Mark Scheme (Results)

November 2023

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
- 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 mark the one that leads to the answer on the answer line. If there is no answer given then mark the method that gives the lowest mark and award this mark.
  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.

International GCSE Maths

Apart from questions 4a, 6, 14, 15ab, 17, 21, 22b, 23, 24 (where the mark scheme states otherwise) the correct answer, unless clearly obtained from an incorrect method, should be taken to imply a correct method.

Question	Working	Answer	Mark	Notes
1 (a)		$25 < m \leqslant 30$	1	B1 Allow $25 < m < 30$ or 25 – 30 oe
(b)	$2.5 \times 8 + 7.5 \times 2 + 12.5 \times 6 + 17.5 \times 4 + 22.5 \times 12 + 27.5 \times 18$ (= 20 + 15 + 75 +70 + 270 + 495) [total using lower boundary = 820 (gains M1] [total using upper boundary = 1070 (gains M1)]		3	M2 For correct products using midpoints (allowing one error) with intention to add. M1 for products using frequency and a consistent value within the range (allowing one error) with intention to add or correct products using midpoint without addition.
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	945		A1 An answer of 18.9 gains M2 only [mean from lower boundary = 16.4 (M1)] [mean from upper boundary = 21.4 (M1)]
				Total 4 marks

Question	Working	Answer	Mark	Notes
2	$10^2 - 8^2 (=36)$ or $8^2 + BC^2 = 10^2$ oe or $\cos BAC = \dfrac{8}{10}$ (BAC =36.869…)		4	M1
	$\sqrt{10^2 - 8^2}\,(=6)$ or tan”36.869…” × 8 (= 6) or sin”36.869…” × 10 (= 6)			M1 (beware that 14 – 8 = 6 has been seen and scores zero)
	$w = \sqrt{(5 + "6")^2 + 14^2}\ \left(= \sqrt{317}\right)$ or $EDC = \tan^{-1}\left(\dfrac{5 + "6"}{14}\right) (= 38.157)$ **and** $w = \dfrac{"11"}{\sin 38.157...}$ or $w = \dfrac{14}{\cos 38.157...}$ or $CED = \tan^{-1}\left(\dfrac{14}{"11"}\right) (= 51.84...)$ **and** $w = \dfrac{11}{\cos 51.84...}$ or $w = \dfrac{14}{\sin 51.84...}$			M1ft Allow use of ***their*** value of *BC*
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	17.8		A1 awrt 17.8 if no other marks scored then B1 for 22.6(5…)
				Total 4 marks

WATCH OUT FOR $\sqrt{10^2 + 8^2}\,(12.8...) + 5 = 17.8$ (which is the same as the answer….but a completely wrong method)

Question		Working	Answer	Mark	Notes	
3	(a)	(4, 2), (4, 3), (5, 3), (5, 4), (6, 4), (6, 1), (5, 1), (5, 2)	Correct shape	2	B2	For the correct shape with all 8 points correct (B1 for the line $y = x$ drawn or a shape of the correct orientation and size anywhere on the grid)
	(b)	Enlarged, enlarge etc	Enlargement	3	B1	With no mention of any other transformation words or turn, move, flip, transform, up, right ….etc
		3 or ×3 or tripled or three or three times (**not** three times smaller)	(Scale factor) 3		B1	Allow ×3 or 3 times bigger or tripled (do not allow –3)
		No need for ‘centre’ Do not allow a column vector for coordinates.	(Centre) (7, 2)		B1	Just coordinates needed – allow without brackets
						Total 5 marks

