Pearson Edexcel

Mark Scheme (Results)

Summer 2025

Pearson Edexcel International GCSE In Mathematics A (4MA1) Paper 2HR Higher Tier

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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.

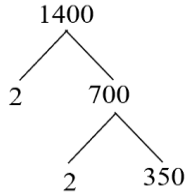
  Transcription errors occur when candidates present a correct answer in working, and write it incorrectly on the answer line; mark the correct answer.
- **Parts of questions**

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

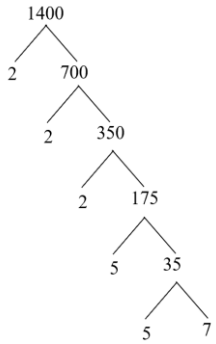
International GCSE Maths					
Values in quotation marks must come from a correct method previously seen unless clearly stated otherwise.					
Q		**Working**	**Answer**	**Mark**	**Notes**
1	(a)		$9c(2 - 5d)$	2	B2 for $9c(2 - 5d)$ or $-9c(5d - 2)$ (B1 for $9(2c - 5cd)$ or $c(18 - 45d)$ or $3c(6 - 15d)$ or $3(6c - 15cd)$ **or** $9c(p + qd)$ where p and q are non-zero integers **or** $(2 - 5d)$ as a factor)
	(b)	eg $5 - 2x = 18x - 24$ **or** $\frac{5}{6} - \frac{2}{6}x = 3x - 4$		3	M1 for removal of the fraction **and** correctly multiplying out RHS by 6 in an equation **or** separating fractions on the LHS in an equation
		$5 + 24 = 18x + 2x$ oe **or** $29 = 20x$ oe **or** $\frac{5}{6} + 4 = \frac{2}{6}x + 3x$ oe			M1ft dep on 4 terms for correctly rearranging their 4 term equation for terms in x on one side of the equation and number terms on the other
		Working required	1.45		A1 dep on M1 oe eg $\frac{29}{20}$ or $1\frac{9}{20}$
					Total 5 marks

<table>
<tr><td rowspan="5">2</td><td rowspan="5"></td><td>eg
2 × 2 × 350
or 2 × 7 × 100
or 2 × 5 × 140
or 5 × 5 × 56
or 7 × 5 × 40
or (14 × 100 = 14 × 25 × 4 =) 2 × 7 × 25 × 4</td><td></td><td rowspan="5">3</td><td rowspan="2">M1 for finding 2 prime factors after at least 2 stages of prime factorisation with 0 incorrect stages
or for finding 2 prime factors after at least 3 stages of prime factorisation with no more than 1 incorrect stage

Each stage gives 2 factors – may be in a factor tree or a table or listed (see LHS for examples of the amount of work needed for the award of this mark) but we want to see 2 prime factors.

Example of finding 2 prime factors after at least 3 stages with 1 incorrect stage:
1400 = 10 × 14 = 2 × 5 × 2 × 7</td></tr>
<tr><td>eg
<table><tr><td>2</td><td>1400</td></tr><tr><td>2</td><td>700</td></tr><tr><td></td><td>350</td></tr></table></td><td>eg
 
</td><td></td></tr>
<tr><td>eg 2 × 2 × 2 × 5 × 5 × 7</td><td></td><td rowspan="3">M1 dep on M1
for factors 2, 2, 2, 5, 5, 7 identified with no others in any form, eg listed, multiplied, added

Ignore 1s

May be seen in a fully correct factor tree or ladder</td></tr>
<tr><td>eg
<table><tr><td>2</td><td>1400</td></tr><tr><td>2</td><td>700</td></tr><tr><td>2</td><td>350</td></tr><tr><td>5</td><td>175</td></tr><tr><td>5</td><td>35</td></tr><tr><td></td><td>7</td></tr></table></td><td>eg
 
</td><td></td></tr>
<tr><td>Working required</td><td>$2^3 \times 5^2 \times 7$</td><td>A1 dep on M2
May be in any order and allow $2^3 \times 5^2 \times 7$</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Total 3 marks</td></tr>
</table>

