EXPERT TUITION

Maths Questions By Topic:

Algebra
Mark Scheme

Edexcel GCSE (Higher)

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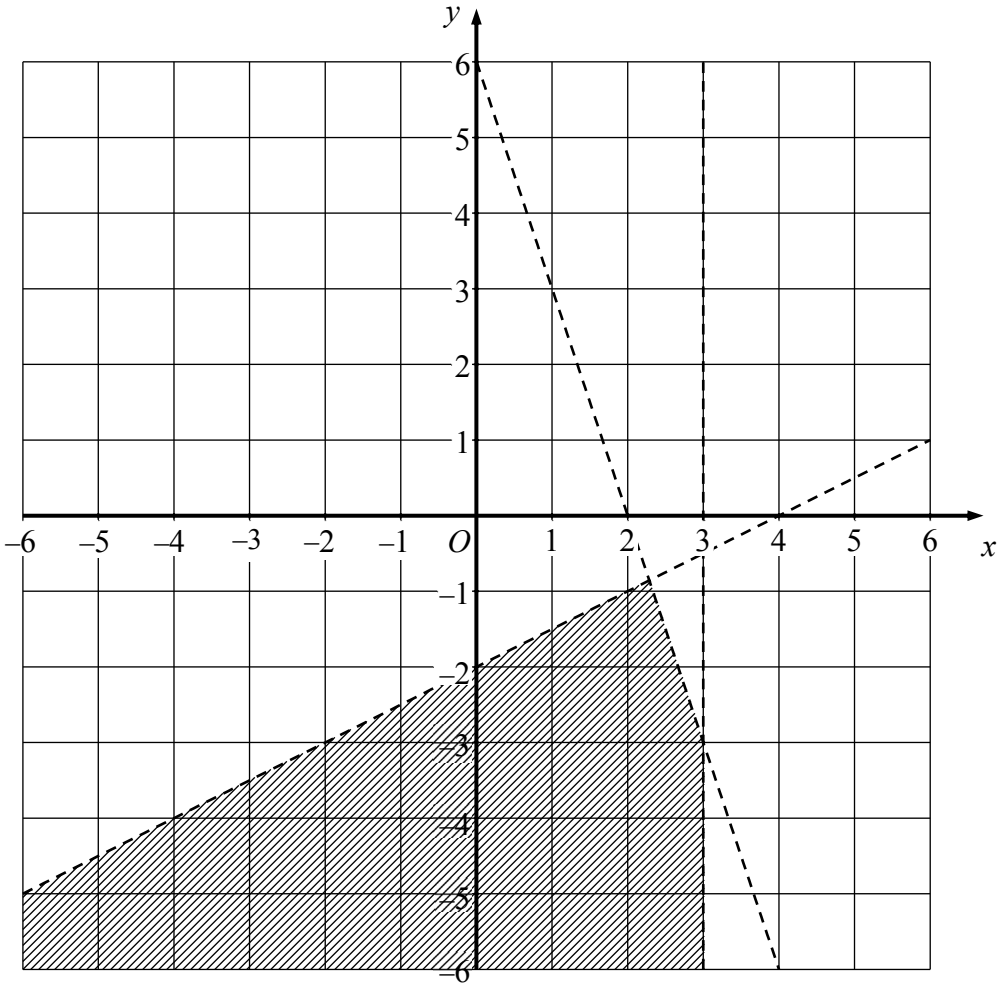
Question	Answer	Mark	Mark scheme	Additional guidance
1	8 and –3	M1	for rearranging to get $x^2 - 5x - 24 (= 0)$ **or** $-x^2 + 5x + 24 (= 0)$	Can be implied by $(x - 8)(x + 3)$ or $(-x + 8)(x + 3)$
		M1	for $(x \pm 8)(x \pm 3)$ **or** $(x + a)(x + b)$ where $ab = -24$ or $a + b = -5$ **or** substitution into formula, condoning one sign error eg $(x =) \dfrac{--5 \pm \sqrt{(-5)^2 - 4 \times 1 \times -24}}{2 \times 1}$	
		A1	for 8 **and** –3	
2	$\dfrac{30w}{6 - 21w}$	P1	for forming an equation, eg $6(2w + y) = 7w(3y + 6)$ **or** $12w + 6y = 21wy + 42w$ oe	Condone missing brackets for this mark
		P1	for expanding brackets correctly and gathering w terms or isolating y terms in a correct equation, eg $6y = 21wy + 30w$ **or** $6y - 21wy = 42w - 12w$ **or** $6y - 21wy = 30w$	
		P1	(dep on two terms in y) for factorising out the y, eg $y(6 - 21w) = 42w - 12w$ **or** $y(6 - 21w) = 30w$ **or** $3y(2 - 7w) = 30w$	
		A1	fo $(y =) \dfrac{30w}{6 - 21w}$ oe	