Question	Working	Answer	Mark		Notes
4 (a)	$2x + 5 = 6(2x - 5)$ or $2x + 5 = 12x - 30$ or $\frac{2}{6}x + \frac{5}{6} = 2x - 5$ oe (allow $0.33x + 0.83 = 2x - 5$)		3	M1	For multiplying both sides by 6 or separating values in fraction correctly in an equation. (decimals 2 dp or better)
	$2x - 12x = -30 - 5$ or $-10x = -35$ or $5 + 30 = 12x - 2x$ or $35 = 10x$ oe or $\frac{5}{6} + 5 = 2x - \frac{1}{3}x$ oe or $1\frac{2}{3}x = 5\frac{5}{6}$ oe			M1ft	For collecting the terms in x on one side and the number terms on the other side. ft from incorrect expansion dep on a number term and a term in x on both sides.
	Working required	3.5		A1	dep on M1 oe eg $\frac{7}{2}$ or $3\frac{1}{2}$
(b)		h^{12}	1	B1	Allow x^{12} or another letter to the power 12 but do not allow just 12
(c)	*Working not required, so correct answer scores full marks (unless from obvious incorrect working)*	$16g^{12}k^{20}$	2	B2	B1 for 2 terms correct in a product [must be 16 and not 2^4]
(d)	eg $\frac{y^n}{y^2} = y^{12}$ or $y^{-2} \times y^n = y^{12}$ or $y^5 \times y^{n-7} = y^{12}$ or $\frac{y^{5+n}}{y^7} = y^{12}$ $y^5 \times y^n = y^{19}$ or $y^{5+n-7} = y^{12}$ or $\frac{y^5}{y^{7-n}} = y^{12}$ or $y^{5+n} = y^{12+7}$ or $5 + n - 7 = 12$ oe		2	M1	for one correct application of an index rule (must be seen in powers of y) this could be after an initial mistake – working will need to be clearly seen **or** for a **correct** equation in n (no mistakes allowed)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	14		A1	Allow y^{14}
					Total 8 marks

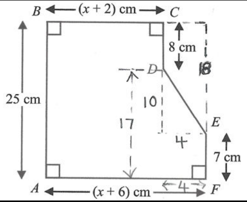
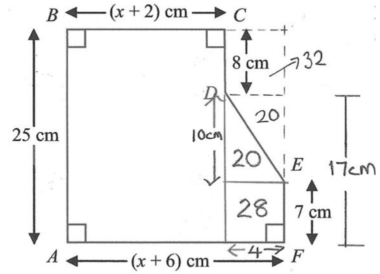
Question	Working	Answer	Mark	Notes
5	eg (one share of the ratio =)120 ÷ 2 (= 60) **or** $120\times\frac{3}{2}(=180)$ **or** 180 (g)[butter] **or** 180 : 120 **or** for writing the 3 parts of the ratio correctly eg 18 : 15 : 10 (or 18 : 15 and 15 : 10 or S : F = 18 : 10) oe eg 3.6 : 3 : 2		3	M1 For finding the value of one share or For a fully correct calculation for amount of butter or stating 180 (g) butter – may be shown in a ratio – does not need to be labelled if it is clear that the number or calculation refers to the amount of butter
	(3 × "60" ÷ 5) × 6 oe **or** $\frac{f}{\text{"180"}}=\frac{6}{5}$ **or** $\frac{18}{10}\times120$ oe eg or $\frac{120}{10}\times18$ oe or $\frac{3.6}{2}\times120$ oe			M1 For a correct calculation to find the amount of flour Avril uses or a correct equation involving flour that if rearranged correctly would give the correct answer (award the M2 for 216 : 180 : 120 not labelled)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	216		A1 or flour = 216 or eg s = 120, b = 180, f = 216 (but flour must be clearly labelled)
				Total 3 marks

Question	Working	Answer	Mark	Notes
6	eg $\frac{24}{7}$ **and** $\frac{8}{3}$		3	M1 for both mixed numbers expressed as improper fractions
	eg $\frac{24}{7}\times\frac{3}{8}$ oe **or** $\frac{72}{21}\div\frac{56}{21}$ oe			M1 (assumes previous M1) for inverting the 2nd fraction and showing intention to multiply or writing both fractions correctly over the same common denominator with division
	eg $\frac{24}{7}\times\frac{3}{8}=\frac{72}{56}=\frac{9}{7}=1\frac{2}{7}$ **or** $\frac{24}{7}\times\frac{3}{8}=\frac{72}{56}=1\frac{16}{56}=1\frac{2}{7}$ **or** $\frac{\cancel{24}^{3}}{7}\times\frac{3}{\cancel{8}^{1}}=\frac{9}{7}=1\frac{2}{7}$ **or** $\frac{24}{7}\div\frac{8}{3}=\frac{72}{21}\div\frac{56}{21}=\frac{72}{56}=\frac{9}{7}=1\frac{2}{7}$ **or** correct working to $\frac{9}{7}$ **and** writing $1\frac{2}{7}=\frac{9}{7}$ (possibly in first line of working)	Shown		A1 dep on M2 for conclusion to $1\frac{2}{7}$ from correct working – either sight of result of multiplication eg $\frac{72}{56}$ must be seen or correct cancelling to $\frac{9}{7}$ or complete method using division and common denominators Note: do not award the use of decimals any marks, but allow this as a check of work in fractions.
				Total 3 marks

