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Mark Scheme (Results)

Summer 2024

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

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- **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**

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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.

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International GCSE Maths

Apart from questions 4, 10, 14ab, 15b, 19, 22, 23, 24 the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method
Values in quotation marks must come from a correct method previously seen unless clearly stated otherwise.

Q	Working	Answer	Mark	Notes
1	for $k = 18$ or eg $(8 + j) \div 2 = 10$ or $(j =)\ 10 \times 2 - 8$ or $8 + j = 2 \times 10$ or $j = 12$ or eg $k - h = 13$ or "18" $- h = 13$ or $h = 5$		3	M1 For a correct value for h, j or k or for a correct statement for one of these
	for two of the above			M1 for 2 correct values from h, j or k or for 2 correct statements for them
	Correct answer scores full marks (unless from obvious incorrect working)	$h = 5$ $j = 12$ $k = 18$		A1 All correct
				Total 3 marks

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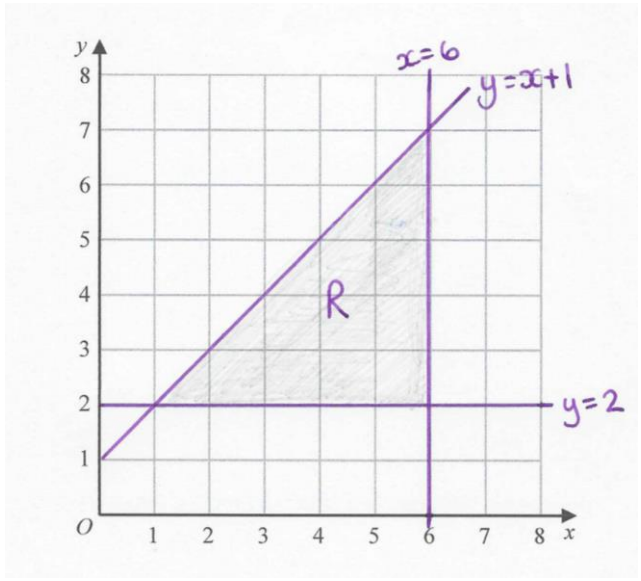
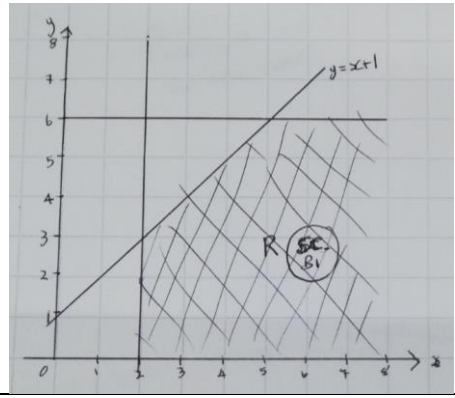
2 (a)(i)		$y = 2$ drawn	3	B1	Lines (can be solid, dotted or dashed) must be at least 2 cm long and need not be labelled
(ii)		$x = 6$ drawn		B1	
(iii)		$y = x + 1$ drawn		B1	
(b)			1	B1ft	Correct region indicated ft dep on at least B2 scored in (a) and a vertical line, a horizontal line and a diagonal line with a positive gradient SCB1 for $y = x + 1$, $y = 6$ and $x = 2$ and area shaded as shown below 
					Total 4 marks

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3	For 9 hrs 36 mins = 9.6 (hrs) or $9\frac{36}{60}$ (hrs) or $9\frac{3}{5}$ (hrs) oe or 576 (mins)		3	M1	For a correct conversion of time into hours or into minutes	Award M2 for $820\times 9+\frac{820}{60}\times 36$ $(=7380+492)$ **or** $\frac{34560}{60\times 60}\times 820$ oe
	eg 820 × "9.6" or $820\times\frac{576}{60}$ or $576\times\frac{820}{60}$ or $576\times\frac{41}{3}$ (allow 13.7 for $\frac{41}{3}$) oe			M1	For use of distance = speed × time in hours (eg allow use of 9.36 for this mark)	
	Correct answer scores full marks (unless from obvious incorrect working)	7872		A1	SCB1 for 7675.2 if no other marks awarded	
						Total 3 marks

