



Mark Scheme (Results)

Summer 2026

Pearson Edexcel International GCSE Mathematics A
(Modular)

4WM2H/01

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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**

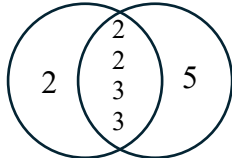
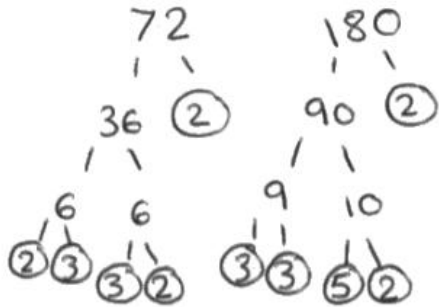
It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: eg. Incorrect cancelling of a fraction that would otherwise be correct.

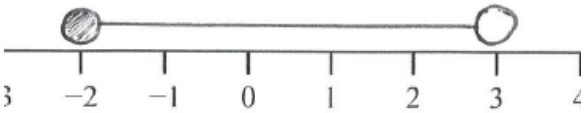
It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect eg algebra.

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.

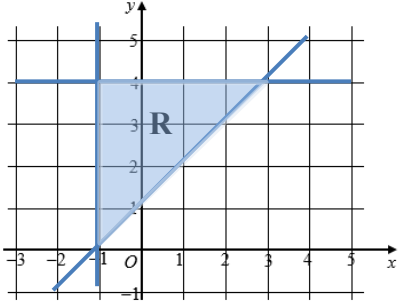
International GCSE Maths											
Values in quotation marks must come from a correct method previously seen unless clearly stated otherwise.											
Question	Working	Answer	Mark	Notes							
1	(1,) 2, 3, 4, 6, 8, 9, 12, 18, 24, 36, (72) and (1,) 2, 3, 4, 5, 6, 9, 10, 12, 15, 18, 20, 30, 36, 45, 60, 90, (180) or eg $72 = 36 \times 2$ and $180 = 36 \times 5$ or eg <table border="1"><tr><td>36</td><td>72</td><td>180</td></tr><tr><td></td><td>2</td><td>5</td></tr></table> or  or eg  or eg 2, 2, 2, 3, 3 and 2, 2, 3, 3, 5	36	72	180		2	5			2	M1 for any correct method with no errors, eg find at least 4 correct factors for each number, excluding 1, 72 and 1, 180, with no errors, if the factors listed are the same it must be clear they have a list for 72 and another list for 180 or list sufficient factors needed to find 36 as the HCF, eg 72, 36, ... and (180,) 90, 60, 45, 36, ... or find 36 as a factor of each number or find the prime factors of each number, eg in a table, Venn diagram, etc accept $2^3 \times 3^2$ and $2^2 \times 3^2 \times 5$ without working
	36	72	180								
	2	5									
Working required		36		A1 dep M1 for an answer of 36 Allow $2^2 \times 3^2$ oe							
Total 2 marks											

Question	Working	Answer	Mark	Notes
2	(a) Example 		2	B2 for a fully correct diagram, accept) for an open circle and [for a closed circle If not B2 then B1 for drawing a line from -2 to 3 or for a closed circle or [at -2 or for an open circle or) at 3
	(b) $5x \dots 9 + 21$		2	M1 For isolating $5x$ (accept any inequality or equal to) or for critical value of 6
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$x < 6$		A1 cao
				Total 4 marks