Question	Working	Answer	Mark	Notes	
7	26 800 × 0.08 oe (= 2144) **or** 26 800 × 0.92 oe (= 24 656)		3	M1 for finding 8% or 92% of the value	OR M2 for 26 800 × $(1 – 0.08)^3$ or M2 for 26 800 × 0.92^4 or 19 199… (M1 for 26 800 × 0.92^2 or 22 683….)
	0.92 × "24 656" (= 22 683.52) 0.92 × "22 683.52" or 0.08 × (26800 – 2144) = 1972.48 0.08 × (24656 – 1972.48) = 1814.6816 22683.52 – 1814.6816 (= 20868.8384)			M1 for completing method	
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	20 869		A1 20 868 to 20 869 (inclusive) (SCB1 for 26 800 × 1.08^3 (= 33760….) or 26 800 × 0.08 × 3 (= 6432)) or 26800 – 3 × 2144 (= 20368)	
				Total 3 marks	

Question	Working	Answer	Mark	Notes	
8	8 × 6 (= 48) or 10 × 7 (= 70)		3	M1	M2 for a correct equation in k that if rearranged correctly should give the correct answer eg $\frac{48+2k}{10}=7$ or allow for $\frac{48+x}{10}=7$ (use of mean increased by 1 so) 8 + 7 + 7 (= 22) oe
	"70" – "48"(= 22) oe eg $\frac{8\times 6+22}{10}=7$ oe			M1	
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	11		A1	
					Total 3 marks

Question	Working	Answer	Mark	Notes
9		$y = 1.5x - 3$	2	B2 oe accept $y = 1.5x + -3$ oe B1 for $y = 1.5x + c$ (where c can be zero) or $y = mx - 3$ (where m is any value but $m \neq 0$ or 1.5) or $1.5x - 3$ or Gradient = 1.5 oe eg $m = \frac{3}{2}$ or a clear calculation for gradient oe (must be labelled or the meaning shown by their diagram or working)
				Total 2 marks

Q	Working	An	Mark	Notes
10	 4 from F to left, vertically below D 17 from D vertically down to left of F 10 from D vertically to left of E 18 vertically up from E to right of C		5	B1 for a length of 4 (cm) or 17 (cm) or 25 – 7 – 8 (=10 (cm)) or 18 (cm) in the correct place on the diagram or calculated or used correctly in working.
	eg $25\left(x+2\right)(=25x+50)$ **or** $\frac{7+(25-8)}{2}\times((x+6)-(x+2))(=48)$ **or** $25(x+6)(=25x+150)$ **or** $\left(\frac{8+(25-7)}{2}\times 4\right)(=52)$ **or** $8(x+2)(=8x+16)$ **or** $\frac{(x+2)+(x+6)}{2}\times(25-8-7)(=10x+40)$ **or** $7(x+2)(=7x+14)$ **or** $10(x+2)(=10x+20)$ or $7(x+6)(=7x+42)$ **or** $(25-7)\times(x+2)(=18x+36)$ **or** $0.5(25-8-7)\times 4(=20)$			M2 for 2 correct expressions or values for the area of any 2 parts of the shape that do not overlap (unless subtracting) (need not be added or subtracted) (figures to be correct or come from correct working to award marks) **(M1 for one correct expression)** 
	eg $25x + 98 = 258$ or $25(x + 2) + 4 \times 7 + 0.5 \times 4 \times 10 = 258$ oe or $25(x + 6) = 258 + 20 + 32$ oe **or** a fully correct numerical method eg $(258 – 98) \div 25$ oe			M1 for an equation that is correct or from correct working. This need not have expanded terms and may not equal 258 if other work has been done. All parts for their method must be included with no overlaps OR a complete numerical method
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	6.4		A1 oe eg $^{160}/_{25}$
				Total 5 marks