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4	$\frac{18}{7}, \frac{28}{9}$		3	M1	for correct improper fractions
	$\frac{\cancel{18}^{2}}{7^{1}} \times \frac{28^{4}}{\cancel{9}^{1}}$ or $\frac{18}{7} \times \frac{28}{9} = \frac{504}{63}$ oe eg $\frac{\cancel{18}^{2}}{7} \times \frac{28}{\cancel{9}^{1}} = \frac{56}{7}$ or $\left(\frac{18}{7} \times \frac{28}{9} =\right) \frac{162}{63} \times \frac{196}{63} = \frac{31752}{3969}$ oe			M1dep	for cancelling fractions fully or cancelling fractions partially and clear intention to multiply (allow arithmetic error in multiplication) or not cancelling and clear intention to multiply (allow arithmetic error in multiplication)
	eg $\frac{\cancel{18}^{2}}{7^{1}} \times \frac{28^{4}}{\cancel{9}^{1}} = 8$ or $\frac{\cancel{18}^{2}}{7^{1}} \times \frac{28^{4}}{\cancel{9}^{1}} = 2 \times 4 = 8$ eg $\frac{18}{7} \times \frac{28}{9} = \frac{504}{63} = 8$ oe or eg $\left(\frac{18}{7} \times \frac{28}{9} =\right) \frac{162}{63} \times \frac{196}{63} = \frac{31752}{3969} \left(= \frac{8}{1}\right) = 8$ *working required*	Shown		A1	Dep on M2 for a correct answer of 8 from fully correct working Candidates may show $8 = \frac{8}{1}$ (maybe under the given 8) and then they need only show the given fraction comes to $\frac{8}{1}$
					Total 3 marks

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5	$\sin 34 = \frac{x}{6.5}$ or $\frac{x}{\sin 34} = \frac{6.5}{\sin 90}$ oe $6.5^2 - (6.5 \times \cos 34)^2$ or $\cos 56 = \frac{x}{6.5}$ oe		3	M1 a correct trig statement for x
	$(x =)\ 6.5 \times \sin 34$ or $x = \frac{6.5 \times \sin 34}{\sin 90}$ or $(x =) \sqrt{6.5^2 - (6.5 \times \cos 34)^2}$ or $(x =) 6.5 \times \cos 56$ oe			M1 a fully correct method to find x
	Correct answer scores full marks (unless from obvious incorrect working)	3.6		A1 awrt 3.6
				Total 3 marks

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6	For one of $w \div 1000$ or $w \div 10^3$ or $w \times 10^{-3}$ or $0.001w$ oe $(w \times 60 \times 60)$ oe or $w \times 3600$ or $w \div \frac{1}{3600}$ oe		3	M1 or $\frac{3600}{1000}$ or $\frac{18}{5}$ or 3.6 oe (without a link to w)
	$\frac{w \times 60 \times 60}{1000}$ oe eg $w \times \frac{3600}{1000}$			M1 For a fully correct method including w
	Correct answer scores full marks (unless from obvious incorrect working)	$3.6w$		A1 or $\frac{18}{5}w$ or $3\frac{3}{5}w$ allow $3.6 \times w$
				Total 3 marks

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7	eg 13 × 21 (=273) **or** 21 × *h* (= 21*h*) **or** 0.5(15 + 21) × *y* **or** 15(*h* – 13) **or** 2 ×½(3(*h* – 13)) **or** ½(13 + *h*) ×3 (= 19.5 + 1.5*h*) **or** 15 × *h* (= 15*h*)		4	M1	A correct calculation for an area linked to the shape. (*h* – 13) might be written as *x* or *y* etc: this is acceptable (even allow *h*) [allow without brackets for this mark only]
	eg 390 – "273" (= 117) **or** 13×21 **and** $0.5(15+21)(h-13)$ **or** 13×21 **and** $0.5(15+21)y$ oe **or** 21*h* **and** 2 ×½(3(*h* – 13)) oe **or** 13 × 21 **and** 15(*h* – 13) **and** 2 ×½(3(*h* – 13)) oe **or** 2 × ½(13 + *h*) ×3 **and** 15 × *h*			M1	For considering the area of all parts of the shape (parts need not be added or subtracted for the whole shape) (where *y* = height of *BCDE*) (*h* – 13) might be written as *x* or *y* etc: this is acceptable (even allow *h*) [correct use of brackets]
	"117" ÷ (0.5 × (15 + 21))(= 6.5) or **or** $\frac{1}{2}(15+21)\times y="117"$ **or** 273 + 18(*h* – 13) = 390 **or** 15(*h* – 13) + 2 ×½(3(*h* – 13)) ="117" oe **or** 2 × ½(13 + *h*) ×3 + 15*h* = 390 **Typical equations here simplify to :** 18*y* = 117, 18*h* – 234 = 117, 18*h* + 39 = 390, 18*h* = 351			M1	A correct calculation to find height of trapezium or height of shape or a correct equation involving height of trapezium or height of shape or 6.5 (*h* – 13) might be written as *x* or *y* etc: this is acceptable (even allow *h*) [correct use of brackets]
	Correct answer scores full marks (unless from obvious incorrect working)	19.5		A1oe	eg $\frac{39}{2}$
					Total 4 marks