Question	Working	Answer	Mark	Notes													
3	eg $2 \times 2250 = 2 \times 225 \times 10$ or $2 \times 2250 = 2 \times 2 \times 1125$ or $2 \times 2250 = 2 \times 5 \times 450$ or $100 \times 45 = 10 \times 10 \times 45$ or $100 \times 45 = 2^2 \times 5^2 \times 45$ or $9 \times 500 = 9 \times 5 \times 100$ or $9 \times 500 = 9 \times 50 \times 10$		3	M1 for finding prime factors or factors after at least 2 stages of factorisation seen with 0 incorrect stages eg $2 \times 2250 = 2 \times 225 \times 10$ or for finding at least 2 prime factors after at least 3 stages in factorisation with no more than 1 incorrect stage eg 45×10 (incorrect) $= 9 \times 5 \times 5 \times 2$ 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)													
	eg <table><tr><td>2</td><td>4500</td></tr><tr><td>2</td><td>2250</td></tr><tr><td></td><td>1125</td></tr></table>			2	4500	2	2250		1125	eg 							
	2			4500													
2	2250																
	1125																
eg $2 \times 2 \times 3 \times 3 \times 5 \times 5 \times 5$ eg <table><tr><td>2</td><td>4500</td></tr><tr><td>2</td><td>2250</td></tr><tr><td>3</td><td>1125</td></tr><tr><td>3</td><td>375</td></tr><tr><td>5</td><td>125</td></tr><tr><td>5</td><td>25</td></tr><tr><td>5</td><td>5</td></tr><tr><td></td><td>(1)</td></tr></table>	2	4500	2	2250	3	1125	3	375	5	125	5	25	5	5		(1)	eg
2	4500																
2	2250																
3	1125																
3	375																
5	125																
5	25																
5	5																
	(1)																
	Working required	$2^2 \times 3^2 \times 5^3$		M1 dep on M1 for prime factors 2, 2, 3, 3, 5, 5, 5 with no others (ignore 1s) OR for getting to factors with a product of 4500 with at most one factor remaining that has not been fully factorised. This remaining factor must be the product of exactly two prime factors or a power of a single prime; allow use of index form eg 4, 3, 3, 5, 5, 5 or 2, 2, 9, 5, 5, 5 or 2, 3, 6, 5, 5, 5 or 4, 3 ² , 5 ³ or 2 ² , 9, 5 ³ or 2, 3, 3, 5, 5, 10 or 2, 2, 3, 3, 125 or 2, 2, 3, 5 ² , 15 Can be in any form, eg listed, multiplied, added May be seen in a factor tree or ladder													
				A1 dep on M1, may be in any order and allow $2^2 \cdot 3^2 \cdot 5^3$													
				Total 3 marks													

Question		Working	Answer	Mark	Notes
4	(a)		$20 < t \leq 40$	1	B1 Accept 20 – 40 allow inequalities to be inclusive or exclusive but must be a closed interval
	(b)	$10 \times 12 + 30 \times 46 + 50 \times 36 + 70 \times 18 + 90 \times 8$ or $120 + 1380 + 1800 + 1260 + 720 (= 5280)$ [LB: $(0 +) 920 + 1440 + 1080 + 640 = 4080$] [UB: $240 + 1840 + 2160 + 1440 + 800 = 6480$]		4	M2 for at least 4 correct products added (need not be evaluated) ie can be in the form $10 \times 12 + 30 \times 46 + \dots$ If not M2 then M1 for use of any values within the intervals (including end points) for at least 4 products, using the corresponding frequencies from the table, which must be added (need not be evaluated ie can be in the form $20 \times 12 + 40 \times 46 + \dots$) or correct midpoints used for at least 4 correct products and not added
		"5280" $\div$ 120			M1 dep on M1 allow division by their sum of frequencies if clearly shown eg workings next to the table
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	44		A1 cao SC B2 for 34 or 54 without working If no marks can be awarded in part b then check workings near the table for the award of method marks
					Total 5 marks

Question		Working	Answer	Mark	Notes
5	(a)	$8 \times 40 - 5 (= 315)$ or $8 \times 60 - 5 (= 475)$ or $\frac{63}{95}$ or $\frac{95}{63}$ or $1\frac{32}{63}$		3	M1 for a method to find the 40th term or the 60th term or the 40th term as a simplified fraction of the 60th term (or the reciprocal)
		“315” : “475” or $95 : 63$ or $1 : \frac{63}{95}$ or $\frac{95}{63} : 1$			M1 for forming the ratio or for the correct simplified ratio the other way around
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	63 : 95		A1 correct ratio in simplest form accept $1 : \frac{95}{63}$ or $\frac{63}{95} : 1$ for $\frac{95}{63}$, accept $1\frac{32}{63}$ oe or 1.51 or 1.507(9...) for $\frac{63}{95}$, accept 0.66(3...)
	(b)			2	M1 $5n + k$ oe k may be algebraic, any integer, zero or absent
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$5n - 2$		A1 oe eg $3 + 5(n - 1)$ NB award full marks for eg $x = 5n - 2$ or $x = 5 \times n - 2$ oe or $x = n \times 5 - 2$ oe or n th term = $5n - 2$ or n th term = $5 \times n - 2$ oe or n th term = $n \times 5 - 2$ oe or Allow eg T_n or U_n or a_n for n th term but award M1A0 for $n = 5n - 2$
					Total 5 marks