3	eg $3x + 2y = 10$ $-\ 3x - 4y = 16$ $(6y = -6)$ **or** eg $3\left(\frac{10 - 2y}{3}\right) - 4y = 16$ **or** $3\left(\frac{16 + 4y}{3}\right) + 2y = 10$ **or** $6y = -6$ oe	Eg $6x + 4y = 20$ $+\ 3x - 4y = 16$ $(9x = 36)$ **or** eg $3x - 4\left(\frac{10 - 3x}{2}\right) = 16$ **or** $3x + 2\left(\frac{3x - 16}{4}\right) = 10$ **or** $9x = 36$ oe		3	M1	a correct method to eliminate x or y: coefficients of x or y are the same **and** the correct operation to eliminate is selected; if operator not written, the correct operation can be implied by 2 out of 3 terms correct Allow one arithmetic error if multiplying to equate coefficients **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. However, if the correct result of this method is seen, the mark can be awarded
	$3x + 2 \times$ "-1" $= 10$ or $3x - 4 \times$ "-1" $= 16$ **or** $x = \frac{10 - 2 \times "-1"}{3}$ or $x = \frac{16 + 4 \times "-1"}{3}$	$3 \times$ "4" $+ 2y = 10$ or $3 \times$ "4" $- 4y = 16$ **or** $y = \frac{10 - 3 \times "4"}{2}$ or $y = \frac{3 \times "4" - 16}{4}$			M1	dep on M1 a correct substitution to find the value of the second variable using their value **or** for starting again with elimination or substitution (as above)
	Working required		$x = 4$ $y = -1$		A1	dep on M1
						Total 3 marks

4		45 ÷ 1.5 (= 30) **or** 5 × 12 (= 60) **or** $\frac{64}{1.5}$ $\left(=\frac{128}{3}=42.6(6...)\right)$		5	M1	for a method to find the number of boxes needed **or** the cost of adhesive **or** cost of tiles per m^2
		"30" × 64 (= 1920) **or** "42.6(6…)" × 45 (=1920)			M1	for a method to find the cost of the boxes of tiles
		"1920" + "60" (= 1980) **or** 3000 – 1920 – 60 (=1020)			M1	for a method to find the total cost **or** the profit
		eg $\frac{3000-"1980"}{"1980"}$ $(=0.515...)$ **or** $\frac{3000-"1980"}{"1980"}\times 100$ **or** $\frac{3000}{"1980"}$ (= 1.515…) **or** $\frac{3000}{"1980"}$ ´ 100 (= 151.5…) **or** $\frac{3000}{"1980"}\times 100-100$			M1	for a method to find the percentage profit or be one step away
		Correct answer scores full marks (unless from obvious incorrect working)	51.5		A1	awrt 51.5 SCB3 for answer 56.3 or 56.25 (from use of 1920 instead of 1980 as total cost)
						Total 5 marks

5	(a)		Vertices at (2, 5) (2, 8) (3, 6) (3, 7)	2	B2 for correct shape in correct position (B1 for correct orientation of shape but wrong position **or** for 3 out of 4 vertices correct **or** for $y = x$ drawn)
	(b)		Vertices at (5, 3) (5, 7) (7, 7) (9, 3)	2	B2 for correct shape in correct position (B1 for correct size **and** orientation of shape but wrong position **or** for 3 out of 4 vertices correct)
					Total 4 marks

6	(a)		1	1	B1	cao
	(b)	eg $(5^9 \times 5^{-3} =) 5^6$ **or** $(5^9 \div 5^{-2} =) 5^{11}$ **or** $(5^{-3} \div 5^{-2} =) 5^{-1}$ **or** $(5^k \times 5^{-2} =) 5^{k-2}$ **or** $9 - 3 = k - 2$ oe **or** $9 - 3 - -2$ **or** $9 - 3 + 2$		2	M1	for one correct application of an index rule (must be seen in powers of 5) this could be after an initial mistake – working will need to be clearly seen **or** for forming a correct equation in the indices alone **or** for a complete method for the value of k
		Correct answer scores full marks (unless from obvious incorrect working)	8		A1	condone 5^8
	(c)		$8d^{12}e^{15}$	2	B2	for a correct answer (B1 for answer of the form kd^me^n where at least two of $k = 8$, $m = 12$ and $n = 15$ are correct)
						Total 5 marks

7		$10.5 = \frac{48.3}{v}$ **or** $10.5v = 48.3$ **or** $\left(v =\right) \frac{48.3}{10.5}$		2	M1	oe for substituting 10.5 and 48.3 correctly into a correct formula for density; may use any letter for the volume
		Correct answer scores full marks (unless from obvious incorrect working)	4.6		A1	allow $\frac{23}{5}$ **or** $4\frac{3}{5}$ oe
						Total 2 marks

8		60 × 7 (= 420) **or** 46 × 3 (= 138)		3	M1	may be embedded within an equation
		"420" – "138" (= 282)			M1	for a method to find the sum of the 4 numbers Allow this mark if they do further incorrect work using 282
		Correct answer scores full marks (unless from obvious incorrect working)	70.5		A1	allow $\frac{141}{2}$ oe eg $\frac{282}{4}$ or $70\frac{1}{2}$
						Total 3 marks

9		1 – 0.15 (= 0.85) **or** 100(%) – 15(%) (= 85(%)) **or** $\frac{612}{85}$ (= 7.2) oe		3	M1	may be seen embedded Do not allow (1 – 15%) unless processed correctly
		612 ÷ "0.85" oe **or** 612 ÷ "85" × 100 oe **or** "7.2" × 100			M1	for a complete method
		Correct answer scores full marks (unless from obvious incorrect working)	720		A1	
						Total 3 marks