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8	600 ÷ (9 + 4 + 2) (= 40) or tulip: 0.45 × 600 (= 270) or crocus: $\frac{5}{8}\times 600$ (= 375)	Tulips: 0.45 × 9 (= 4.05) or $0.45\times\frac{9}{15}\left(=\frac{27}{100}(=0.27)\right)$ oe		5	M1	A correct method to find one share or 45% of 600 or $\frac{5}{8}$ of 600 or the fraction of the share that is for tulips
	Daffodils: "40" × 2 (= 80) $\frac{2}{15}\times 600(=80)$ (implies 1st M1)	Crocus: $\frac{5}{8}\times 4(=2.5)$ or $\frac{5}{8}\times\frac{4}{15}\left(=\frac{1}{6}(=0.16\dot{6})\right)$ oe			M1	A correct method to find number of daffodils or the fraction of the share that is for crocus
	Tulip: 0.45 × (9 × "40")(=162) or $0.45\times 600\times\frac{9}{15}$ (=162) (implies 1st M1)	Total of parts 4.05 + 2.5 + 2 (= 8.55) or $\frac{27}{100}+\frac{1}{6}+\frac{2}{15}\left(=\frac{57}{100}\right)$ oe (implies 1st and 2nd M marks)			M1	A correct method to find number of yellow tulips or the total of the parts that are yellow
	Crocus: $\frac{5}{8}\times(4\times"40")$ (= 100) or $\frac{5}{8}\times 600\times\frac{4}{15}$ (=100) (implies 1st M1)	$\frac{8.55}{9+4+2}\times 600$ oe or $\frac{57}{100}\times 600$ oe (implies all previous M marks)			M1	A correct method to find number of yellow crocuses or multiplying the total of the correct shares by 600
	Correct answer scores full marks (unless from obvious incorrect working)		342		A1	
						Total 5 marks

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9	4500 × 1.024 (= 4608) oe or 4500 × 0.024 (= 108)		3	M1	M2 for 4500×1.024^4 or 4500×1.024^5
	"4608" × 1.024 (= 4718.592) and "4718.592"× 1.024 (= 4831.838…) and "4831.838"× 1.024 (=4947.80…)			M1	
	Correct answer scores full marks (unless from obvious incorrect working)	4948		A1 4947 – 4948 if no other mark awarded, SCB1 for 4500 × 0.024 × 4 (= 432) 0.096 × 4500 (=432) or 4500 + 4500 × 0.024 × 4 (= 4932) 4500 × 1.096 (= 4932) 0.976 × 4500 (=4392) or 0.904 × 4500 (=4068) or 0.976^4 × 4500 (=4083…) or 4500×1.024^3 (= 4831.83...)	
					Total 3 marks

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10	$_6x + 4y = 1$ $\quad\quad$ $_30x + 20y = 5$ eg $6x + 10y = 16$ or $12x + 20y = 32$ oe $(6y = 15)$ $\quad\quad$ $(18x = -27)$ or eg $6x + 4\left(\frac{8-3x}{5}\right) = 1$ or $3\left(\frac{1-4y}{6}\right) + 5y = 8$		3	M1	A correct method to eliminate x or y – multiplying one or both equations so that one value can be eliminated **and** the correct operation to eliminate which can be shown by 2 out of 3 terms correct for subtraction or addition (allow one arithmetic error in multiplying) **or** for a correct substitution of one variable into the other equation. NB: the mark is for the method and not for the result of the method – although if the correct result is seen, this means the mark is awarded
				M1dep	A correct method to calculate the value of the other letter (dep on M1) eg substitution of found variable into an equation (equation does not need to be solved) or starting again with elimination or substitution
	working required	$x = -1.5$, $y = 2.5$		A1oe	dep on M1 Must be a vulgar fraction or mixed number or a decimal (eg do not allow $y = \frac{12.5}{5}$)
					Total 3 marks

