



Mark Scheme (Final)

Summer 2026

Pearson Edexcel International GCSE

Mathematics A

4MA1/2H

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Summer 2026

Question Paper Log Number P81064A

Publication Code 4MA1_2H_2606_MS

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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
- eooo – 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	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 <pre> 4500 / \ 2 2250 / \ 2 1125 / \ 2 1125</pre>								
	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 <pre> 4500 / \ 2 2250 / \ 2 1125 / \ 2 1125 / \ 3 375 / \ 3 125 / \ 3 125 / \ 5 25 / \ 5 5</pre>
2	4500																	
2	2250																	
3	1125																	
3	375																	
5	125																	
5	25																	
5	5																	
	(1)																	
Working required		$2^2 \times 3^2 \times 5^3$	A1 dep on M1, may be in any order and allow $2^2 \cdot 3^2 \cdot 5^3$															
Total 3 marks																		

2	(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 correct 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	

3 (a)		$27 < h \leq 31$	1	B1 for the correct class allow eg $27 \leq h \leq 31$ or $27 < h < 31$ or $27 \leq h < 31$ or $27 - 31$
(b)	$17 \times 2 + 21 \times 5 + 25 \times 12 + 29 \times 15 + 33 \times 6$ or $34 + 105 + 300 + 435 + 198 (= 1072)$ [lower bound products are: 30, 95, 276, 405, 186] [upper bound products are: 38, 115, 324, 465, 210]		4	M2 for at least 4 correct products added (need not be evaluated) (M1 for use of values within interval (including end points) for at least 4 products added or correct midpoints used for at least 4 products and not added)
	“1072” $\div$ 40			M1 dep on M1 allow division by their Σf provided addition or total under column seen
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	26.8		A1 accept $\frac{134}{5}$ or $26\frac{4}{5}$ oe mixed number accept 27 if $\frac{1072}{40}$ or $1072 \div 40$ or 26.8 oe seen ignore conversion to hours and minutes
				Total 5 marks

4	$612 - 450 (= 162)$ or $\frac{612}{450} (= 1.36)$ oe		3	M1 for finding the difference or the fractional increase
	$\frac{"162"}{450} \left(= \frac{9}{25} = 0.36 \right)$ or $\frac{"162"}{450} \times 100$ or $"1.36" - 1 \left(= \frac{9}{25} = 0.36 \right)$ or $("1.36" - 1) \times 100$ or $"1.36" \times 100 (=136)$ or $("1.36" \times 100) - 100$			M1 for a correct method to find the percentage increase or be one calculation away
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	36		A1
				Total 3 marks

5	(a)	enlargement	3	B1 for enlargement with no mention of translate, reflect, rotate, move, flip etc Accept: enlargement, enlarge, enlarged
		(scale factor) 2		B1 for scale factor 2 with no mention of a vector, line of symmetry or angle Accept: scale factor 2, SF 2, $\times 2$, factor of 2, two times, 2
		(centre) (1, 3)		B1 for the correct centre (1, 3) as a coordinate Accept: (1, 3) or 1, 3
	(b)	Use overlay	1	B1 Condone missing label
				Total 4 marks

6	$180 \times (5 - 2) \text{ or } 5 \times \left(180 - \frac{360}{5}\right) (= 540) \text{ oe}$ 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 $(2x =) \text{ "540" } - 96 - 91 - 93 (= \text{ "540" } - 280 = 260)$ or $(x =) \frac{\text{ "540" } - 96 - 91 - 93}{2} \text{ oe } \left(= \frac{\text{ "540" } - 280}{2} \right)$ OR $(y =) \frac{\text{ "100" }}{2} (=50) \text{ or } (x =) 180 - \frac{\text{ "100" }}{2} \text{ oe}$			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
	<i>Correct answer scores full marks (unless from obvious incorrect working).</i>	130		A1 cao
				Total 3 marks

7	$\pi \times 7^2 \times 18$ (= 882 π 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	

