − 4.74
						Total 5 marks

18	eg $(BV^2 =)3^2+6^2(=45)$ **or** $(CT^2 =)3^2+6^2(=45)$ **or** $(DH^2 =)\ 6^2 + 6^2\ (= 72)$ **or** $(MV^2 =)3^2+3^2(=18)$		4	M1	a correct expression for eg BV^2 **or** CT^2 **or** DH^2 **or** MV^2 where M is the midpoint of DC **or** a correct expression for [length]^2 for any length in the cube using Pythagoras	M3 for $(VT =)\sqrt{6^2+3^2+3^2}$ $(=3\sqrt{6}$ or 7.34...) (M2 for $(VT^2 =)$ $6^2+3^2+3^2\ (=54)$)
	eg $(BV =)\sqrt{3^2+6^2}\ \left(=\sqrt{45}\text{ or }3\sqrt{5}\text{ or }6.70...\right)$ **or** $(CT =)\sqrt{3^2+6^2}\ \left(=\sqrt{45}\text{ or }3\sqrt{5}\text{ or }6.70...\right)$ **or** $(DH =)\sqrt{6^2+6^2}\ \left(=\sqrt{72}\text{ or }6\sqrt{2}\text{ or }8.48...\right)$ **or** $(MV =)\sqrt{3^2+3^2}\ \left(=\sqrt{18}\text{ or }3\sqrt{2}\text{ or }4.24...\right)$			M1	for a complete method for eg BV **or** CT **or** DH **or** MV **or** any length in the cube using Pythagoras	
	$(VT =)\ \sqrt{"45"+3^2}$ **or** $\sqrt{\left(\frac{"\sqrt{72}"}{2}\right)^2+6^2}$ **or** $\sqrt{"18"+6^2}$ **or** $3\sqrt{6}$ **or** 7.34...			M1	for a correct expression for VT (condone missing brackets around $3\sqrt{5}$ or $3\sqrt{2}$ or $\frac{\sqrt{72}}{2}$)	
		$\sqrt{54}$		A1	if $\sqrt{54}$ seen and answer then given as $3\sqrt{6}$ isw and award full marks	
						Total 4 marks

19	eg (7.5+2.5) − 6 = 4 large squares represents 8 trees **or** 5 × 37.5 + 5 × 12.5 – 10 × 15 = 100 small squares represents 8 trees 200 – 250 = 10 250 – 300 = 8 300 – 400 = 12 400 – 450 = 15 450 – 600 = 15 (or 450 – 500 = 5 or 500 – 600 = 10) 600 – 800 = 4		3	M1	oe eg 1 large square represents 2 trees **or** 12.5 small squares represents 1 tree **or** a frequency density axis scale where one large square vertically is FD of 0.04 with no contradictions **or** a correct frequency for any bar (could be seen on the diagram)
	5 × 2 + 2 × 2 **or** $\frac{10\times12.5+20\times2.5}{100}\times8$ oe **or** 100 × 0.1 + 200 × 0.02			M1	for a correct method to find the total number of trees greater than 500 cm.
		14		A1	
					Total 3 marks

20	(Length sf =) $\sqrt[3]{0.8}(=0.928...)$ **or** $\sqrt[3]{1.25}(=1.07...)$ **or** $\sqrt[3]{4}:\sqrt[3]{5}$ oe		4	M1	for a correct linear scale factor
	(Area sf =) $\left(\sqrt[3]{0.8}\right)^2$ $(=0.861...)$ **or** 86.1...(%) **or** $\left(\sqrt[3]{1.25}\right)^2$ $(=1.16...)$ **or** 116...(%) **or** $\left(\sqrt[3]{4}\right)^2:\left(\sqrt[3]{5}\right)^2$ oe			M1	for a correct area scale factor
	eg (k =) $(1-"0.861...")\times 100$ **or** (100 – "86.1...") **or** $100-\frac{100}{"1.16"}$ **or** $100-\frac{100}{"116"}\times 100$ **or** $100-100\times\frac{\left(\sqrt[3]{4}\right)^2}{\left(\sqrt[3]{5}\right)^2}$			M1	for a method to find the percentage reduction
		13.8		A1	accept 13.7 – 13.9
					Total 4 marks

21	$(\sqrt{2}-1)^2 = 2-\sqrt{2}-\sqrt{2}+1\left(=3-2\sqrt{2}\right)$	$\frac{(3+\sqrt{8})}{(\sqrt{2}-1)^2}\times\frac{(\sqrt{2}+1)^2}{(\sqrt{2}+1)^2}$		4	M1	expand the denominator (accept $2-2\sqrt{2}+1$ - must see expansion) **OR** method to rationalise using $(\sqrt{2}+1)^2$
	$\frac{\left(3+\sqrt{8}\right)}{"\left(3-2\sqrt{2}\right)"}\times\frac{\left(3+2\sqrt{2}\right)}{\left(3+2\sqrt{2}\right)}$	$(\sqrt{2}-1)^2 = 2-\sqrt{2}-\sqrt{2}+1\left(=3-2\sqrt{2}\right)$ **or** $(\sqrt{2}+1)^2 = 2+\sqrt{2}+\sqrt{2}+1\left(=3+2\sqrt{2}\right)$ **or** $(\sqrt{2}-1)(\sqrt{2}+1) = 2-\sqrt{2}+\sqrt{2}-1\left(=1\right)$			M1	oe ft $3-2\sqrt{2}$ method to rationalise **OR** expansion of $(\sqrt{2}-1)^2$ (accept $2-2\sqrt{2}+1$) **or** $(\sqrt{2}+1)^2$ (accept $2+2\sqrt{2}+1$) **or** $(\sqrt{2}-1)(\sqrt{2}+1)$
	eg $\frac{9+6\sqrt{2}+3\sqrt{8}+8}{9-6\sqrt{2}+6\sqrt{2}-8}$ **or** $\frac{9+12\sqrt{2}+8}{9-8}$ **or** $\frac{9+6\sqrt{2}+3\sqrt{8}+8}{1}$ **or** $\frac{9+12\sqrt{2}+8}{1}$				M1	dep on 2nd M1 correct expansion of brackets
			$17+\sqrt{288}$		A1	or p =17, q =288 answer from fully correct working with intermediate steps of working seen
						Total 4 marks