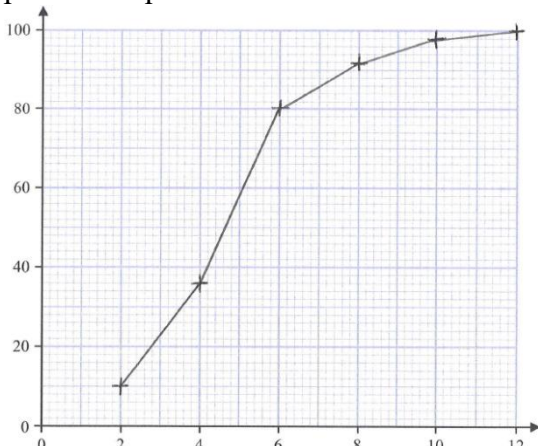
Question	Working	Answer	Mark	Notes
6	(a) (i) (ii) (iii)	Correct lines drawn	3	B1 line $x = -1$ drawn B1 line $y = 4$ drawn B1 line $y = x + 1$ drawn allow some imprecision but the intention should be clear allow solid or dashed lines, minimum length 2 squares line labels are not required unless there is ambiguity, accept a correctly identified region in part b as evidence for the correct lines being selected if for example more than one unlabelled vertical line is given etc
	(b)	 Correct region identified	1	B1 Correct region shaded ft for one vertical line (not $x = 0$), one horizontal line (not $y = 0$) and one line with a positive gradient, if shaded and/or label R is used the region indicated must correspond to the given inequalities for their acceptable lines Without shading, placement of label R must be correct Allow shading either inside or outside
				Total 4 marks

Question		Working	Answer	Mark	Notes	
7	(a)	$0.06 \times 25\,000 (= 1500)$ oe or $1.06 \times 25\,000 (= 26\,500)$ oe or $1.06 \times 1.06 \times 25\,000 (= 28\,090)$ oe or $1.06^3 (= 1.19(1016))$		3	M1 correct method for the amount of money in the account, or the interest, after 1 or 2 years, or the correct multiplier for 3 years do not accept eg $(1 + 6\%)$ without correct evaluation	M2 for $1.06^3 \times 25\,000$
		$1.06 \times 1.06 \times "26\,500"$ oe or $1.06 \times "28\,090"$ oe or $0.06 \times "26\,500" (= 1590)$ and $0.06 \times ("26\,500" + "1590") (= 1685(.4))$ or "1500" + "1590" + "1685.4" (= 4775(.4))			M1 correct method for the total amount of money in the account, or total interest, after 3 years	
		Correct answer scores full marks (unless from obvious incorrect working)	29 775		A1 Accept 29 775 – 29 776 If no other mark awarded SC B2 for $1.06^4 \times 25\,000 (= 31561(.924))$ if not SC B2 then SC B1 for $3 \times 0.06 \times 25\,000 (= 4500)$ oe $1.18 \times 25\,000 (= 29\,500)$ oe $0.94 \times 25\,000 (= 23\,500)$ $0.94^2 \times 25\,000 (= 22\,090)$ $0.94^3 \times 25\,000 (= 20\,764(.6))$	
	(b)	eg $0.045 \times I = 180$ oe eg $\frac{4.5}{100} \times I = 180$ oe or $4.5 : 180$ oe or $\frac{180}{4.5} (= 40)$ oe		3	M1 Set up and equation with the correct multiplier or sets up a correct ratio or correct method to find 1% of the 180 lira accept eg $4.5(\%)=180$ as a ratio Do not allow eg $4.5\% \times I$ without correct evaluation	
		$\frac{180}{0.045}$ oe eg $\frac{180}{4.5} \times 100$ oe or "40" $\times 100$ oe			M1 correct method to find the amount invested implies previous M1	
		Correct answer scores full marks (unless from obvious incorrect working)	4000		A1 accept an answer of 4180 SCB2 172(.248...) if a factor of $180/1.045$ oe seen	
					Total 6 marks	

Question	Working	Answer	Mark	Notes
8	$180 \times (5 - 2) \text{ or } 5 \times \left(180 - \frac{360}{5}\right) (= 540)$ oe OR $(180 - 96) + (180 - 91) + (180 - 93) + 2y = 360$ or $84 + 89 + 87 + 2y = 360$ or $(180 - 96) + (180 - 91) + (180 - 93)$ $(= 84 + 89 + 87 = 260)$ or $360 - (180 - 96) - (180 - 91) - (180 - 93)$ $(= 100)$		3	M1 for a correct method to find the sum of the interior angles OR forming an equation involving exterior angles (y is the exterior angle at E and B) may use any letter or finding the total of the exterior angles for the known angles or for the unknown angles
	eg $(2x =) \text{ "540" } - 96 - 91 - 93 (= \text{ "540" } - \text{ "280" } = 260)$ or $(x =) \frac{\text{ "540" } - 96 - 91 - 93}{2} \text{ oe}$ $\left(= \frac{\text{ "540" } - 280}{2} \right)$ OR $(y =) \frac{\text{ "100" }}{2} (=50) \text{ or } (x =) 180 - \frac{\text{ "100" }}{2}$ oe			M1 (dep on M1) for getting as far as the value for $2x$ or for a complete method for x using interior angles OR for finding the exterior angle at E or B or for a complete method using exterior angles
	Correct answer scores full marks (unless from obvious incorrect working)	130		A1 cao
				Total 3 marks