8	100(%) + 17(%) (=117(%)) or 1 + 0.17 (=1.17) oe or $\frac{3276}{117}$ (= 28) oe		3	M1	may be seen embedded Do not allow (1 + 17%) unless correctly processed
	$\frac{3276}{1.17}$ or $\frac{3276}{117} \times 100$ oe			M1	for a complete method
	<i>Correct answer scores full marks (unless from obvious incorrect working).</i>	2800		A1	
				Total 3 marks	

9	(a)		7	1	B1
	(b)		$8m^{15}p^{12}$	2	B2 for $8m^{15}p^{12}$ (B1 for a single product with any two of 8, m^{15} and p^{12} correct, eg $km^{15}p^{12}$ where $k \neq 8$ or $8m^ap^{12}$ where $a \neq 15$ or $8m^{15}p^b$ where $b \neq 12$. One term can be missing with 2 correct for B1)
	(c)		$6cw^2(3c^4 + 5w)$	2	B2 for the correct factorisation (B1 for a correct partial factorisation of at least 2 from 6, c and w or w^2 outside the bracket, eg $6c(3c^4w^2 + 5w^3)$ or $cw(18c^4w + 30w^2)$ or for the correct highest common factor on the outside and two terms inside the bracket with one correct eg $6cw^2(3c^4 + \dots)$ or $6cw^2(\dots + 5w)$ or for $(3c^4 + 5w)$ as a factor)
	(d)	$(x \pm 9)(x \pm 3)$ or $x(x - 3) + 9(x - 3)$ or $x(x + 9) - 3(x + 9)$ OR $(x + a)(x + b)$ where $ab = -27$ or $a + b = 6$ and a and b are integers and $a, b \neq 0$		2	M1 allow any letter for x
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$(x + 9)(x - 3)$		A1 correct factorisation; allow any letter for x ISW if correct factorisation is seen followed by an attempt to solve
					Total 7 marks

10	$0.15 \times 32\,000 (= 4800)$ oe or $(1 - 0.15) \times 32\,000 (= 27\,200)$ oe		4	M1 for a correct method to find 15% or 85% of 32 000 allow this mark for sight of 36 800 or 48 668 or 14 400 or 17 600	M2	for $0.85^3 \times 32\,000 (= 19\,652)$ or $0.85^4 \times 32\,000 (= 16\,704)$
	eg $0.15 \times (32\,000 - "4800") (= 4080)$ and $0.15 \times (32\,000 - "4800" - "4080") (= 3468)$ and $32\,000 - (4800 + 4080 + 3468) (= 19\,652)$ OR $(1 - 0.15) \times "27\,200" (= 23\,120)$ oe and $(1 - 0.15) \times "23\,120" (= 19\,652)$ oe OR $0.85^2 \times "27\,200" (= 19\,652)$			M1 for a complete method to find the value of the car after 3 years Do not accept $(1 - 15\%)$ in place of $(1 - 0.15)$ unless correctly processed		
	$\frac{"19\,652" - 2516}{3 \times 12}$ or $17\,136 \div (3 \times 12)$ oe or $\frac{[\text{value of the car}] - 2516}{3 \times 12}$ oe			M1 dep on M1 for a method to find the monthly payment [value of the car] is what they believe to be the value of the car after 3 years. There must be some attempt to use more than one year of depreciation and the value must satisfy $2516 < [\text{value of the car}] < 32\,000$		
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	476		A1 cao SCB3 for either of the following: <ul style="list-style-type: none"> answer in the range [394, 395] (use of 4 years) answer 1282 (use of 15% increase) SCB2 for: <ul style="list-style-type: none"> answer 419 (simple depreciation) 		
				Total 4 marks		

11		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

12 (a)		25, 26	1	B1 25 and 26 in any order and not repeated, no other numbers
(b)		31, 32	1	B1 31 and 32 in any order and not repeated, no other numbers
				Total 2 marks

13	$12 \times 150 (= 1800)$		4	M1 correct method to find total weight of apples for tree A
	$2610 \div 145 (= 18)$			M1 correct 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 $142\frac{1}{5}$ oe mixed number if 142.2 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