Question	Working	Answer	Mark	Notes
11 (a)		$\frac{11}{16}$	2	B1 for $\frac{11}{16}$ oe (0.68(75)) on LH bottom branch (decimals to at least 2 dp truncated or rounded)
		$\frac{7}{20}, \frac{13}{20}, \frac{7}{20}, \frac{13}{20}$		B1 for $\frac{7}{20}, \frac{13}{20}, \frac{7}{20}, \frac{13}{20}$ on RH branches (0.35, 0.65, 0.35, 0.65)
(b)	$\frac{5}{16}\times"\frac{7}{20}"$ **or** $"\frac{11}{16}"\times"\frac{13}{20}"$ **or** $\frac{5}{16}\times\frac{13}{20}$ **or** $"\frac{11}{16}"\times"\frac{7}{20}"$		3	M1 ft their tree diagram (dep on $0 < p < 1$)
	$\frac{5}{16}\times"\frac{7}{20}"+"\frac{11}{16}"\times"\frac{13}{20}"$ **or** $1-\frac{5}{16}\times"\frac{13}{20}"-"\frac{11}{16}"\times"\frac{7}{20}"$			M1 ft their tree diagram (dep on $0 < p < 1$)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$\frac{89}{160}$		A1 oe 0.55(625) 55% or 56% SCB1 for $\frac{5}{16}\times"\frac{7}{20}"\times"\frac{11}{16}"\times"\frac{13}{20}"\left(=\frac{5005}{102400}\right)\left(=\frac{1001}{20480}=0.0488....\right)$
				Total 5 marks

Question	Working	Answer	Mark	Notes
12 (a)	$2^7 \times \left(2^2\right)^5 = \left(2^2\right)^x$ oe eg $2^7 \times 2^{10} = 2^{2x}$ or $\left(4^{\frac{1}{2}}\right)^7 \times 4^5 \left[= (4)^x\right]$ oe or LHS written as 2^{17}		2	M1 writing 4^5 and 4^x as powers of 2 or or writing 2^7 as $4^{3.5}$ oe or writing (LHS) $2^7 \times 4^5$ as 2^{17}
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	8.5		A1 oe $\frac{17}{2}$, $8\frac{1}{2}$, allow $4^{8.5}$ oe
(b)		$25p^4y^{16}$	2	B2 (award B1 for 2 parts correct must be 25 and not 5^2)
				Total 4 marks

Question	Working	Answer	Mark	Notes
13			2	M1 For identifying 4 and 13 (may also indicate 8 as part of their working)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	9		A1
				Total 2 marks

Question	Working	Answer	Mark	Notes	
14	For drawing the line $y - x - 2 = 0$ ($y = x + 2$) Goes through (–2, 0) (–1, 1) (0, 2) (1, 3) (2, 4) etc		3	M1	At least long enough for the intercept with the other line and to clearly see that it is the correct line
	This question is testing use of graphs to solve simultaneous equations H2.6B Therefore please ignore any algebraic methods to solve the equations.	$x = -1$ $y = 1$		A2	for both values correct, dep on M1 (A1 dep on M1 for one correct value or both values the wrong way round,) [if more than one line is drawn, one of which is correct, and the correct coordinates given, please given credit]
					Total 3 marks