10		eg $y = -5x$ (+ k) **or** $y - a = -5(x - b)$ **or** eg $y = mx + 6$ **or** $y - 6 = m(x - 0)$ **or** eg $-5x + 6$ **or** **L** $= -5x + 6$		2	M1	for the equation of any line with gradient −5 other than $y = 2 - 5x$ **or** for the equation of any line passing through the point (0, 6) **or** the correct line missing '$y =$' or with the wrong subject
		Correct answer scores full marks (unless from obvious incorrect working)	$y = -5x + 6$		A1	oe equation eg $y = 6 - 5x$ **or** $y - 6 = -5(x - 0)$ **or** $y + 5x = 6$
						Total 2 marks

11	$(AD^2 =)\ 28^2 + 45^2\ \ (= 784 + 2025 = 2809)$ **or** $(EDA =)\ \tan^{-1}\left(\frac{28}{45}\right)\ \left(= 31.8(9...)\right)$ **or** $\left(EAD =\right)\ \tan^{-1}\left(\frac{45}{28}\right)\ (= 58.1(09...))$		5	M1	for a correct method to find AD^2 **or** angle *EDA* **or** angle *EAD*
	eg $(AD =)\ \sqrt{28^2 + 45^2}\ \ (= \sqrt{784 + 2025} = \sqrt{2809} = 53)$ oe **or** $\left(AD =\right)\ \frac{28}{\sin 31.8(9...)}\ (= 53...)$ **or** $\left(AD =\right)\ \frac{45}{\cos 31.8(9...)}\ (= 53...)$ oe **or** $\left(AD =\right)\ \frac{45}{\sin 58.1...}\ (= 53...)$ **or** $\left(AD =\right)\ \frac{28}{\cos 58.1...}\ (= 53...)$ oe			M1	for a correct method to find *AD*
	eg $(BC =)\ \sqrt{35^2 - ("53" - 21)^2}\ \ (= \sqrt{1225 - 1024} = \sqrt{201} = 14.1(7...))$ **or** $(BDC =)\ \cos^{-1}\left(\frac{"53" - 21}{35}\right)\left(= 23.8(9...)\right)$ **or** $(BCD =)\ \sin^{-1}\left(\frac{"53" - 21}{35}\right)\left(= 66.1...\right)$			M1	for correct method to find *BC* **or** angle *BDC* **or** angle *BCD*
	eg $\frac{1}{2} \times "14.1(7...)" \times ("53" - 21)\ (= 16\sqrt{201})$ **or** $\frac{1}{2} \times 35 \times ("53" - 21) \times \sin("23.8(9...)")$ **or** $\frac{1}{2} \times 35 \times "14.1(7...)" \times \sin("66.1...")$			M1	for a correct method to find the area of triangle *CDB*
	Correct answer scores full marks (unless from obvious incorrect working)	227		A1	awrt 227 accept $16\sqrt{201}$
					Total 5 marks

12		$16\,000 \times \left(1 - \frac{12}{100}\right)^2$ (= 12 390.4) **or** 16 000 × 0.7744 (= 12 390.4) oe **or** $16\,000 \times \left(1 - \frac{12}{100}\right)$ (= 14 080) **and** "14 080" × $\left(1 - \frac{12}{100}\right)$ (=12 390.4) oe **or** $\left(1 - \frac{12}{100}\right)^2$ (= 0.7744) **and** $\frac{11461.12}{16000}$ $\left(= \frac{4477}{6250} = 0.71632\right)$		3	M1	for a method to find the value of the car after two years **or** a method to find the overall percentage multiplier after two years **and** the overall percentage multiplier for the three years May be seen embedded, eg in an equation Do not allow (1 – 12%) unless processed correctly
		eg $\frac{"12390.4" - 11461.12}{"12390.4"}$ (×100) (= 0.075) **or** $1 - \frac{11461.12}{"12390.4"}$ (×100) **or** 1 – 0.925 (= 0.075) **or** $\frac{11461.12}{"12390.4"}$ (×100) (= 0.925) **or** $\frac{"0.71632"}{"0.7744"}$ (´ 100) (= 0.925)			M1	for a complete method to find the value of the decimal equivalent of x% **or** for a complete method to find the percentage multiplier for the third year May be seen embedded, eg within a correct equation rearranged to one of these equivalent forms
		Correct answer only scores full marks (unless from obviously incorrect working)	7.5		A1	oe SCB2 for answer –7.5
						Total 3 marks