Question		Working	Answer	Mark	Notes
9	(a)		5.6×10^{-4}	1	B1 cao
	(b)	$8^2 \times (10^{52})^2$ oe or 64×10^{104} oe		2	M1 correct expansion or correct but not in standard form do not accept 8×10^{104}
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	6.4×10^{105}		A1 accept 6.4 with trailing zeroes eg 6.40
	(c)	$\frac{2.8}{7} \times \frac{10^{-58}}{10^{61}}$ oe or 0.4×10^{-119} oe		2	M1 correct separation or correct but not in standard form
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	4×10^{-120}		A1 accept 4.0 (or with more trailing zeroes)
					Total 5 marks

Question	Working	Answer	Mark	Notes
10	$\pi \times 7^2 \times 18$ (= 882π or [2769, 2772])		3	M1 for a correct method to find the volume of the cylinder
	$120L = \pi \times 7^2 \times 18$ or $(L =) \frac{\pi \times 7^2 \times 18}{120}$			M1 for forming an equation or a complete method allow any letter for L ignore any units used in the equation
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	23.1		A1 awrt 23.1
				Total 3 marks

Question	Working	Answer	Mark	Notes	
11	(a)	Example with line segments, crosses indicate points ± 1 sq  (2, 10), (4, 36), (6, 80), (8, 92), (10, 98), (12, 100)	Correct graph	2	B2 Fully correct graph with points at the ends of intervals and joined with a smooth curve or line segments; be tolerant of some imprecision in joining points. The line/curve may extend to (0, 0) If not B2 then B1 for 5 or 6 points plotted correctly at end points but may not be joined or for 5 or 6 points plotted consistently within each interval at correct heights and joined with a curve or line segments Allow up to ± 1 square tolerance each point
	(b)		4.6	1	B1 Accept 4.4 to 4.8 accept a correct value for their increasing curve ± 1 square tolerance
	(c)	reading corresponding to $t = 7$		2	M1 accept 84 to 88 or a correct method to show that they have tried to read up from 7 and then across, this may be evident from a mark on the vertical axis or at the curve fit a correct reading from an increasing curve
		Correct answer scores full marks (unless from obvious incorrect working)	14		A1 accept 12 to 16 (integer values only) for M1A1 fit from an increasing curve
				Total 5 marks	

Question	Working	Answer	Mark	Notes
12		5	2	B2 cao (B1 for 3 or 5 seen as a factor in the working Can be seen written next to the given number, as part of a factor tree or within a division statement etc)
				Total 2 marks

Question	Working		Answer	Mark	Notes
13	eg + $35x - 21y = 210$ $27x + 21y = 69$ ($62x = 279$) or $5x - 3\left(\frac{23-9x}{7}\right) = 30$ or $9x + 7\left(\frac{5x-30}{3}\right) = 23$	$45x - 27y = 270$ $- 45x + 35y = 115$ ($-62y = 155$) or $5\left(\frac{23-7y}{9}\right) - 3y = 30$ or $9\left(\frac{30+3y}{5}\right) + 7y = 23$		4	M1 A correct method to eliminate x or y (multiplying one or both equations so that one variable can be eliminated and the correct operation needed to eliminate this variable, which can be shown by 2 terms out of 3 correct). Allow one error in multiplying. or for a correct substitution of one variable into the other equation This mark is for the method and not for the result of the method although eg $62x = 279$ or $-62y = 155$ would imply this mark
	$x = 4.5$	$y = -2.5$			A1 oe dep on M1 for either value
	eg $5 \times "4.5" - 3y = 30$ or $9 \times "4.5" + 7y = 23$	$5x - 3 \times "-2.5" = 30$ or $9x + 7 \times "-2.5" = 23$			M1 dep on M1 for a correct method to find the second variable (eg substitution or elimination from original equations.)
	Working required		$x = 4.5$ $y = -2.5$		A1 oe dep on first M1 Award 4 marks for correct values following first M1
					Total 4 marks