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11	(i)	$(x \pm 2)(x \pm 11)$		2	M1	Or $(x + a)(x + b)$ where $ab = -22$ **or** $a + b = 9$
		Correct answer scores full marks (unless from obvious incorrect working)	$(x - 2)(x + 11)$		A1	
	(ii)		$2, -11$	1	B1ft	**Must** ft from their factors in (i)
						Total 3 marks

12	$4 \times 11\,800$ (= 47 200) or $3 \times 13\,207$ (= 39 621) or 86 821		3	M1	for one correct product or for the sum of the products
	$\frac{"47\,200" + "39\,621"}{7} \left(= \frac{86821}{7}\right)$			M1	for a fully correct method to find the mean for the 7 days
	Correct answer scores full marks (unless from obvious incorrect working)	12 403		A1	cao
					Total 3 marks

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13	(a)		7, 24, 42, 56, 66, 70	1	B1	Correct values for cumulative frequency
	(b)	**USE OVERLAY** (NB: a 'bar chart' type graph scores zero marks) (ignore any part of the graph before (10, 7))	6 points plotted at ends of intervals and joined with curve or line segments	2	B2	Fully correct graph. (B1 for 5 correct points plotted and joined or B1for 5 or 6 points plotted but not joined or B1 for 5 or 6 points plotted consistently within each interval (not at upper end) at their correct heights and joined eg plotted at 5, 15, 25, 35, 45, 55 For any of the B1 options, you can ft a table with just one error provided values are ascending)
	(c)	NB: readings are 16 – 18 and 36 – 38 (but for this M1 these do not have to be correct if correct working is shown – eg lines or marks indicating use of CF 17.5 and CF 52.5 with an indication on the distance axis at the correct points (or they can just show the correct readings))		2	M1ft	For a correct method to **allow** readings to be taken on the distance axis from cf 52.5 (or 53.25) and from cf 17.5 (or 17.75) oe Ft from their cf graph
		If a graph is drawn and answer is in the given range, then award the marks – unless from obvious incorrect working	18 - 22		A1ft	Accept a single value in range or ft from their cf graph
	(d)			2	M1ft	A line up from 46 to the line and reading across – or a reading of 61 – 64 (can be non-whole number) from their cf graph
		If a graph is drawn and answer is in the given range, then award the marks – unless from obvious incorrect working	6 or 7 or 8 or 9		A1ft	ft their cf graph, must be a whole number
						Total 7 marks

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14 (a)	$(3y)(2y + 5) = 6y^2 + 15y$ $(3y)(y + 7) = 3y^2 + 21y$ $(2y + 5)(y + 7) = 2y^2 + 14y + 5y + 35$ $(=2y^2 + 19y + 35)$		3	M1	An expansion with only one error. Do not award this mark for $6y^2 + 15y + 3y^2 + 21y$	M2 for 3 (out of a maximum of 4) of $6y^3+42y^2+15y^2+105y$ (M1 for 2 correct out of a maximum of 4)
	$(6y^2 + 15y)(y + 7) = 6y^3 +42y^2 +15y^2 + 105y$ $(3y^2 +21y)(2y + 5) = 6y^3 +15y^2 +42y^2 + 105y$ $3y(2y^2 + 19y + 35) = 6y^3 + 57y^2 + 105y$			M1	ft dep on M1 allow one further error	
	working required	$6y^3 + 57y^2 + 105y$		A1	cao (terms may be in any order but must be simplified) dep on M1 accept $a = 6$, $b = 57$, $c = 105$	