13	(a)	$(2x \pm 5y)(2x \pm 5y)$ **or** $(2x)^2 - (5y)^2$		2	M1		
		Correct answer only scores full marks (unless from obviously incorrect working)	$(2x + 5y)(2x - 5y)$		A1		
	(b)	$4x(x + 3) = 4x^2 + 12x$ **or** $4x(2x - 5) = 8x^2 - 20x$ **or** $(x + 3)(2x - 5) = 2x^2 - 5x + 6x - 15$ $(= 2x^2 + x - 15)$		3	M1	An expansion with only one error Do **not** award this mark for $4x^2 + 12x + 8x^2 - 20x$	M2 for 3 terms (out of a maximum of 4 terms) from: $8x^3 - 20x^2 + 24x^2 - 60x$ If not M2, then M1 for 2 correct out of a maximum of 4
		$(4x^2 + 12x)(2x - 5) = 8x^3 - 20x^2 + 24x^2 - 60x$ **or** $(8x^2 - 20x)(x + 3) = 8x^3 + 24x^2 - 20x^2 - 60x$ **or** $4x(2x^2 - 5x + 6x - 15) = 8x^3 - 20x^2 + 24x^2 - 60x$ **or** $4x(2x^2 + x - 15) = 8x^3 + 4x^2 - 60x$			M1	ft dep on M1 allow one further error	
		Working required	$8x^3 + 4x^2 - 60x$		A1	cao dep on M1 Terms may be in any order but must be simplified ISW **correct** factorisation $8x^3 + 4x^2 - 60x$ must be seen previously to award 3 marks eg $4(2x^3 + x^2 - 15x)$ $x(8x^2 + 4x - 60)$ Do not ISW incorrect simplification or further incorrect work following $8x^3 + 4x^2 - 60x$ eg $8x^3 + 4x^2 - 60x = 2x^3 + x^2 - 15x$ gets M2A0	
							Total 5 marks

14	(a)		$\frac{5}{9}$ and $\frac{4}{9}$ $\frac{7}{10}$ and $\frac{3}{10}$ $\frac{7}{10}$ and $\frac{3}{10}$	2	B2	for all 3 correct pairs of probabilities on the correct branches (B1 for 1 or 2 correct pairs of probabilities on the correct branches) Accept decimals or percentages rounded or truncated to at least 2sf. NB $\frac{5}{9} = 0.55(55\ldots)$ and $\frac{4}{9} = 0.44(44\ldots)$	
	(b)	$\frac{5}{9}$, $\frac{7}{10}$ **or** $1-\left(\frac{5}{9}\times\frac{3}{10}+\frac{4}{9}\times\frac{7}{10}+\frac{4}{9}\times\frac{3}{10}\right)$		2	M1ft	ft diagram, oe	Allow ft their tree diagram provided the relevant probabilities are less than 1 in each case For A1, allow decimals or percentages that round or truncate correctly to at least 2sf. ISW any attempt to convert to other form once correct probability seen
		Correct answer only scores full marks (unless from obviously incorrect working)	$\frac{7}{18}$		A1ft	ft diagram, oe fraction, decimal or percentage. NB $\frac{7}{18} = \frac{35}{90} = 0.38(88\ldots)$	

	(c)	$(RRR =) \frac{5}{9} \times \frac{7}{10} \times \left(1 - \frac{2}{11}\right) \left(= \frac{315}{990} = \frac{7}{22}\right)$ **or** $(RRG =) \frac{5}{9} \times \frac{7}{10} \times \frac{2}{11} \left(= \frac{70}{990} = \frac{7}{99}\right)$ **or** $(RGR =) \frac{5}{9} \times \frac{3}{10} \times \left(1 - \frac{2}{11}\right) \left(= \frac{135}{990} = \frac{3}{22}\right)$ **or** $(GRR =) \frac{4}{9} \times \frac{7}{10} \times \left(1 - \frac{2}{11}\right) \left(= \frac{252}{990} = \frac{14}{55}\right)$ **OR** $(GGG =) \frac{4}{9} \times \frac{3}{10} \times \frac{2}{11} \left(= \frac{24}{990} = \frac{4}{165}\right)$ **or** $(GGR =) \frac{4}{9} \times \frac{3}{10} \times \left(1 - \frac{2}{11}\right) \left(= \frac{108}{990} = \frac{6}{55}\right)$ **or** $(GRG =) \frac{4}{9} \times \frac{7}{10} \times \frac{2}{11} \left(= \frac{56}{990} = \frac{28}{495}\right)$ **or** $(RGG =) \frac{5}{9} \times \frac{3}{10} \times \frac{2}{11} \left(= \frac{30}{990} = \frac{1}{33}\right)$		3	M1ft	ft diagram for a correct calculation to find the probability of one relevant outcome, eg *RRR* or *RRG* or *RGR* or *GRR* **OR** eg *GGG* or *GGR* or *GRG* or *RGG* May see *RRR* or *RRG* found using their answer to part (b): $(RRR =) \left[\frac{7}{18}\right] \times \left(1 - \frac{2}{11}\right)$ $(RRG =) \left[\frac{7}{18}\right] \times \frac{2}{11}$ where $\left[\frac{7}{18}\right]$ is their answer to part (b) and must be less than 1	Allow ft their tree diagram provided the relevant probabilities are less than 1 in each case For A1, allow decimals or percentages that round or truncate correctly to at least 2sf. ISW any attempt to convert to other form once correct probability seen
		$"\frac{7}{22}" + "\frac{7}{99}" + "\frac{3}{22}" + "\frac{14}{55}"$ oe **OR** $1 - \left("\frac{4}{165}" + "\frac{6}{55}" + "\frac{28}{495}" + "\frac{1}{33}"\right)$			M1ft	ft diagram, for a method to find the probability required. Condone one error in one of the four relevant outcomes **or** omission of one outcome Note P(*RR*) = P(*RRR*) + P(*RRG*), so may see $\frac{5}{9} \times \frac{7}{10} \left(= \frac{7}{18}\right)$ in place of $"\frac{7}{22}" + "\frac{7}{99}"$ for this mark (similar with P(*GG*))	
		Correct answer only scores full marks (unless from obviously incorrect working)	$\frac{386}{495}$		A1ft	ft diagram, correct probability oe fraction, decimal or percentage NB $\frac{386}{495} = \frac{772}{990} = 0.77(979\ldots)$	
						Total 7 marks