15	$\frac{80}{360} \times \pi \times r^2 = 32\pi$ oe		4	M1	for forming a correct equation, allow use of any variable NB: treat consistent use of 32 instead of 32π as the area as a misread (all M marks available)
	$(r =) \sqrt{\frac{32\pi \times 360}{80 \times \pi}}$ ($=\sqrt{144} = 12$)			M1	for a correct method to solve for r NB: misread of the area as 32 gives $r = 6.7(7\dots)$
	$\frac{80}{360} \times 2 \times \pi \times "12" \left(= \frac{16}{3} \pi = 16.7(551\dots) \right)$ oe			M1	substitution of r from a correct method to find the arc length NB: misread of the area as 32 gives arc length = awrt 9.5
	<i>Correct answer scores full marks (unless from obvious incorrect working).</i>	40.8		A1	allow an answer in the range 40.7 – 40.8
				Total 4 marks	

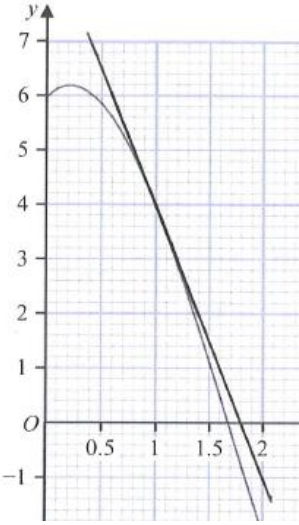
16	(a)		50	1	B1
	(b)	$7 = 4 + x$ or $(f^{-1}(x) =) x - 4$ oe		2	M1 for forming a correct equation (allow any letter for x) or for the correct inverse function (allow in terms of any variable)
		<i>Correct answer scores full marks (unless from obvious incorrect working).</i>	3		A1 cao
	(c)	$3(4+x)^2 + 2$ 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

17	<p>eg $\begin{array}{r} (100x =) 53.939..._ \\ (x =) 0.539... \end{array}$</p> <p>or $\begin{array}{r} (1000x =) 539.39..._ \\ (10x =) 5.39... \end{array}$</p> <p>or $\begin{array}{r} (100\,000x =) 539\,39.39..._ \\ (1000x =) 539.39... \end{array}$</p> <p>or $0.5 + 0.0\dot{3}\dot{9}$ and eg $\begin{array}{r} (1000y =) 39.393..._ \\ (10y =) 0.39... \end{array}$</p>		2	<p>M1 for 2 correct recurring decimals that when subtracted should give a whole number or terminating decimal and intention to subtract (ie may give 53.4 or 534 or 53 400 or 39 or 3900 etc)</p> <p>eg any of the following with intention to subtract $(100x =) 53.939...$ and $(x =) 0.539....$</p> <p>or $(1000x =) 539.39...$ and $(10x =) 5.39....$</p> <p>or $(100\,000x =) 53939....$ and $(1000x =) 539.39....$</p> <p>or $0.5 + 0.0\dot{3}\dot{9}$ and $(1000y =) 39.393...$ and $(10y =) 0.39...$</p> <p>x is not required to award this mark</p> <p>if recurring dots not shown in both numbers then showing at least one of the numbers to at least 5sf is sufficient</p> <p>NB Accept bar notation for dot notation to indicate recurring decimals</p>
	<p>$100x - x = 53.939... - 0.539... = 53.4$ and $\frac{53.4}{99} = \frac{89}{165}$</p> <p>or $1000x - 10x = 539.39... - 5.39... = 534$ and $\frac{534}{990} = \frac{89}{165}$</p> <p>or $100\,000x - 1000x = 53939 - 539 = 53\,400$ and $\frac{53\,400}{99\,000} = \frac{89}{165}$</p> <p>or $1000y - 10y = 39.393... - 0.39... = 39$ and $0.5 + \frac{39}{990} = \frac{0.5 \times 990 + 39}{990} = \frac{534}{990} = \frac{89}{165}$</p>	Shown		<p>A1 dep on M1, for completion to $\frac{89}{165}$</p> <p>must use algebra for this final mark to be awarded</p> <p>No algebra used gets a maximum of 1 mark</p>
	Working required			Total 2 marks