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14 (b)	eg $\frac{4(2x+3)+5(6x-5)}{20}(=1.63)$ oe or $\frac{40x+60}{100}(+)\frac{150x-125}{100}\left(=\frac{163}{100}\right)$ oe $4(2x + 3) + 5(6x – 5) = 1.63 \times 5 \times 4$ oe		4	M1	Writing fractions over a common denominator(can be 2 fractions) or for a method to remove the denominator by multiplying each term by eg 20 or 100 etc (if expanded numerator, allow one error) or $20(2x+3)+25(6x-5)=163$ (could all be written over 100)
	eg $8x + 12 + 30x – 25 = 32.6$ or $40x + 60 + 150x – 125 = 163$ or $\frac{190x-65}{100}=\frac{163}{100}$ or $\frac{38x-13}{20}=\frac{163}{100}$ oe			M1	Removing brackets and fractions on the LHS in an equation with no more than one error from expanding on the numerator or an equation with terms on numerator of fraction simplified with no more than one error from expanding on the numerator
	$8x + 30x = 32.6 – 12 + 25$ or oe eg $38x = 45.6$ or $190x = 228$			M1	Terms in x on one side and number terms the other in a correct equation.
	working required	1.2		A1	oe dep on M1
					Total 7 marks

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15 (a)	$e^2 = \frac{7g+5}{11+2g}$		4	M1	for removing square root
	$11e^2 + 2e^2g = 7g + 5$			M1	For multiplying by denominator and expanding in a correct equation
	eg $2e^2g - 7g = 5 - 11e^2$ or $11e^2 - 5 = 7g - 2e^2g$ oe			M1	For gathering terms in g on one side and other terms the other side in a correct equation.
	Correct answer scores full marks (unless from obvious incorrect working)	$g = \frac{5-11e^2}{2e^2-7}$		A1	or $g = \frac{11e^2-5}{7-2e^2}$ oe eg $g = \frac{\frac{5}{e^2}-11}{2-\frac{7}{e^2}}$ or $g = \left(\frac{5-11e^2}{e^2-3.5}\right) \div 2$ etc
(b)	$(3y - 8)(y + 4)$		3	M1	For correct factorisation or correct use of quadratic formula $\frac{-4 \pm \sqrt{4^2 - 4\times3\times-32}}{2\times3}$ or as far as $\frac{-4 \pm \sqrt{400}}{6}$ $\left(y - \frac{8}{3}\right)(y+4)$ is not valid factorisation, unless preceded by division of quadratic by 3, so no marks
	$y = \frac{8}{3}, y = -4$			A1	dep on M1 for correct critical values (allow 2.6 or better or 2.7)
	working required	$y < -4,\ y > \frac{8}{3}$		A1	oe dep on M1 (allow use of x rather than y) or $(-\infty, -4)$, $\left(\frac{8}{3}, (+)\infty\right)$ or $(-\infty, -4) \cup \left(\frac{8}{3}, (+)\infty\right)$ oe
					Total 7 marks

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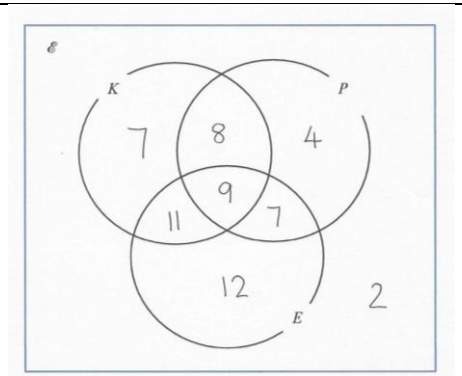
16	(a)		Fully correct Venn diagram	3	B1 B2	For 7 in just knitting For all 7 others correct (B1 for 4, 5 or 6 others correct)
	(b)	can either ft their Venn diagram or use values given in text	$\frac{17}{28}$	2	B2 ft	oe 0.61 or 61% or 0.607… or 60.7% or better (B1ft for 17 as numerator or 28 as denominator in a fraction between 0 and 1) only ft where regions in Venn diagram have numbers indicated
	(c)	can either ft their Venn diagram or use values given in text	11	1	B1ft	only ft where regions in Venn diagram have numbers indicated
	(d)	can either ft their Venn diagram or use values given in text	28	1	B1ft	only ft where regions in Venn diagram have numbers indicated
						Total 7 marks

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17	$Q = k\sqrt{d}$ oe or $kQ = \sqrt{d}$ or $Q = \sqrt{kd}$		3	M1	$k \neq 1$
	eg $4.5 = k \times \sqrt{324}$ or $k = 0.25$ oe			M1	Allow this for M2 if $Q = k\sqrt{d}$ is not seen Condone use of $\propto$ for method marks
	Correct answer scores full marks (unless from obvious incorrect working)	$Q = 0.25\sqrt{d}$		A1	oe but must be $Q = \ldots$ eg $Q = \frac{\sqrt{d}}{4}$ or $Q = \sqrt{\frac{d}{16}}$ oe
					Total 3 marks