15	*ABC* = 21 + 36 (= 57) **or** angle *ABO* = 36 **and** angle *CBO* = 21 **and** 21 + 36 (=57) **or** (reflex) *AOC* = 360 – (21 + 21 + 36 + 36) (= 246) **or** (obtuse) *AOC* = 2 × (21 + 36) (=114) **or** *BAX* = 90 – 36 (= 54) with the tangent at *A* drawn oe **or** *BCY* = 90 – 21 (= 69) with the tangent at *C* drawn oe **or** angle *ADB* = 180 – 90 – 36 (= 54) **OR** eg *x* = angle *ACO* and *y* = *ABC* **and** $x + x + 2y = 180$ oe **and** $y + (x + 36) + (x + 21) = 180$ oe **or** eg $180 – 2x = 2(180 – 2x – 21 – 36)$		3	M1	for a method to find one of the angles on the scheme; for this mark, values and calculations must be linked to the correct angle by notation or by being marked on the diagram. May also be awarded for a correct method to set up and solve an equation to find one of these angles; the variable must be clearly defined where *X* is a point on the tangent at *A* where *Y* is a point on the tangent at *C* where *AD* is a diameter **OR** for any **correct** pair of simultaneous equations with clearly defined variables one of which must be angle *ACO* **or** any **correct** equation in terms of *ACO* only
	$(ACO =) \frac{180 - 2\acute{}\ "57"}{2}$ **or** $(ACO =) \frac{180 - (360 - "246")}{2}$ **or** $(ACO =) \frac{180 - "57" - 21 - 36}{2}$ **or** (*ACO* =) "54" – 21 **or** (*ACO* =) "69" – 36 **or** (*ACO* =) 90 – "57" **OR** eg $180 – 2x = 2(180 – 2x – 21 – 36) \Rightarrow x = \ldots$			M1	for a complete method to find angle *ACO* **OR** forms a correct equation in terms of *ACO* only and solves to get a value (condone arithmetic errors) implies the 1st M mark (provided no incorrect working seen)
	Correct answer only scores full marks (unless from obviously incorrect working)	33		A1	
					Total 3 marks

16		$\frac{4}{3\sqrt{5}+7}$, $\frac{3\sqrt{5}-7}{3\sqrt{5}-7}$ **or** $\frac{4}{3\sqrt{5}+7}$, $\frac{-3\sqrt{5}+7}{-3\sqrt{5}+7}$ oe		3	M1 for multiplying the numerator and denominator by $3\sqrt{5}-7$ or $-3\sqrt{5}+7$ (may be implied)
		eg $\frac{4(3\sqrt{5}-7)}{45-21\sqrt{5}+21\sqrt{5}-49}$ **or** $\frac{4(3\sqrt{5}-7)}{45-7^2}$ **or** $\frac{12\sqrt{5}-28}{45-21\sqrt{5}+21\sqrt{5}-49}$ **or** $\frac{12\sqrt{5}-28}{45-7^2}$ **or** $\frac{4(3\sqrt{5}-7)}{45-49}$ **or** $\frac{4(3\sqrt{5}-7)}{-4}$ **or** $\frac{12\sqrt{5}-28}{45-49}$ **or** $\frac{12\sqrt{5}-28}{-4}$			M1 for expanding the denominator in a correct fraction denominator may be 4 terms which all need to be correct $\frac{4}{3\sqrt{5}+7}$, $\frac{3\sqrt{5}-7}{3\sqrt{5}-7} = 7-3\sqrt{5}$ scores M1M0 Implies the 1st mark
		Working required	$7-\sqrt{45}$		A1 dep on M2 SCB1 for answer $7-\sqrt{45}$ with no method marks awarded SCB2 for $7-\sqrt{45}$ if you would award the 1st M1 but not the 2nd M1 (total 2 marks)
					Total 3 marks