18	$ax^2 + 6a = 3w - x^2$ oe		4	M1 for multiplying both sides by the denominator and expanding the brackets to get a correct equation
	$ax^2 + x^2 = 3w - 6a$ or $-ax^2 - x^2 = 6a - 3w$			M1 ft dep on 2 terms in x^2 and 2 other terms for correctly collecting their x^2 terms on one side and their other terms on the other side
	eg $x^2(a+1) = 3w - 6a$ or $x^2(-a-1) = 6a - 3w$			M1 ft dep on 2 terms in x^2 on one side and 2 other terms on the other side of an equation for correctly factorising x^2 or $-x^2$ from their equation
	<i>Correct answer scores full marks (unless from obvious incorrect working).</i>	$x = (\pm) \sqrt{\frac{3w-6a}{a+1}}$		A1 oe eg $x = (\pm) \sqrt{\frac{6a-3w}{-a-1}}$ or $x = (\pm) \left(\frac{3w-6a}{a+1} \right)^{\frac{1}{2}}$ or $x = (\pm) \left(\frac{3w-6a}{a+1} \right)^{0.5}$ (condone omission of $\pm$) allow correct factorisation of the numerator NB: to award A1, we must see $x = (\pm) \sqrt{\frac{3w-6a}{a+1}}$ in working if $(\pm) \sqrt{\frac{3w-6a}{a+1}}$ alone is given as an answer
				Total 4 marks

19	(angle) $EDB = 52$ or $\frac{180 - 52}{2} \left(= \frac{128}{2} \right)$		2	M1 for correctly identifying (angle) EDB as 52 in the working or on the diagram or for a complete method
	<i>Correct answer scores full marks (unless from obvious incorrect working).</i>	64		A1
				Total 2 marks

20	<u>Way 1</u> $p^2 = 1 - \frac{39}{64}$ oe or $p^2 = \frac{25}{64}$ oe or $(p =) \sqrt{1 - \frac{39}{64}} \left(= \sqrt{\frac{25}{64}} \right)$ oe or $(p =) \frac{5}{8}$ or 0.625 oe	<u>Way 2</u> $q^2 + 2q(1 - q) = \frac{39}{64}$ oe or $64q^2 - 128q + 39 (= 0)$ oe or $(q =) \frac{3}{8}$ or 0.375 oe	3	M1 <u>Way 1 (p = probability of choosing green)</u> award M1 for a correct equation in terms of p only or for a complete method to find p or for the correct value of p do not accept pp for p^2 unless evidenced by further correct work (eg square rooting) but allow $p.p$ or $p \times p$ <u>Way 2 (q = probability of choosing red)</u> award M1 for a correct equation in terms of q only or for the correct value of q may use any letter for their variable
	$\frac{5}{8} \times \left(1 - \frac{5}{8} \right) [\times 2]$ oe $\left(= \frac{15}{64} [\times 2] \right)$ or $\frac{39}{64} - \left(\frac{3}{8} \right) \left(\frac{3}{8} \right)$ or $\frac{39}{64} - \left(1 - \frac{5}{8} \right) \left(1 - \frac{5}{8} \right)$ oe or $1 - \left(\frac{5}{8} \right) \left(\frac{5}{8} \right) - \left(1 - \frac{5}{8} \right) \left(1 - \frac{5}{8} \right)$ oe or $1 - \left(\frac{3}{8} \right) \left(\frac{3}{8} \right) - \left(1 - \frac{3}{8} \right) \left(1 - \frac{3}{8} \right)$ oe			M1 for a method to find the probability Nuno chooses exactly one red counter condone omission of $\times 2$ if doing $P(R) \times P(G)$, but do not allow if this is multiplied by any other value or if combined with additional incorrect probabilities If incorrect, $\frac{5}{8}$ must come from $\sqrt{1 - \frac{39}{64}}$ oe If incorrect, $\frac{3}{8}$ must come from a valid method to solve a 3-term quadratic following M1 (factorising, quadratic formula or completing the square)
	<i>Correct answer scores full marks (unless from obvious incorrect working).</i>	$\frac{15}{32}$		A1 oe eg $\frac{30}{64}$ or 0.46(875) or 46(.875)% truncated or rounded to at least 2sf. ISW conversion to other forms (fraction, decimal or percentage) once correct probability has been seen
				Total 3 marks