15	(a)	eg $x = 0.372....$ **and** $100x = 37.272....$ **or** $10x = 3.72....$ **and** $1000x = 372.72....$		2	M1	For 2 recurring decimals that when subtracted give a whole number or terminating decimal eg $100x = 37.272....$ and $x = 0.372....$ or $1000x = 372.72....$and $10x = 3.72....$ **with intention to subtract. (**At least one of the numbers must be shown with recurring dots or to at least 5 sf) **or** $0.3 + 0.0727\ldots$ **and** eg $y = 0.072....$, $100y = 7.2727....$ with intention to subtract.
		eg $100x - x = 37.272.... - 0.372.... = 36.9$ **and** $\frac{36.9}{99} = \frac{41}{110}$ **or** $1000x - 10x = 372.72.... - 3.72.... = 369$ **and** $\frac{369}{990} = \frac{41}{110}$ **or** $100y - y = 7.2727.... - 0.072.... = 7.2$ **and** $\frac{7.2}{99}$ **and** $\frac{3}{10} + \frac{7.2}{99} = \frac{297+72}{990} = \frac{369}{990} = \frac{41}{110}$ oe *Working required*	Shown		A1	Dep on M1 and **use of algebra** for completion to $\frac{41}{110}$ NB: this is a ‘show that’ question and requires students to clearly show steps that could be used to change the recurring decimal into the given fraction– some may have slight variations to this mark scheme but if the stages can be clearly followed then marks should be awarded.

	Award method marks in either order				
(b)	eg $\frac{\sqrt{125}+\sqrt{80}}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$ or $\frac{\sqrt{375}+\sqrt{240}}{3}$ **or** $\frac{5\sqrt{5}+4\sqrt{5}}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$ or $\frac{5\sqrt{15}+4\sqrt{15}}{3}$ or $\frac{9\sqrt{5}}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$ or $\frac{9\sqrt{15}}{3}$ or $\frac{9\sqrt{5}}{\sqrt{3}} = \frac{\sqrt{405}}{\sqrt{3}}$ oe **or**		3	M1	For rationalising by multiplying by $\frac{\sqrt{3}}{\sqrt{3}}$ or $\frac{-\sqrt{3}}{-\sqrt{3}}$ **or** for $\frac{9\sqrt{5}}{\sqrt{3}} = \frac{\sqrt{405}}{\sqrt{3}}$
	eg $\frac{\sqrt{125}+\sqrt{80}}{\sqrt{3}} = \frac{5\sqrt{5}+4\sqrt{5}}{\left(\sqrt{3}\right)}$ or $\frac{\sqrt{375}+\sqrt{240}}{3} = \frac{5\sqrt{15}+4\sqrt{15}}{3}$ (must see $\frac{\sqrt{375}+\sqrt{240}}{3}$ before simplifying)			M1	For simplifying the individual surds – either before rationalisation or after rationalisation (for the given surds, we do not need to see the denominator)
	Working required	$\sqrt{135}$		A1	dep on M2 SCB1 for $\sqrt{135}$ gained with no method marks awarded SCB2 for $\sqrt{135}$ and rationalisation also shown or $\sqrt{135}$ and simplifying the numerator shown
					Total 5 marks

Question	Working	Answer	Mark	Notes
16	$(2x+3)(x-5)=2x^2-10x+3x-15(=2x^2-7x-15)$ or $(2x+3)(x+4)=2x^2+8x+3x+12(=2x^2+11x+12)$ or $(x-5)(x+4)=x^2+4x-5x-20(=x^2-x-20)$ oe		3	M1 For a correct method to expand two brackets with at least 3 terms correct out of 4 terms (or 2 terms correct out of 3 terms) Do not award this mark for eg $2x^2-10x+3x-15+x^2+4x-5x-20$ or eg $2x^2-10x+3x-15+x+4$
	$(2x^2-7x-15)(x+4)=2x^3+8x^2-7x^2-28x-15x-60$ or $(2x^2+11x+12)(x-5)=2x^3-10x^2+11x^2-55x+12x-60$ or $(x^2-x-20)(2x+3)=2x^3+3x^2-2x^2-3x-40x-60$ oe			M1ft Ft dep on M1 and a quadratic for a correct method to multiply by the 3rd bracket – allow one further error
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$2x^3+x^2-43x-60$		A1 If no working shown then award B2 for 3 out of a maximum of 4 terms correct
	ALTERNATIVE			
	$2x^3+8x^2-10x^2-40x+3x^2+12x-15x-60$		3	M2 For a complete expansion with 8 terms present of which 4 are correct (M1 for 4 correct terms from any number of terms)
		$2x^3+x^2-43x-60$		A1
				Total 3 marks