17		$7p - 3k^2p = 8k^2 + 5$		4	M1	for correctly multiplying both sides by the denominator **and** expanding the brackets
		$7p - 5 = 8k^2 + 3k^2p$ **or** $-3k^2p - 8k^2 = 5 - 7p$			M1ft	dep on 2 terms in k^2 and 2 other terms for correctly collecting their k^2 terms on one side and their other terms on the other side Note: eg $8k^2 + 3k^2$ does **not** count as 2 terms in k^2
		eg $7p - 5 = k^2(8 + 3p)$ **or** $k^2(-3p - 8) = 5 - 7p$			M1ft	dep on previous M1 for correctly factorising for k^2 or $-k^2$ in their equation
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$k = (\pm)\sqrt{\frac{7p - 5}{8 + 3p}}$		A1	oe eg $k = (\pm)\sqrt{\frac{5 - 7p}{-3p - 8}}$ **or** $k = (\pm)\left(\frac{7p - 5}{8 + 3p}\right)^{\frac{1}{2}}$ **or** $k = (\pm)\left(\frac{7p - 5}{8 + 3p}\right)^{0.5}$ (condone omission of ±) NB: to award A1 we must see $k = (\pm)\sqrt{\frac{7p - 5}{8 + 3p}}$ in working if $(\pm)\sqrt{\frac{7p - 5}{8 + 3p}}$ alone is given as an answer
						Total 4 marks

18	(a)		$-4\mathbf{a} + 4\mathbf{b}$	1	B1	oe eg $4(\mathbf{b} - \mathbf{a})$
	(b)	$4\mathbf{a} + \frac{1}{4}\left(-4\mathbf{a} + 4\mathbf{b}\right)$ oe or $4\mathbf{a} + \frac{1}{4}[\overrightarrow{AB}]$ **or** $4\mathbf{b} - \frac{3}{4}\left(-4\mathbf{a} + 4\mathbf{b}\right)$ oe or $4\mathbf{b} - \frac{3}{4}[\overrightarrow{AB}]$		2	M1ft	for a correct expression ft their (a) where $[\overrightarrow{AB}]$ is their answer to (a) of the form $m\mathbf{a} + n\mathbf{b}$, $m, n \neq 0$
		Correct answer only scores full marks (unless from obviously incorrect working)	$3\mathbf{a} + \mathbf{b}$		A1	allow $\mathbf{b} + 3\mathbf{a}$
						Total 3 marks

19	(a)		$-\frac{1}{2}$	1	B1	oe Accept $x = -\frac{1}{2}$, accept $x \neq -\frac{1}{2}$ Do not allow inequalities, eg $x > -\frac{1}{2}$ or $x \leq -\frac{1}{2}$
	(b)	$\frac{3x - 4}{2(3x - 4) + 1}$		2	M1	for a correct unsimplified expression for gf(x)
		Correct answer only scores full marks (unless from obviously incorrect working)	$\frac{3x - 4}{6x - 7}$		A1	oe eg $\frac{4 - 3x}{7 - 6x}$ Correct answer seen followed by incorrect subsequent working scores M1A0
						Total 3 marks