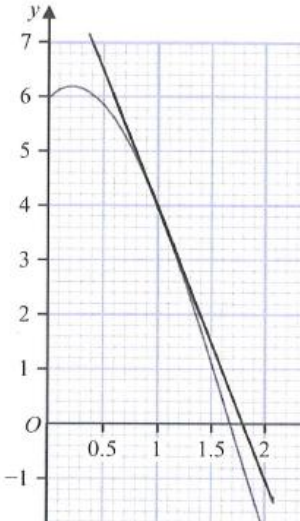
Question	Working	Answer	Mark	Notes
14	$12 \times 150 (= 1800)$		4	M1 method to find total weight of apples for tree A
	$2610 \div 145 (= 18)$			M1 method to find total number of apples for tree C
	$\frac{"1800"+2700+2610}{12+20+"18"} \left(= \frac{7110}{50} \right)$			M1 for a complete method
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	142.2		A1 accept $\frac{711}{5}$ or $142\frac{1}{5}$ or equivalent mixed number if 142.2 oe seen in working, allow rounding to 142 or 140 on answer line if 142.2 not seen in working, allow an answer of 142 or 140 if $\frac{7110}{50}$ or $7110 \div 50$ seen
				Total 4 marks

Question	Working		Answer	Mark	Notes
15	angle $ADC = 68^\circ$ <u>and</u> alternate segment theorem	(angle $ADC =$) $180^\circ - x$ <u>and</u> opposite angles of a cyclic quadrilateral add up to 180°		4	M2 for a correct angle <u>and</u> a correct reason or a correct expression for angle ADC in terms of x <u>and</u> the correct reason If not M2 then M1 for one correct angle or expression unless from an obviously incorrect method or without the correct reason
	or *obtuse angle $EAC = 112^\circ$ <u>and</u> on a straight line with angles or add up to 180	or (angle $ADC =$) $\frac{360^\circ - 2x}{2}$ oe <u>and</u> angle at the centre is twice the angle at circumference	112 with reasons		A2 dep on M1 for correct answer with the correct reason accept the evidence shown opposite If not A2 then A1 for correct answer without the correct reason *note that 112 may be an intermediate result and does not automatically score A1, there must be an association with x , which may be seen on the diagram If no other marks awarded SCB2 for $180 - [\text{their } ADC]$ and opposite angles of a cyclic quadrilateral add up to 180° SCB1 for $180 - [\text{their } ADC]$ where $[\text{their } ADC]$ does not depend on a correct method
					Total 4 marks

Question	Working	Answer	Mark	Notes
16	$q^2 = \frac{p-2t}{2+3t}$		4	M1 square both sides, condoning one miscopy in the fraction
	$2q^2 + 3tq^2 = p - 2t$			M1 ft dep M1 reaches an equation with no fraction and no brackets that follows from their equation if awarded the previous M1
	$3tq^2 + 2t = p - 2q^2$ or $t(3q^2 + 2) = p - 2q^2$			M1 ft dep on previous M1 Collect two terms in t on one side and two other terms on the other side, may be first seen in factorised form, with no further errors seen
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$t = \frac{p-2q^2}{3q^2+2}$		A1 accept $t = -\frac{2q^2-p}{3q^2+2}$ oe
				Total 4 marks

Question	Working	Answer	Mark	Notes
17	$3 \times \frac{59+1}{4} (= 45)$ oe or $3 \times \frac{59}{4} (= 44.25)$ oe eg $59 - 14.75$ or 45th (value) oe median = 3 and $\frac{29+1}{2} (= 15)$ or 15th (value) oe		2	M1 correct method to locate the upper quartile, may be seen after correct method to locate the lower quartile (eg 15, 45) implied by sight of 45 (not from incorrect working)
	<i>Working required</i>	4		A1 award for 4 following a value in range [44, 45] do not accept an answer of 4 without working
				Total 2 marks

Question		Working	Answer	Mark	Notes
18	(a)		50	1	B1
	(b)	$7 = 4 + x$ or $(f^{-1}(x) =) x - 4$ oe		2	M1
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	3		A1 cao
	(c)	$3(4+x)^2 + 2$ oe		2	M1 for correct substitution
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$3x^2 + 24x + 50$		A1 terms may be in any order
					Total 5 marks

Question	Working	Answer	Mark	Notes
19	(a) Examples using (1, 4) and (2, -1) $\frac{4 - -1}{1 - 2} (= -5)$ or $\frac{4 - -1}{-1} (= -5)$ oe or $4 = m + c$ and $-1 = 2m + c$ $\Rightarrow m = \dots (= -5)$		2	M1 for drawing a tangent at $x = 1$ and an attempt to use $\frac{\text{difference in } y\text{-values}}{\text{difference in } x\text{-values}}$. Must be able to see where the values being used have come from, eg from points clearly shown on tangent or a clearly labelled gradient triangle. At least 3 out of 4 values should be accurate to ± 1 sq or both coordinate differences accurate to ± 1 sq if coordinates not written Alternatively, may see use of their values to solve two correctly formed linear simultaneous equations and obtain a value for the gradient
	<i>Working required</i>	-5		A1 dep on tangent drawn, accept -5.7 to -4.3 SCB1 for tangent drawn at $x = 1$ and answer in range [4.3, 5.7]
	(b) (f(x) =) $2x - 6$ oe or eg (0, -6) and (1, -4)		3	M1 for correctly identifying the line that needs to be drawn or correct coordinates of at least two points on the line (may be seen in a table or plotted)
	Draws $y = 2x - 6$ on the grid			M1 for drawing $y = 2x - 6$ on the grid; allow a solid or dashed line the length of the line must be long enough to allow at least one of the solutions to be read implies previous M mark
	<i>Working required</i>	2 and/or 4.4		A1 dep on M2, for at least one correct value if a correct value for x is given, ignore any other value(s) of x given even if incorrect A0 for an answer that includes y -values or gives coordinates, but condone an answer of (2, 4.4) for 4.4, allow 4.35 to 4.45
				Total 5 marks