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18	Gradient of **P** = $-\frac{2}{5}$ or $y = \frac{7-2x}{5}$ oe or $y = -0.4x + \ldots.$ or $\frac{5}{2}x$ or $y = \frac{5}{2}x(+....)$		2	M1 oe for the given equation rearranged so it is possible to see the gradient or for an equation with gradient of 2.5 oe or $\frac{5}{2}x$ oe
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{5}{2}$		A1 oe gradient must be stated but isw if seen and then used in an equation SCB1 for the equation of a line with gradient $\frac{5}{2}$ if $\frac{5}{2}$ not seen separately and no other mark awarded
				Total 2 marks

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19	7.5, 8.5, 6.615, 6.625, 1.15, 1.25		3	B1	For a correct upper or lower bound Allow $8.49\dot{}$ for 8.5, $6.6249\dot{}$ for 6.5, $1.249\dot{}$ for 1.25
	$(G=)\dfrac{7.5}{2\times6.625-3\times1.15}\left(=\dfrac{7.5}{13.25-3.45}=\dfrac{7.5}{9.8}=\dfrac{75}{98}\right)$			M1	$\dfrac{LB_c}{2\times UB_f-3\times LB_h}$ where $7.5,\ LB_c<8$ $6.62<UB_f,\ 6.625,\ 1.15,\ LB_h<1.2$ SCB1 for $\dfrac{7.5}{6.625-1.15}(=1.369(8...)$ [in addition to the first B1]
	working required	0.765		A1	awrt 0.765 dep on completely correct bounds (0.7653061224…) dep on M1
					Total 3 marks

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20	$\dfrac{5\left(\dfrac{1}{4y}-y\right)}{\dfrac{1}{4y}+2}\left(=\dfrac{\dfrac{5}{4y}-5y}{\dfrac{1}{4y}+2}\right)$ oe or $\dfrac{4y(5x-5y)}{8y+1}$ oe		3	M1	For a correct substitution with only values of y or an expression containing xy (not just x) or a correct denominator of $1 + 8y$
	$\dfrac{\frac{5}{4y}\times 4y-5y\times 4y}{\frac{1}{4y}\times 4y+2\times 4y}$ or $\dfrac{\frac{5-20y^2}{4y}}{\frac{1+8y}{4y}}$ oe or $\dfrac{4y(5x-5y)}{8y+1}=\dfrac{20xy-20y^2}{8y+1}$			M1	multiplying every term by $4y$ or a multiple of $4y$ or writing numerator and denominator over 4y or a multiple of $4y$ or correctly expanded with an xy term (xy could be replaced with 0.25 oe) or 3 of a, b, c or d correct if written in the form $\dfrac{a-by^2}{c+dy}$ where a, b, c and d are integers
	Correct answer scores full marks (unless from obvious incorrect working)	$\dfrac{5-20y^2}{1+8y}$		A1	oe eg $\dfrac{-5+20y^2}{-1-8y}$ or $\dfrac{20-80y^2}{4+32y}$
					Total 3 marks

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21	$(2r)^2 - \pi r^2$ oe or $x^2 - \pi \times (0.5x)^2$		5	M1	A correct expression for the area of the shaded parts in one variable only **for this mark only**, accept without brackets (eg $2r^2 - \pi r^2$ or $x^2 - \pi \times \frac{1}{2}x^2$) (any letter can be used eg *AB*, *x*, *y* etc, here, *r* = radius, *x* = side of square)
	$4r^2 - \pi r^2 = 80$ oe eg $r^2 - 0.25\pi r^2 = 20$ or $x^2 - 0.25\pi x^2 = 80$ or $4x^2 - \pi x^2 = 320$ oe			M1	A correct equation in one variable with brackets expanded (may be seen later in working)
	$r^2 = \frac{80}{4-\pi}$ $(= 93.19\ldots)$ or $r = \sqrt{\frac{80}{4-\pi}}$ $(= 9.65\ldots)$ $x^2 = \frac{80}{1-0.25\pi} (= 372.78..)$ or $x = \sqrt{\frac{80}{1-0.25\pi}} (19.307...)$ oe eg $\sqrt{\frac{320}{4-\pi}}$			M1	A correct expression for the radius squared or radius or for the side of the square squared or for the side of the square
	$(AC =) \sqrt{(2\times"9.65")^2 + (2\times"9.65")^2}$ oe or $(AC =)\ 2\times\sqrt{"9.65"^2 + 9.65"^2}$ $(AC =) \sqrt{"19.307"^2 + "19.307..."^2}$ oe eg $\sqrt{8\times\frac{80}{4-\pi}}$ oe or $(AC =) \frac{2\times"9.65"}{\sin 45}$ or $\frac{2\times"9.65"}{\cos 45}$			M1	For a correct calculation to find the length of *AC*
	Correct answer scores full marks (unless from obvious incorrect working)	27.3		A1	27.3 – 27.5
					Total 5 marks