20	(frequency density =) 75 ÷ 100 (= 0.75) **or** any one correct value marked on the FD axis **or** uses their own linear FD scale to find the area of at least one of the third, fourth or fifth bars **OR** eg 1 (large) box / 1 (large) square = 12.5 books oe **or** 5 (sml) squares = 2.5 books **or** 1 (sml) square / 1 box = 0.5 books		4	M1	for a correct calculation of frequency density **or** a correct value on the frequency density axis **or** use of their own linear frequency density scale to find the area of at least one of the third, fourth or fifth bars **OR** or a correct measure of scale Implied by a correct frequency for the third (250), fourth (125) or fifth (50) bar	M3 for any complete method that relies only on counting squares, eg counting large squares: $\frac{4+10+2}{6+18+20+10+4}$ Allow one error in number of squares in each of numerator and denominator but do not allow any omissions Must use a consistent method for the award of more than one mark
	eg using frequency densities 75 + (“2.25” × 100) + (“1” × 250) + (“2.5” × 50) + (“0.25” × 200) (= 75 + 225 + 250 + 125 + 50 = 725) **OR** eg using a measure of scale (eg large squares) (6 + 18 + 20 + 10 + 4) × “12.5” (=725) oe **OR** eg total no. of large squares = 6 + 18 + 20 + 10 + 4 (=58) **or** total no. of sml squares = 150 + 450 + 500 + 250 + 100 (=1450)			M1	for a method to work out the total number of books **OR** the total number of squares Allow one error in a frequency density value, class width value or number of squares but not an omission Allow ft their own linear frequency density scale	
	eg using frequency densities (“1” × 50) + (“2.5” × 50) + (“0.25” × 100) (= 50 + 125 + 25 = 200) **OR** eg using a measure of scale (eg large squares) (4 + 10 + 2) × “12.5” (=200) oe **OR** eg no. of large squares = 4 + 10 + 2 (= 16) **or** no. of sml squares = 100 + 250 + 50 (= 400)			M1	for a method to estimate the number of books between 400g and 600 g **OR** the total number of squares between 400 g and 600 g Allow one error in a frequency density value, class width value or number of squares but not an omission Allow ft their own linear frequency density scale	
	Correct answer only scores full marks (unless from obviously incorrect working)	$\frac{200}{725}$		A1	oe eg $\frac{8}{29}$ or any correct decimal or correct percentage rounded or truncated to 2sf. NB $\frac{200}{725}$ = 0.27(58…)	
						Total 4 marks

21		eg $(2x+3)(x-5)$ oe **or** $\frac{--7\pm\sqrt{(-7)^2-4\times2\times(-15)}}{2\times2}$ oe **or** $2\left[\left(x-\frac{7}{4}\right)^2-\left(\frac{7}{4}\right)^2\right]-15$ oe		3	M1	for a **correct** method to find the critical values Minimum evidence for quadratic formula is a two-term discriminant, eg $\frac{7\pm\sqrt{49+120}}{4}$ (must have the ±) Allow $(x + 1.5)(2x – 10)$ as a correct factorisation, but do **not** allow $\left(x+\frac{3}{2}\right)(x-5)$ unless preceeded by division of the quadratic by 2	Allow M1A1 for the correct critical values **AND** evidence of another algebraic method that has led to these: eg $x(2x + 3) – 5(2x + 3)$ **and** the correct critical values **or** $2x(x – 5) + 3(x – 5)$ **and** the correct critical values **or** $(2x + 3)(2x – 10)$ **and** the correct critical values
		$(x=)\ -\frac{3}{2}$ **and** $(x=)\ 5$			A1	dep on M1 for correct critical values oe	
		Working required	$x<-\frac{3}{2}$, $x>5$		A1	dep on M1 for correct inequalities (must be separate inequalities) allow interval notation eg $\left(-\infty,-\frac{3}{2}\right)\cup(5,\infty)$ **or** $\left(-\infty,-\frac{3}{2}\right),(5,¥)$ **or** $]-\infty,-\frac{3}{2}[\ \cup\ ]5,\infty[$ **or** $]-\infty,-\frac{3}{2}[\ ,\ ]5,\infty[$ Acceptable notation: allow a comma, space, “or”, “and” or “∪” to link the two regions Do **not** allow as a single inequality $-\frac{3}{2}>x>5$	
							Total 3 marks

22		$(V =)\ x(x)(15 - 4x)\quad (= 15x^2 - 4x^3)$		5	M1	for a correct expression for the volume (condone missing $V = \ldots$)
		$\left(\frac{dV}{dx} =\right)\ 30x - 12x^2$			M1ft	ft dep on a V of the form $ax^3 + bx^2$ where $a, b \neq 0$ for a two-term derivative with at least one term correct for their V eg $15(2)x$ **or** $30x$ **or** $-3(4)x^2$ **or** $-12x^2$
		$30x - 12x^2 = 0 \Rightarrow x = \ldots$ **or** $(x =)\ 2.5$ oe			M1ft	dep on previous M mark for equating their 2-term first derivative to 0 and solving to get a value of x (the value of x obtained must be greater than 0 and must not be where their second derivative is equal to 0) **or** the correct value of x
		$(V =)$ "2.5" × "2.5" × (15 – 4 × "2.5") **or** $(V =)\ 15(\text{"2.5"})^2 - 4(\text{"2.5"})^3$			M1	dep on M3 for a full and correct substitution of their value of x
		Correct answer only scores full marks (unless from obviously incorrect working)	31.25		A1	oe eg $\frac{125}{4}$ ignore any units on the answer line
						Total 5 marks