22	(a)	$\left(\frac{dy}{dx} =\right) 2x + px^{-2}$ oe		4	M2	Both terms correct (M1 for one term correct)
		$2(-3) + p(-3)^{-2} (= 0)$			M1	(dep on M1) substitute -3 into a derivative of the form $ax + bx^{-2}$
			54		A1	
	(b)	$\left(\frac{dy}{dx} =\right) 2x + 16x^{-2} = 0$		3	M1	set $\frac{dy}{dx} = 0$, at least one term correct
		eg $2x^3 + 16 = 0$ **or** $2x^3 = -16$ **or** $x^3 = -8$ **or** $x = \sqrt[3]{-8}$ **or** $x = -2$			M1	rearrangement of the correct equation to remove the negative power of x
			12		A1	
						Total 7 marks

23	(a)	$2(x^2 - 6x) + 3$ **or** $2(x^2 - 6x + \frac{3}{2})$		3	M1	**or** for one of a, b or c correct **OR** expanding $a(x^2 + 2bx + b^2) + c$
		$2\left[(x-3)^2 - 9\right] + 3$ **or** $2\left[(x-3)^2 - 3^2 + \frac{3}{2}\right]$ oe			M1	**or** for two of a, b or c correct **OR** $-12 = 2ab$ **or** $3 = ab^2 + c$
			$2(x-3)^2 - 15$		A1	accept $a = 2$, $b = -3$, $c = -15$
	(b)		$(-1, -15)$	2	B2ft	eg accept [their $-b - 4$] for the x-coordinate or [their c] for the y-coordinate (B1 ft for one correct coordinate)
						Total 5 marks

24	$\frac{5}{x}\times\frac{(x-4)}{x}$ oe **or** $\frac{(x-5)}{x}\times\frac{6}{x}$ oe		5	M1	for a correct expression for P(R,G) or P(G,R)
	$\frac{5}{x}\times\frac{(x-4)}{x}$ + $\frac{(x-5)}{x}\times\frac{6}{x}$ oe			M1	for a correct expression for P(R,G) + P(G,R)
	$19x^2 - 352x + 1600$ (= 0) oe **or** $19x^2 - 352x = -1600$ oe			M1	for a correct equation in the form $ax^2 + bx + c$ (= 0) oe **or** $ax^2 + bx = -c$ oe
	$(x - 8)(19x - 200)$ (= 0) **or** $(x=)\frac{--352\pm\sqrt{(-352)^2-(4\times19\times1600)}}{2\times19}$ **or** $19\left[\left(x-\frac{176}{19}\right)^2-\left(\frac{176}{19}\right)^2\right]+1600(=0)$			M1	for solving their 3-term quadratic equation using any correct method - if factorising, allow brackets which expanded give 2 out of 3 terms correct (if using formula or completing the square allow one sign error and some simplification – allow as far as $\frac{352\pm\sqrt{123904-121600}}{38}$ oe **or** $19\left(x-\frac{176}{19}\right)^2-\frac{576}{19}(=0)$ oe)
		8		A1	cao, dep on M2. Do not award if non−integer solution also given. 8 must come from correct working.
					Total 5 marks

25	$(S_{10}=)\frac{10}{2}(2a+9d)$ **or** $(S_5=)\frac{5}{2}(2a+4d)$ oe **or** $a+7d=45$		5	M1	for a correct expression for the sum of the first 10 terms (S_{10}) or the first 5 terms (S_5) **or** a correct equation for the 8^{th} term Take 9 as their 10 – 1 and 4 as their 5 – 1 and 7 as their 8 – 1
	$\frac{10}{2}(2a+9d)=4\times\frac{5}{2}(2a+4d)$ oe			M1	for a correct equation relating S_{10} and S_5
	eg $d = 2a$ oe **or** $a=\frac{d}{2}$ oe **or** $a + 7d = 45$ oe **and** eg $10a – 5d = 0$ oe **or** eg $\frac{10}{2}(2(45-7d)+9d)=4\times\frac{5}{2}(2(45-7d)+4d)$ oe **or** $5d = 10(45 – 7d)$ oe			M1	(dep on M1) for d in terms of a, or vice-versa (must be correct) **or** for $a + 7d = 45$ oe **and** correctly reducing the equation relating S_{10} and S_5 to an equation with one term in a and one term in d eg $10a – 5d = 0$ oe **or** substituting a correct expression into their correct equation to obtain an equation in just d
	eg $a+7(2a)=45$ **or** $d = 6$ **or** eg $70a-35d=0$ $5a+35d=225$ + $(75a=225)$ or $10a-5d=0$ $10a+70d=450$ – $(-75d=-450)$			M1	(dep on M2) for a correct equation in just a **or** for $d = 6$ **or** for a correct method to eliminate a or d: coefficients of a or d the same **and** correct operation to eliminate selected variable (condone 1 arithmetical error)
		3		A1	Dep on M3
					Total 5 marks

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