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22	eg $2(5-y)^2+3y^2=210$ $\sqrt{\frac{210-3y^2}{2}}=5-y$ oe	Eg $2x^2+3(5-x)^2=210$ $\sqrt{\frac{210-2x^2}{3}}=5-x$ oe		5	M1 substitution of $x=\pm5\pm y$ or $y=\pm5\pm x$ into $2x^2+3y^2=210$ or a correct equation formed by using $x=\pm5\pm y$ or $y=\pm5\pm x$ to obtain an equation in x only or y only
	eg $5y^2-20y-160\ (=0)$ **or** $y^2-4y-32\ (=0)$	eg $5x^2-30x-135\ (=0)$ **or** $x^2-6x-27\ (=0)$			M1 dep on previous M1 for multiplying out and collecting terms, forming a three term quadratic in any form of $ax^2+bx+c\ (=0)$ where **at least 2** coefficients (a or b or c) are correct
	eg $(y-8)(y+4)\ (=0)$ $y=\frac{--4\pm\sqrt{(-4)^2-4\times1\times-32}}{2\times1}$ eg $(y-2)^2-2^2=-32$ (allow incorrect labels for x/y)	eg $(x-9)(x+3)\ (=0)$ $x=$ $\frac{--6\pm\sqrt{(-6)^2-4\times1\times-27}}{2\times1}$ eg $(x-3)^2-3^2-27=0$ (allow incorrect labels for x/y)			M1 (dep on first M1) for a complete method to solve their 3-term quadratic equation (ax^2+bx+c)= 0); correct factorisation or substitution into formula (allow one sign error and some simplification – allow as far as $\frac{4\pm\sqrt{16+128}}{2}$ or $\frac{6\pm\sqrt{36+108}}{2}$) or completing the square or for seeing $x=9$, $x=-3$ **or** $y=8$, $y=-4$
	eg $x+8=5$ and $x+-4=5$ (correct labels for x/y)	eg $y=5-9$ and $y=5--3$ (correct labels for x/y)			M1ft dep on previous M1 for substituting **their** 2 found values of x or y in a suitable equation (allow use of quadratic equation) **or** fully correct values for the other variable must see substitution for incorrect x/y values
	working required		(9, –4) (–3, 8)		A1 (dep on M2)
					Total 5 marks

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23	**For 2 of** $30=5\times6$ or $30=5\times2\times3$ oe (for numerator) or $\sqrt{180}=6\sqrt{5}$ oe or $\sqrt{180}=2\times3\times\sqrt{5}$ (for denominator) or $25^{2x+7}=\left(5^2\right)^{2x+7}$ or $5^{2(2x+7)}$ oe or $\left(\sqrt{5}\right)^{4x+9}=\left(5^{\frac{1}{2}}\right)^{4x+9}$ or $5^{\frac{1}{2}(4x+9)}$ oe or $\frac{30}{\sqrt{180}}=\sqrt{5}$ oe or 5^{4x+15} as the numerator or 5^{2x+5} as the denominator		3	M1 or 5^{4x+15} as the numerator or 5^{2x+5} as the denominator or $30=5\times6$ or $30=5\times2\times3$ oe or $\sqrt{180}=6\sqrt{5}$ oe or $\sqrt{180}=2\times3\times\sqrt{5}$ or $25^{2x+7}=\left(5^2\right)^{2x+7}$ or $5^{2(2x+7)}$ oe or $\left(\sqrt{5}\right)^{4x+9}=\left(5^{\frac{1}{2}}\right)^{4x+9}$ or $5^{\frac{1}{2}(4x+9)}$ oe or
	$\frac{6\times5\times5^{4x+14}}{6\times5^{0.5}\times5^{2x+4.5}}$ oe eg $\frac{5^{4x+15}}{5^{2x+5}}$ or $\frac{\sqrt{5}^{8x+30}}{\sqrt{5}^{4x+10}}$ oe or $\frac{25^{2x+7.5}}{25^{x+2.5}}$ oe			M1 Correct expression in terms of 6 (or 2 and 3) and 5 with indices Some cancellation could have taken place **or** fully correct with $\sqrt{5}$ and powers **or** 25 and powers
	working required	5^{2x+10}		A1 dep on M2 allow $w = 2x + 10$
				Total 3 marks