Question	Working	Answer	Mark	Notes
20	$2\pi \times 8^2 + 2\pi \times (8+x)^2$ oe eg $2\pi x^2 + 32\pi x + 256\pi$ or $\pi \times (8+x)^2 - \pi \times 8^2$ oe eg $\pi x^2 + 16\pi x$		6	M1 Correct expression for curved SA or flat SA
	$2\pi \times 8^2 + 2\pi \times (8+x)^2 + \pi \times (8+x)^2 - \pi \times 8^2$ oe eg $\pi \times 8^2 + 3\pi \times (8+x)^2$ oe or $3\pi \times 8^2 + 3\pi \times (8+x)^2 - 2\pi \times 8^2$ oe eg $3\pi x^2 + 48\pi x + 256\pi$			M1 Correct expression for total SA implies previous M1
	$12x^2 + 192x - 555 = 0$ oe or $3x^2 + 48x - 138.75 = 0$ oe or $x^2 + 16x - 46.25 = 0$ oe or $(8+x)^2 = 110.25$ oe			M1 dep M2 achieves a three-term quadratic in any form with at least two correct terms in which π may not be cancelled or correct solution for $(8+x)^2$ or their symbol for $8+x$
	$(x =) 2.5$ oe			A1 oe depends on having the correct quadratic in x or $8+x$ the negative solution for x (-18.5) should be omitted or rejected and there should be no other non-negative solutions stated if working with $8+x$, score this mark when substituting 10.5 into an expression for the volume of the bowl
	$\frac{2}{3}\pi(8+2.5)^3 - \frac{2}{3}\pi \times 8^3$ oe or $\frac{2}{3}\pi(10.5)^3 - \frac{1024}{3}\pi$ oe			M1 dep on M3A1 for a correct expression for the volume of the bowl using the correct value for x or $8+x$ implied by the correct answer
	Working required	1350		A1 dep on M3A1 accept a value in [1351, 1353] or $\frac{5165}{12}\pi$ oe or 430π

Question	Working	Answer	Mark	Notes
21 ALT 1	$\overrightarrow{EH} = 2(\mathbf{a} + \mathbf{b} + \mathbf{c})$ or $\overrightarrow{HE} = -2(\mathbf{a} + \mathbf{b} + \mathbf{c})$ $\overrightarrow{EN} = \overrightarrow{NH} = \mathbf{a} + \mathbf{b} + \mathbf{c}$ or $\overrightarrow{NE} = \overrightarrow{HN} = -\mathbf{a} - \mathbf{b} - \mathbf{c}$		4	M1 for one of the vectors opposite in terms of vectors a, b, c ; may be unsimplified equivalent expressions accept one of these vectors correctly placed on the diagram
	$\overrightarrow{LM} = \mathbf{b} + \mathbf{c}$ or $\overrightarrow{ML} = -\mathbf{b} - \mathbf{c}$ or $\overrightarrow{KL} = \mathbf{a} + \mathbf{b}$ or $\overrightarrow{LK} = -\mathbf{a} - \mathbf{b}$			M1 indep for one of the vectors opposite in terms of vectors a, b, c ; may be unsimplified equivalent expressions
	eg $\overrightarrow{LM}$ and $\overrightarrow{KN} = -\mathbf{a} + (\mathbf{a} + \mathbf{b} + \mathbf{c}) = \mathbf{b} + \mathbf{c}$ or $\overrightarrow{NK} = -(\mathbf{a} + \mathbf{b} + \mathbf{c}) + \mathbf{a} = -\mathbf{b} - \mathbf{c}$ OR eg $\overrightarrow{KL}$ and $\overrightarrow{NM} = (\mathbf{a} + \mathbf{b} + \mathbf{c}) - \mathbf{c} = \mathbf{a} + \mathbf{b}$ or $\overrightarrow{MN} = \mathbf{c} - (\mathbf{a} + \mathbf{b} + \mathbf{c}) = -\mathbf{a} - \mathbf{b}$			M1 dep on first M1 and may imply that mark For a vector parallel to LM or KL in terms of vectors a, b, c may be unsimplified equivalent expressions Vector notation is not required for method marks
	<i>Working required</i>	Correct conclusion		A1 dep on M3 with no errors seen and eg $\overrightarrow{LM} = \overrightarrow{KN}$ or $\overrightarrow{KL} = \overrightarrow{NM}$ oe, using vector notation, or a statement that eg $LM = KN$ (or eg $LM = NK$) and these sides are parallel
				Total 4 marks