21 (a)	<p>Examples using (1, 4) and (2, -1)</p> $\frac{4 - (-1)}{1 - 2} (= -5) \text{ or } \frac{4 - (-1)}{-1} (= -5) \text{ oe}$ <p>or</p> $4 = m + c \text{ and } -1 = 2m + c \Rightarrow m = \dots (= -5)$		<p>2 M1 for drawing a tangent at $x = 1$ and an attempt to use $\frac{\text{difference in } y\text{-values}}{\text{difference in } x\text{-values}}$.</p> <p>Must be able to see where the values being used have come from, eg from points clearly shown on tangent or a drawn 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</p> <p>Alternatively, may see use of their values to solve two correctly formed linear simultaneous equations and obtain a value for the gradient</p>
	<i>Working required</i>	-5	<p>A1 dep on tangent drawn, accept -5.7 to -4.3 allow integer/integer if in range SCB1 for tangent drawn at $x = 1$ and answer in range [4.3, 5.7]</p>
(b)	<p>(f(x) =) $2x - 6$ oe or eg (0, -6) and (1, -4)</p>		<p>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)</p>
	Draws $y = 2x - 6$ on the grid		<p>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</p>
	<i>Working required</i>	2 and/or 4.4	<p>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</p> <p>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</p>
			<p>Total 5 marks</p>

22	<p>eg</p> $\left(\overrightarrow{AC} = \begin{pmatrix} 12 \\ 3 \end{pmatrix} - \begin{pmatrix} 2 \\ 8 \end{pmatrix} = \begin{pmatrix} \pm 10 \\ \pm 5 \end{pmatrix}\right) \text{ oe}$ <p>or</p> $\left(\overrightarrow{BC} = \begin{pmatrix} 12 \\ 3 \end{pmatrix} - \begin{pmatrix} 21 \\ 14 \end{pmatrix} = \begin{pmatrix} \pm 9 \\ \pm 11 \end{pmatrix}\right) \text{ oe}$ <p>or</p> $\left(\overrightarrow{AB} = \begin{pmatrix} 21 \\ 14 \end{pmatrix} - \begin{pmatrix} 2 \\ 8 \end{pmatrix} = \begin{pmatrix} \pm 19 \\ \pm 6 \end{pmatrix}\right) \text{ oe}$		4	<p>M1 for a method to find at least one of $\overrightarrow{AC}$ (or $\overrightarrow{CA}$), $\overrightarrow{BC}$ (or $\overrightarrow{CB}$), or $\overrightarrow{AB}$ (or $\overrightarrow{BA}$); allow subtraction to be either way around and ignore any labelling</p> <p>this mark can be implied by the correct components for at least one of the vectors (ignoring signs)</p> <p>allow components to be seen in coordinate form or on a diagram etc</p>
	$(AC =) \sqrt{(\pm 10)^2 + (\pm 5)^2} (= \sqrt{125} = 5\sqrt{5} = 11.1(8...)) \text{ oe}$ <p>or</p> $(BC =) \sqrt{(\pm 9)^2 + (\pm 11)^2} (= \sqrt{202} = 14.2(1...)) \text{ oe}$ <p>or</p> $(AB =) \sqrt{(\pm 19)^2 + (\pm 6)^2} (= \sqrt{397} = 19.9(2...)) \text{ oe}$ <p>or (Anna's distance =) $\sqrt{(\pm 10)^2 + (\pm 5)^2} + \sqrt{(\pm 9)^2 + (\pm 11)^2} (= 25.3(9...)) \text{ oe}$</p>			<p>M1 for a method to find the length of at least one of AC, BC or AB</p> <p>or for a method to find the distance Anna walks</p> <p>invisible brackets must be recovered</p> <p>implies previous M mark</p>
	$"\sqrt{125}" + "\sqrt{202}" - "\sqrt{397}" (= "25.3(9...)" - "19.9(2...)" = 5.4(68...)) \text{ oe}$ <p>or</p> $"\sqrt{125}" + "\sqrt{202}" - [AB] \text{ oe}$ <p>or</p> $"\sqrt{125}" + [BC] - "\sqrt{397}" \text{ oe}$ <p>or</p> $[AC] + "\sqrt{202}" - "\sqrt{397}" \text{ oe}$			<p>M1 for a complete method using lengths from a correct method</p> <p>or</p> <p>for a complete method where at least two lengths come from a correct method</p> <p>$[AB]$, $[BC]$ and $[AC]$ are their identifiable lengths of AB, BC and AC respectively. The length must come from a calculation of the form $\sqrt{x^2 + y^2}$ (condone unrecovered invisible brackets here), but do NOT allow this mark if the third length comes from use of $[AB] = \sqrt{[BC]^2 + [AC]^2}$ oe</p> <p>lengths used may be exact or decimal values rounded or truncated to 1dp</p>
	Correct answer scores full marks (unless from obvious incorrect working).	5.5		<p>A1 allow an answer in the range 5.4 – 5.5</p>
				Total 4 marks