Question	Working	Answer	Mark	Notes
17	8.25, 8.35, 2.5, 1.5, 17.5, 12.5		3	B1 For any one of these stated or used accept $8.34\dot{9}, 2.4\dot{9}, 17.4\dot{9}$
	$8.35(2.5+17.5)$ oe			M1 For $UB_a(UB_c+UB_y)$ $8.3 < UBa \le 8.35$, $2 < UBc \le 2.5$ $15 < UBy \le 17.5$ (this allows for the student who uses some sort of upper value, but is slightly inaccurate, eg using 17.4 for y)
	Working required	167		A1 cao dep on previous marks
				Total 3 marks

Question	Working	Answer	Mark	Notes
18	$(\frac{\mathrm{d}s}{\mathrm{d}t}=)\ 6t^2-10t+6$		4	M1 at least 2 terms correct
	$(\frac{\mathrm{d}v}{\mathrm{d}t}=)12t-10$			M1ft ft from a 3 term quadratic
	"$12t-10$" $= 5$			M1ft ft dep on previous M1 awarded
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	1.25		A1oe
				Total 4 marks

Question	Working	Answer	Mark	Notes
19 (a)		4.5	1	B1oe 4.5, $x = 4.5$, $x \neq 4.5$ Allow anything with 4.5, $\frac{9}{2}$ or $4\frac{1}{2}$ apart from $x < 4.5$, $x > 4.5$, $x \leq 4.5$, $x \geq 4.5$
(b)	$(\mathrm{g}(4)) = \frac{5}{2\times 4-9} (= -5)$ **or** $5\left(\frac{5}{2\times 4-9}\right)+7$ oe		2	M1
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	–18		A1
(c)	$(y =)3(x^2 - 4x) + ...$ **or** $y = 3(x^2 - 4x + ...)$ where ….can be number(s) or nothing		4	M1 **or** $3x^2 - 12x + (8 - y) = 0$ oe
	$(y =)3(x-2)^2.....$ **or** $y = 3[(x-2)^2....]$ could have: $y - 8 = 3[(x-2)^2....]$ oe			M1 **or** $(x =)\frac{12 \pm \sqrt{144 - 12(8-y)}}{6}$ may have + rather than ±
	$(x-2)^2 = \frac{y+4}{3}$ oe or an answer of $2 \pm \sqrt{\frac{4+x}{3}}$			M1 **or** $(x =)2 \pm \sqrt{\frac{4+y}{3}}$ may have + rather than ±
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$2 + \sqrt{\frac{x+4}{3}}$		A1 oe eg $2 + \frac{\sqrt{12+3x}}{3}$
NB: Allow candidates to swap *x* and *y* (or other letter) at any stage when finding the inverse – but the answer must be in terms of *x*				
				Total 7 marks

Question	Working	Answer	Mark	Notes
20	$0.5\times10\times10\times\sin60\,(=25\sqrt{3}=43.3...)$ oe or $0.5\times10\times\sqrt{10^2-5^2}\ (=25\sqrt{3}=43.3...)$ oe or $0.5\times10\times5\times\tan60\ (=25\sqrt{3}=43.3...)$ oe or $\sqrt{15(15-10)^3}\ (=25\sqrt{3}=43.3...)$ oe		4	M1 For a correct method to find the area of the triangle – this list is not exhaustive – please credit any relevant method
	(radius =) $5\tan30\ (=\frac{5\sqrt{3}}{3}=2.886....)$ oe eg $\frac{5}{\sin60}\times\sin30$ or $\sqrt{10^2-5^2}-\frac{5(\sin90)}{\sin60}$ [*BF – OB where O is centre*] or $6\left(\frac{1}{2}\times5\times r\right)=25\sqrt{3}\Rightarrow r=\frac{25\sqrt{3}}{15}(=\frac{5\sqrt{3}}{3})$ oe or $r=\frac{\sqrt{10^2-5^2}}{3}$			M1 Indep – correct method to find radius – this list is not exhaustive – please credit any relevant method
	$\pi\times\left(\frac{5\sqrt{3}}{3}\right)^2$ or $\pi\times(2.886...)^2\,(=\frac{25}{3}\pi=26.17\ldots)$			A1 A **correct** value or expression for the area of the circle
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	17.1		A1 awrt 17.1
				Total 4 marks