Question	Working	Answer	Mark	Notes
21 ALT 2			4	M1 see main scheme
	$\overrightarrow{KM} = \mathbf{a} + 2\mathbf{b} + \mathbf{c}$ or $\overrightarrow{MK} = -\mathbf{a} - 2\mathbf{b} - \mathbf{c}$ and $\overrightarrow{LN} = \mathbf{c} - \mathbf{a}$ or $\overrightarrow{NL} = \mathbf{a} - \mathbf{c}$			M1 method to find the vectors along diagonals KM and LN with at least one correct, in terms of vectors a, b, c and in any form
	eg $\overrightarrow{EX} = \mathbf{a} + \lambda \overrightarrow{KM}$ and $\overrightarrow{EX} = \overrightarrow{EN} + \mu \overrightarrow{NL}$ or $\mathbf{a} + \lambda(\mathbf{a} + 2\mathbf{b} + \mathbf{c}) = \mathbf{a} + \mathbf{b} + \mathbf{c} + \mu(\mathbf{a} - \mathbf{c})$ oe			M1 gives two vector equations that include the point where the diagonals cross (X), in terms of two parameters that are to be found, or forms a single vector equation directly The first M1 may be implied
	<i>Working required</i>	Correct conclusion		A1 dep on M3 achieves, their parameters, $\mu = \lambda = 1/2$ oe
				Total 4 marks

Question	Working	Answer	Mark	Notes
22	$\frac{1000}{2}(1+1000)$ oe or $\frac{1000}{2}[2 \times 1 + (1000 - 1) \times 1]$ oe or 500 500		4	M1 correct method to find the sum of integers 1 to 1000, implied by the correct value
	$\frac{333}{2}(3+999)$ oe or $\frac{333}{2}[2 \times 3 + (333 - 1) \times 3]$ oe or 166 833			M1 correct method to find the sum of multiples of 3 from 3 to 999, implied by the correct value 500500/3 (= 166833.33...) scores M0
	"500 500" – "166 833"			M1 dep M2
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	333 667		A1 cao
				Total 4 marks

Question	Working	Answer	Mark	Notes
23	$2r + 2x + \pi r = 200$ oe		6	M1 forms correct equation for the perimeter
	$2rx + \frac{1}{2}\pi r^2$			M1 forms correct expression for the area
	$2r\left(\frac{200 - 2r - \pi r}{2}\right) + \frac{1}{2}\pi r^2$ oe eg $200r - 2r^2 - \frac{1}{2}\pi r^2$ oe or $200r - \left(2 + \frac{1}{2}\pi\right)r^2$ oe			M1 dep on M2 for a correct substitution using the equations leading to an expression in r only (this expression does not need to be correctly simplified) condone an incorrect expression for x only if the correct expression is seen at some stage, allow at most one error in their rearrangement
	$\left(\frac{dA}{dr} = \right) 200 - 4r - \pi r$ oe			M1 ft dep on previous M1 and having a quadratic expression in r for at least two terms of their quadratic expression for area differentiated correctly resulting in a linear expression
	$r(4 + \pi) - 200 = 0$ oe			M1 ft dep on previous M1 for putting their linear derivative in r only equal to zero
	<i>Working required</i>	28		A1 dep on M4 accept $\frac{200}{4 + \pi}$ or awrt 28
				Total 6 marks