23	eg $x^2 + (3x - 2)^2 - 2(3x - 2) = 12$	eg $\left(\frac{y+2}{3}\right)^2 + y^2 - 2y = 12$		5	M1 for substitution of $y = 3x - 2$ or $x = \frac{\pm y \pm 2}{3}$ into $x^2 + y^2 - 2y = 12$ to obtain an equation in x only (or y only)
	eg $10x^2 - 18x - 4 (= 0)$ oe or $10x^2 - 18x = 4$ oe or $5x^2 - 9x = 2$ oe	eg $10y^2 - 14y - 104 (= 0)$ oe or $10y^2 - 14y = 104$ oe or $5y^2 - 7y = 52$ oe			M1ft dep on previous M1, for multiplying out and collecting terms, forming a 3-term quadratic in any form, where at least 2 coefficients are correct for their substitution
	$(10x + 2)(x - 2) (= 0)$ or $(x - 2)(5x + 1) (= 0)$ or $(x =) \frac{18 \pm \sqrt{(-18)^2 - 4 \times 10 \times (-4)}}{2 \times 10}$ or $10 \left[\left(x - \frac{18}{20}\right)^2 - \left(\frac{18}{20}\right)^2 \right] - 4 (= 0)$ or $x = 2$ and $x = -0.2$ oe	$(10y + 26)(y - 4) (= 0)$ or $(y - 4)(5y + 13) (= 0)$ or $(y =) \frac{14 \pm \sqrt{(-14)^2 - 4 \times 10 \times (-104)}}{2 \times 10}$ or $10 \left[\left(y - \frac{14}{20}\right)^2 - \left(\frac{14}{20}\right)^2 \right] - 104 (= 0)$ or $y = 4$ and $y = -2.6$ oe			M1ft dep on first M1, for solving their 3-term quadratic equation using any correct method By factorising, allow brackets which if expanded would give 2 out of 3 terms correct for their quadratic By formula allow simplification as far as: $\frac{18 \pm \sqrt{324 + 160}}{20}$ or $\frac{14 \pm \sqrt{196 + 4160}}{20}$ where $\pm$ is required; allow one sign error By completing the square look for method as far as is shown opposite Implied by the correct values for x or for y
	$(y =) 3 \times "2" - 2 (= 4)$ and $(y =) 3 \times "-0.2" - 2 (= -2.6)$ oe	$(x =) \frac{"4" + 2}{3} (= 2)$ and $(x =) \frac{"-2.6" + 2}{3} (= -0.2)$			M1ft dep on previous M1, for substitution of their values x or y into a given equation or allowed expression used for substitution or both correct values for the other variable or a correct x - y pair
	<i>Working required</i>		(2, 4) and (-0.2, -2.6)	A1	oe dep on M2 and a correct quadratic
					Total 5 marks