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24	(a)	eg $\overrightarrow{AC} = \overrightarrow{AO} + \overrightarrow{OB} + \overrightarrow{BC}$ or eg $-4\mathbf{a} + 3\mathbf{b} + 2\mathbf{a} + \mathbf{b}$			2	M1	
		Correct answer scores full marks (unless from obvious incorrect working)		$4\mathbf{b} - 2\mathbf{a}$		A1	oe but must be simplified eg $-2\mathbf{a} + 4\mathbf{b}$, $2(2\mathbf{b} - \mathbf{a})$
	(b)	eg $\overrightarrow{OP} = 4\mathbf{a} + \frac{3}{5}"(4\mathbf{b} - 2\mathbf{a})"$ $(= \frac{14}{5}\mathbf{a} + \frac{12}{5}\mathbf{b}$ or $2.8\mathbf{a} + 2.4\mathbf{b})$ oe **or** eg $\overrightarrow{OP} = 3\mathbf{b} + 2\mathbf{a} + \mathbf{b} - \frac{2}{5}"(4\mathbf{b} - 2\mathbf{a})"(= \frac{14}{5}\mathbf{a} + \frac{12}{5}\mathbf{b})$ oe			4	M1ft	For $\overrightarrow{OP}$ (could be part of another vector equation) ft their $\overrightarrow{AC}$
		eg $\overrightarrow{OQ} = \lambda"(\frac{14}{5}\mathbf{a} + \frac{12}{5}\mathbf{b})"$ **or** eg $\overrightarrow{OQ} = 3\mathbf{b} + \mu(2\mathbf{a} + \mathbf{b})$ **or** eg $\overrightarrow{OQ} = 4\mathbf{b} + 2\mathbf{a} + \omega(2\mathbf{a} + \mathbf{b})$	eg $\overrightarrow{PQ} = k(2.8\mathbf{a} + 2.4\mathbf{b})$ **or** eg $\overrightarrow{PQ} = \frac{2}{5}(4\mathbf{b} - 2\mathbf{a}) + m(2\mathbf{a} + \mathbf{b})$			M1ft	ft their $\overrightarrow{AC}$ (This mark can be awarded without the previous mark awarded) a correct expression for $\overrightarrow{OQ}$ or $\overrightarrow{PQ}$ oe
		eg $\overrightarrow{OQ} = \lambda"(\frac{14}{5}\mathbf{a} + \frac{12}{5}\mathbf{b})"$ **and** eg $\overrightarrow{OQ} = 3\mathbf{b} + \mu(2\mathbf{a} + \mathbf{b})$ or $4\mathbf{b} + 2\mathbf{a} + \omega(2\mathbf{a} + \mathbf{b})$	eg $\overrightarrow{PQ} = k(2.8\mathbf{a} + 2.4\mathbf{b})$ **and** eg $\overrightarrow{PQ} = \frac{2}{5}(4\mathbf{b} - 2\mathbf{a}) + m(2\mathbf{a} + \mathbf{b})$			M1ft	ft their $\overrightarrow{AC}$ 2 correct expressions for $\overrightarrow{OQ}$ or $\overrightarrow{PQ}$ oe ft dep on previous M1
		working required		$\frac{42}{5}\mathbf{a} + \frac{36}{5}\mathbf{b}$		A1	oe dep on M2 $8.4\mathbf{a} + 7.2\mathbf{b}$
							Total 6 marks

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25	(i)		(30, 2)	1	B1 cao
	(ii)		(300, 0)	1	B1 cao
					Total 2 marks

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