Question	Working	Answer	Mark	Notes
24 ALT 1	$\sqrt{4} : \sqrt{9} (= 2 : 3)$ or $\sqrt{9} : \sqrt{4} (= 3 : 2)$ oe or $\frac{\sqrt{4}}{\sqrt{9}} \left(= \frac{2}{3} \right)$ oe or $\frac{\sqrt{9}}{\sqrt{4}} \left(= \frac{3}{2} \right)$ oe		5	M1 for a method to find the length scale factor may be seen as a ratio or a fraction may be seen embedded in a method to find the volume scale factor. NB a correct volume scale factor (as a ratio or a fraction) implies this mark, eg $8 : 27$ or $\frac{8}{27}$
	$(h_1 =) \frac{"2"}{"2"+"3"} \times 30 (= 12)$ or $(h_2 =) \frac{"3"}{"2"+"3"} \times 30 (= 18)$ or (Volume of C ₂ =) $\left(\frac{3}{2} \right)^3 \times 23.04\pi \left(= \frac{1944}{25}\pi = 77.76\pi = 244.2(90...) \right)$			M1 for correct method to find the height of one of the cones or for a correct method to find the volume of C ₂ h_1 and h_2 are the heights of C ₁ and C ₂ respectively implies previous M mark
	eg (Volume of C ₁ in terms of r_1): $\frac{1}{3} \times \pi \times r_1^2 \times "12" = 23.04\pi$ oe or (Volume of C ₁ in terms of r_2): $\frac{1}{3} \times \pi \times \left(\frac{2}{3} \times r_2 \right)^2 \times "12" = 23.04\pi$ oe or (Volume of C ₂ in terms of r_2): $\frac{1}{3} \times \pi \times r_2^2 \times "18" = "77.76\pi"$ oe or (Volume of C ₂ in terms of r_1): $\frac{1}{3} \times \pi \times \left(\frac{3}{2} \times r_1 \right)^2 \times "18" = "77.76\pi"$ oe			M1 for forming an equation common factors of π may be omitted r_1 and r_2 are the base radii of C ₁ and C ₂ respectively
	eg $r_1 = \sqrt{\frac{3 \times 23.04\pi}{"12" \times \pi}} (= 2.4)$ or $r_2 = \sqrt{\frac{3 \times "77.76\pi"}{"18" \times \pi}}$ oe			M1 dep on M3 for a complete method to find the radius of the base of one of the cones
	Working required	3.6		A1 dep on M3, accept equivalents eg $\frac{18}{5}$ or $3\frac{3}{5}$
				Total 5 marks

Question	Working	Answer	Mark	Notes
24 ALT 2	$\sqrt{4} : \sqrt{9}$ (= 2 : 3) or $\sqrt{9} : \sqrt{4}$ (= 3 : 2) oe or $\frac{\sqrt{4}}{\sqrt{9}} \left(= \frac{2}{3} \right)$ oe or $\frac{\sqrt{9}}{\sqrt{4}} \left(= \frac{3}{2} \right)$ oe		5	M1 for a method to find the length scale factor may be seen as a ratio or a fraction may be seen embedded in a method to find the volume scale factor. NB a correct volume scale factor (as a ratio or a fraction) implies this mark, eg 8 : 27 or $\frac{8}{27}$
	eg $\frac{1}{3} \times \pi \times r_1^2 \times h = 23.04\pi$ or $r_1^2 h = 69.12$ oe or $\frac{27}{8} \times \frac{1}{3} \times \pi \times r_1^2 \times h = \frac{1}{3} \times \pi \times r_2^2 \times (30 - h)$ or (Volume of C ₂ =) $\left(\frac{3}{2} \right)^3 \times 23.04\pi \left(= \frac{1944}{25} \pi = 77.76\pi = 244.2(90...) \right)$			M1 dep on M1 for a correct equation linking the radius and height of C ₁ or for a correct equation linking the radius and heights of both cones (<i>h</i> and 30 – <i>h</i> may be interchanged) or for a correct method to find the volume C ₂ <i>h</i> is the height of one of the cones <i>r</i> ₁ and <i>r</i> ₂ are the base radii of C ₁ and C ₂ respectively
	eg $\frac{3}{2} \times "69.12" = \frac{"69.12"}{h} \times (30 - h)$ oe OR $\frac{27}{8} \times r_1^2 \times \frac{"69.12"}{r_1^2} = \left(\frac{3}{2} r_1 \right)^2 \times \left(30 - \frac{"69.12"}{r_1^2} \right)$ oe			M1 uses two correct equations and $r_2 = \frac{3}{2} r_1$ oe to form a correct equation in one variable only the variable should represent the radius or height of one of the cones
	eg $\frac{3}{2} \times "69.12" = \frac{"69.12"}{h} \times (30 - h)$ oe leading to <i>h</i> = ... OR $\frac{27}{8} \times r_1^2 \times \frac{"69.12"}{r_1^2} = \left(\frac{3}{2} r_1 \right)^2 \times \left(30 - \frac{"69.12"}{r_1^2} \right)$ oe leading to <i>r</i> ₁ = ...			M1 dep on M3 for a complete method to solve their equation to find the height or radius of one of the cones implied by a correct value eg (<i>r</i> ₁ =) 2.4 or (<i>r</i> ₂ =) 3.6 or (<i>h</i> =) 12 or 18
	Working required	3.6		A1 dep on M3, accept equivalents eg $\frac{18}{5}$ or $3\frac{3}{5}$
Total 5 marks				