Question	Working		Answer	Mark	Notes
21	$(5-2y)^2+3y^2=13$	$x^2+3\left(\frac{5-x}{2}\right)^2=13$		5	M1 substitution of linear equation into quadratic allow $\pm5\pm2y$ or $\frac{\pm5\pm x}{2}$ oe
	$7y^2-20y+12[=0]$ oe	$7x^2-30x+23[=0]$ oe			M1 dep on M1 simplified to a 3 term quadratic(in any form) with at least 2 correct coefficients
	$(7y-6)(y-2)$ [= 0] $\frac{-(-20)\pm\sqrt{(-20)^2-4\times7\times12}}{2\times7}$ $7[(y-\frac{20}{14})^2-\frac{400}{196}]+12=0$ oe (leading to y values of 2 and $\frac{6}{7}$(0.857...)) (allow if labelled x)	$(7x-23)(x-1)$ [= 0] $\frac{-(-30)\pm\sqrt{(-30)^2-4\times7\times23}}{2\times7}$ $7[(x-\frac{30}{14})^2-\frac{900}{196}]+23=0$ oe (leading to x values of 1 and $\frac{23}{7}$(3.28…)			M1 ft dep on 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 allow one sign error and some simplification – allow as far as $\frac{20\pm\sqrt{400-336}}{14}$ or $\frac{30\pm\sqrt{900-644}}{14}$) or if completing the square then as far as shown on LHS **or** both correct values for the correct equation
	$(x=)\ 5-2\times2$ oe eg $5-2\times\frac{6}{7}$oe (=1 & $\frac{23}{7}$)	$(y=)\frac{5-1}{2}$oe, $\frac{5-\frac{23}{7}}{2}$ (=2 & $\frac{6}{7}$)			M1 Dep on previous M1 for correct method to find both other values or correct other values
	Working required		(1, 2) $\left(\frac{23}{7},\frac{6}{7}\right)$		A1 oe (allow (3.2(8), 0.85(7)) oe 2 sf or better rounded or truncated) dep on M2
					Total 5 marks

Question	Working	Answer	Mark	Notes
22 (a) (i)		2**a** + 2**b**	2	B1oe but must be simplified
(ii)		4**b** – 3**a**		B1oe need not be simplified
(b)	eg $\overrightarrow{AP} = \lambda(4\mathbf{b} - 3\mathbf{a})$ **and** $\overrightarrow{AP} = -3\mathbf{a} + k(2\mathbf{a} + 2\mathbf{b})$ oe [$\overrightarrow{AP} = 2\mathbf{b} - \mathbf{a} - x(2\mathbf{a} + 2\mathbf{b})$] oe eg $\overrightarrow{BP} = \mu(3\mathbf{a} - 4\mathbf{b})$ **and** $\overrightarrow{BP} = -4\mathbf{b} + m(2\mathbf{a} + 2\mathbf{b})$ oe [$\overrightarrow{BP} = 2\mathbf{a} - 2\mathbf{b} - v(2\mathbf{a} + 2\mathbf{b})$] eg $\overrightarrow{OP} = x(2\mathbf{b} + 2\mathbf{a})$ **and** $\overrightarrow{OP} = 3\mathbf{a} + y(4\mathbf{b} - 3\mathbf{a})$ oe [$\overrightarrow{OP} = 4\mathbf{b} + t(3\mathbf{a} - 4\mathbf{b})$]		3	M1 ft ft their answers in (a) Writing $\overrightarrow{AP}$ or $\overrightarrow{BP}$ or $\overrightarrow{OP}$ as correct vectors in 2 different independent ways – there may be other equivalent vectors Students may use other variations such as $\overrightarrow{PA}$, $\overrightarrow{PB}$, $\overrightarrow{PO}$
	eg $4\lambda = 2k$ and $-3\lambda = -3 + 2k$ or $3\mu = 2m$ and $-4\mu = -4 + 2m$ or $4y = 2x$ and $2x = 3 - 3y$			M1 2 correct equations gained from comparing coefficients
	Working required	3 : 4		A1oe Dep on M1 Any correct equivalent form eg 6 : 8, 0.75 : 1, 1 : $\frac{4}{3}$, 1 : 1.3(333…) etc
				Total 5 marks