23		eg (*CE* =) $40 \times \tan 35$ (= 28(.0…)) **or** (*CE* =) $\frac{40}{\tan(90 - 35)}$ (= 28(.0…)) **or** (*CE* =) $\frac{40\sin 35}{\sin(90 - 35)}$ (= 28(.0…))		3	M1	for a correct method to find *CE*
		eg (angle *CME* =) $\tan^{-1}\left(\frac{"28"}{40.2}\right)$ **or** (angle *CME* =) $\sin^{-1}\left(\frac{"28"}{\sqrt{(40.2)^2 + "28"^2}}\right)$ **or** (angle *CME* =) $\cos^{-1}\left(\frac{40.2}{\sqrt{(40.2)^2 + "28"^2}}\right)$			M1	for a complete method to find angle *CME*
		Correct answer only scores full marks (unless from obviously incorrect working)	54.5		A1	awrt 54.5
						Total 3 marks

24		eg $\sqrt{(3a - a)^2 + (7 - -5)^2} = 4\sqrt{10}$ oe **or** $(2a)^2 + 12^2 = (4\sqrt{10})^2$ oe **or** $4a^2 + 144 = 160$ oe		6	M1	for forming a correct equation in terms of a; brackets must be used correctly, but allow recovery from missing or incorrect brackets to be recovered condone $4\sqrt{10}^2$ in place of $(4\sqrt{10})^2$
		$a = \sqrt{\frac{"160" - "144"}{4}}$ $(= \sqrt{4} = 2)$			M1	dep on M1 for a complete method to solve a correct equation for a; condone inclusion of ±
		$(m_{PQ} =) \frac{3a - a}{7 - -5} \left(= \frac{2a}{12} = \frac{a}{6}\right)$ oe **or** $(m_{PQ} =) \frac{3 \times [2] - [2]}{7 - -5} \left(= \frac{4}{12} = \frac{1}{3}\right)$ oe			M1ft	for a method to find the gradient of PQ where [2] is what they believe the value of a to be; must be positive and clearly identified
		$\left[\frac{a}{6}\right] \times m_{perp} = -1$ **or** $(m_{perp} =) -1 \div \left[\frac{a}{6}\right] \left(= -\frac{6}{a}\right)$ oe **or** $\left[\frac{1}{3}\right] \times m_{perp} = -1$ **or** $(m_{perp} =) -1 \div \left[\frac{1}{3}\right] (= -3)$ oe			M1ft	for a method to find the gradient of the perpendicular bisector where $\left[\frac{a}{6}\right]$ or $\left[\frac{1}{3}\right]$ is what they believe to be the gradient of PQ; must be clearly identified
		$\frac{-5+7}{2}$ (= 1) **and** $\frac{3a + a}{2}$ $(= 2a)$ **or** $\frac{-5+7}{2}$ (= 1) **and** $\frac{3 \times [2] + [2]}{2}$ (= 4)			M1ft	for a method to find the x coordinate and y coordinate of the midpoint of PQ; condone if the coordinates are the wrong way around where [2] is what they believe the value of a to be; must be positive and clearly identified
		Correct answer only scores full marks (unless from obviously incorrect working)	$y = -3x + 7$		A1	oe correct equation in required form eg $y = 7 - 3x$
						Total 6 marks

25		$a = 3$ $b = 45$ $c = 1$ **OR** $a = -3$ $b = 225$ $c = 1$	3	B1 for $a = 3$ **or** $a = -3$ B1 for $a > 0$ and $b = 45$ **or** for $a < 0$ and $b = 225$ if no answer for a is seen allow this mark for $b = 45$ B1 for $c = 1$ Allow correct alternative angles for the value of b, eg 45 or –315, 225 or –135
				Total 3 marks

26		eg $\frac{1}{2} \times \frac{4}{3}\pi x^3 = 6174\pi$		5	M1	oe for forming a correct equation; allow use of any letter	
		$(x =) \sqrt[3]{\frac{6174\pi \times 3}{2\pi}}$ $(= \sqrt[3]{9261} = 21)$			M1	for a correct method to find the radius of the hemisphere	
		eg $\pi([21])^2 - \pi([21] - 2)^2$ $(= 441\pi - 361\pi = 80\pi)$ oe **or** $2\pi([21])^2 + 2\pi([21] - 2)^2$ $(= 882\pi + 722\pi = 1604\pi)$ oe			M1ft	for a method to find the area of the top of the bowl **or** the total area of the two curved surfaces of the bowl where [21] is what they believe to be radius of the hemisphere	M2 for use of formula for total surface area of hemispherical shell in a complete method, eg $3\pi([21])^2 + \pi([21] - 2)^2$ oe If not M2, allow M1 for this formula used with omission of π eg $3([21])^2 + ([21] - 2)^2$
		"1604π" + "80π"			M1ft	ft their [21] for a complete method	
		Correct answer only scores full marks (unless from obviously incorrect working)	1684π		A1	cao SCB4 for 2028π (use of 23 as the outer radius)	
							Total 5 marks