ALT 1: finding h first using the ratio

24	$\sqrt{4}:\sqrt{9} (= 2:3)$ 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 correct 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 a correct equation in one variable 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
	<i>Working required</i>	3.6		A1 dep on M3, accept equivalents eg $\frac{18}{5}$ or $3\frac{3}{5}$
				Total 5 marks

ALT 2: simultaneous equations

24	$\sqrt{4} : \sqrt{9} (= 2 : 3)$ 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 correct 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 (h and $30 - h$ may be interchanged) or for a correct method to find the volume of C_2 h is the height of one of the cones r_1 and r_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 $h = \dots$ 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 $r_1 = \dots$			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 ($r_1 =$) 2.4 or ($r_2 =$) 3.6 or ($h =$) 12 or 18
	<i>Working required</i>	3.6		A1 dep on M3, accept equivalents eg $\frac{18}{5}$ or $3\frac{3}{5}$
				Total 5 marks

25	$(S_{5k} =) \frac{5k}{2}[2(3) + (5k-1)(8)] \quad \left(= \frac{5k}{2}(40k-2) = 100k^2 - 5k \right) \text{ oe}$ <p>or</p> $(S_{3k} =) \frac{3k}{2}[2(3) + (3k-1)(8)] \quad \left(= \frac{3k}{2}(24k-2) = 36k^2 - 3k \right) \text{ oe}$		5	<p>M1 finds an expression for S_{5k} or S_{3k} by using the correct S_n formula with $a = 3$ and $d = 8$</p> <p>the substitution into S_n may be seen in stages; condone slips in simplification between stages provided the expression remains quadratic in n</p> <p>condone use of a different letter for k including n</p> <p>incorrect brackets must be recovered</p>
	<p>eg</p> $\frac{5k}{2}[2(3) + (5k-1)(8)] - \frac{3k}{2}[2(3) + (3k-1)(8)] = 25\,560 \text{ oe}$ <p>or</p> $100k^2 - 5k - (36k^2 - 3k) = 25\,560$ <p>or</p> $5k(40k-2) - 3k(24k-2) = 51\,120 \text{ oe}$			<p>M1 for forming an equation using their S_{5k} and S_{3k} both of which must be quadratic in k and come from an attempt to use the correct S_n formula with $a = 3$ and $d = 8$</p> <p>condone use of a different letter for k including n</p> <p>condone invisible brackets for the subtraction eg $100k^2 - 5k - 36k^2 - 3k = 25\,560$</p>
	<p>eg</p> $128k^2 - 4k - 51\,120 (=0) \text{ oe}$ <p>or</p> $64k^2 - 2k - 25\,560 (=0) \text{ oe}$ <p>or</p> $32k^2 - k - 12\,780 (=0) \text{ oe}$			<p>A1 dep on M2</p> <p>for reaching a correct 3-term quadratic; allow if terms not all on one side</p>
	<p>$(u_{4k} =) 3 + (4 \times [\text{their } k] - 1) \times 8 \text{ oe}$</p> <p>or</p> <p>$(u_{4k} =) 8(4 \times [\text{their } k]) - 5 \text{ oe}$</p>			<p>M1 dep on M2</p> <p>for a correct method to find u_{4k} using $[\text{their } k] > 0$</p> <p>$[\text{their } k]$ is what they believe to be a solution to their 3-term quadratic and must be positive</p> <p>allow this mark if a second value of k is used to find u_{4k} (even if this second k is negative)</p> <p>(note the correct value of k is 20)</p>
	Working required	635		A1 dep on M2A1
				Total 5 marks

26	(a)		$(-5, 12)$	1	B1	cao
	(b)	Acceptable examples <u>reflection</u> in the <u>y-axis</u> / <u>$x = 0$</u> <u>translation</u> $\begin{pmatrix} 6 \\ 0 \end{pmatrix}$ <u>stretch</u> of SF <u>-1</u> in the <u>x direction</u>	description	1	B1	for correct description of a single transformation accept ' <u>horizontal</u> ' in place of ' <u>x direction</u> '
	(c)		$a = 2$ $b = 60$ $c = 3$	3	B3	for all three values correct (B2 for two values correct) (B1 for one value correct)
					Total 5 marks	