Question	Working	Answer	Mark	Notes
23	$V=\frac{1}{3}\pi\times6^2\times15(=180\pi=565.48...)$		5	M1 a correct expression for volume of large cone
	$\frac{6}{15}=\frac{x}{\text{height}}$ or height $=\frac{15}{6}x=\frac{5}{2}x$ oe used or (vol sml cone =) $\left(\frac{x}{6}\right)^3 V$ or $\left(\frac{x}{6}\right)^3\times180\pi$ or (vol sml cone $=$"180π"$-\frac{4212}{25}\pi\left(=\frac{288}{25}\pi=11.52\pi=36.19...\right)$			M1 working with the scale factor (where V = vol of large cone) **or** formula for volume of sml cone, (ft their vol of large cone dep on a correct method) (NB: $\frac{4212}{25}=168.48$, $\frac{4212}{25}\pi=529.29...$)
	eg $\frac{1}{3}\pi\times x^2\times\frac{5}{2}x$ $(=\frac{5}{6}\pi x^3)$ oe or linear SF = $\sqrt[3]{\frac{180\pi}{\frac{288}{25}\pi}}(=2.5)$ oe or $\sqrt[3]{\frac{288/25}{180}}(=0.4)$ oe ***2.5 and 0.4 must be from correct working seen to award the mark (not from height/radius)***			M1 dep on previous M1 correct formula for volume of small cone in terms of x only, could be seen as part of an equation and π could be cancelled out **or** Correct calculation for linear SF of v to V
	eg $\frac{1}{3}\times\pi\times6^2\times15-\frac{1}{3}\times\pi\times x^2\times\frac{5}{2}x=\frac{4212}{25}\pi$ **or** $180-\frac{5}{6}x^3=\frac{4212}{25}$ oe **or** $\left[1-\left(\frac{x}{6}\right)^3\right]180\pi=\frac{4212}{25}\pi$ oe **or** $x=\frac{6}{2.5}$ **or** $h=\frac{15}{2.5}=6$ **and** $\frac{1}{3}\pi x^2 6=\frac{288}{25}\pi(=11.52\pi)$			M1 dep on M3 A correct equation in x (if using 2.5 this must come from a correct method)
	Working required	2.4		A1oe dep on M3
				Total 5 marks

Question	Working	Answer	Mark	Notes
24	$\frac{x+3x-4}{x(3x-4)}$ or $\frac{4x-4}{3x^2-4x}$ oe eg $\frac{4(x-1)}{x(3x-4)}$		5	M1 For adding the terms in the brackets correctly eg $\frac{x+3x-4}{x(3x-4)}$ oe and may be 2 fractions with a common denominator
	$\frac{5x(3x+4)(3x-4)}{(3x+4)(x-1)}$ **or** $(45x^3-80x)(4x-4)=180x^4-180x^3-320x^2+320x$ **or** $(3x^2+x-4)(3x^2-4x)=9x^4-12x^3+3x^3-4x^2-12x^2+16x$ $\left(=9x^4-9x^3-16x^2+16x\right)$			M1 indep (score best method if both shown) For factorising the numerator of the first fraction correctly **or** factorising the denominator of the first fraction correctly **OR** expanding the numerators correctly **or** expanding the denominators correctly
	$\frac{5x(3x+4)(3x-4)}{(3x+4)(x-1)}\times\frac{4(x-1)}{x(3x-4)}(=20)$ oe eg $\frac{5x(9x^2-16)\times 4}{x(9x^2-16)}$ oe $\frac{180x^4-180x^3-320x^2+320x}{9x^4-9x^3-16x^2+16x}(=20)$ oe			M1 (assumes previous mark if this is awarded) All terms factorised (some terms may be cancelled) **or** showing an expression that will cancel **or** the correct fraction with all terms correctly expanded
	$20=\frac{4(x+2)}{5x-8}$ oe allow up to a quadratic on the LHS – must be correct			M1 Cancelling and LHS = RHS or division of top by bottom = 20 and LHS = RHS
	Working required	$\frac{7}{4}$		A1 oe dep on a fully correct method shown, ie all steps that lead to the correct answer
				Total 5 marks