Question	Answer	Mark	Mark scheme	Additional guidance
3	Shown	M1	for a start to the method, eg finds one correct area $4(x + 1)$ **or** $(x + 7)(2x + 6)$ **or** $(x + 1)(x + 11)$ **or** $(x + 7)(x + 5)$ **or** $4(x + 5)$ **or** $(x + 11)(2x + 6)$	
		M1	for a complete expression for the total area, eg $4(x + 1) + (x + 7)(2x + 6)$ **or** $4x + 4 + 2x^2 + 14x + 6x + 42$ **OR** $(x + 1)(x + 11) + (x + 7)(x + 5)$ **or** $x^2 + x + 11x + 11 + x^2 + 7x + 5x + 35$ **OR** $(x + 11)(2x + 6) - 4(x + 5)$ **or** $2x^2 + 22x + 6x + 66 - 4x - 20$	
		A1	for a complete chain of reasoning with fully correct algebra leading to $2x^2 + 24x + 46$	$2x^2 + 24x + 46$ is given so need to see brackets expanded correctly
4	$\frac{26x+15}{10x}$	M1	for method to write at least one of the fractions with a suitable denominator, eg $\frac{4x+3}{2x}\times\frac{5}{5}\left(=\frac{20x+15}{10x}\right)$ **or** $\frac{3}{5}\times\frac{2x}{2x}\left(=\frac{6x}{10x}\right)$	
		M1	for method to combine the fractions, eg $\frac{5(4x+3)}{5\times 2x}+\frac{3\times 2x}{5\times 2x}$ **or** $\frac{5(4x+3)+3\times 2x}{5\times 2x}$ **or** $\frac{20x+15}{10x}+\frac{6x}{10x}$	
		A1	for correct algebra leading to $\frac{26x+15}{10x}$ oe in form $\frac{ax+b}{cx}$	

Question	Answer	Mark	Mark scheme	Additional guidance
5	Region shaded	M1 M1 A1	for two of the lines $2y + 4 = x$, $x = 3$, $y = 6 - 3x$ correctly drawn for all three correct lines correctly drawn for a fully correct region indicated with all lines correct	Accept full or broken lines for all marks Award for clear intention, shading not needed Diagram at end of mark scheme
6	$x = 2.1$, $y = 5.1$ $x = -2.9$, $y = -4.7$	M1 A1 A1	for drawing the graph of $y - 2x = 1$ for one correct pair of values **or** for both correct x values, **or** for both correct y values for both correct pairs, correctly matched	 For both A marks accept answers in the ranges $x = 2.0$ to 2.2, $y = 5.0$ to 5.2 $x = -2.8$ to -3.0, $y = -4.6$ to -4.8 Accept values given as coordinates

Question 5



Question	Answer	Mark	Mark scheme	Additional guidance
7 (a)	$\frac{1}{4}$	M1	for f(1) = 3 × 1^2 + 1 (= 4) **and** a clear intention to find g("4") **or** for $\frac{4}{\left(3\times1^2+1\right)^2}$ **or** for stating gf(x), eg $\frac{4}{\left(3x^2+1\right)^2}$ oe	
		A1	oe	
(b)	$\sqrt[4]{\frac{48}{x-1}}$	M1	for finding fg(x), eg $3\times\left(\frac{4}{x^2}\right)^2+1$ **or** $\frac{48}{x^4}+1$	
		M1	for start of method to find the inverse of fg(x), eg $y-1=3\times\left(\frac{4}{x^2}\right)^2$ **or** $y-1=\frac{48}{x^4}$ **or** $x-1=\frac{48}{y^4}$ **or** $x-1=3\times\left(\frac{4}{y^2}\right)^2$	
		M1	for $y^4=\frac{48}{x-1}$ **or** $x^4=\frac{48}{y-1}$ **or** for a final answer of $\sqrt[4]{\frac{48}{y-1}}$	
		A1	oe	
8	(3, 36)	P1	for factorising –3 from the expression, eg $-3(x^2-6x-3)$ **or** $-3(x^2-6x)+9$	
		P1	for starting the process to complete the square, eg $(x-3)^2-9$	ft from their factorising if only one error
		P1	for completing the process of completing the square, eg $-3[[(x-3)^2-12]]$ **or** $-3(x-3)^2+36$	
		A1	cao	An answer only and no working is 0 marks

Question	Answer	Mark	Mark scheme	Additional guidance
9	3n − 2	B2 (B1	for $3n - 2$ oe for $3n + k$ where $k \neq -2$ or is absent unambiguously shown)	Accept a different variable, eg. $3x - 2$ $n = 3n - 2$ gets B1 only $n + 3$ gets NO marks
10	B C D A	B2 (B1	cao for two or three correct)	

Question	Answer	Mark	Mark scheme	Additional guidance
11	$y=-\frac{1}{3}x+8$	M1	for a method for finding the gradient of L_2 eg use of $-\frac{1}{m}$ **or** $-\frac{1}{3}$	
		M1	(dep) for substitution of (9, 5) into $y="-\frac{1}{3}"x+c$	
		A1	for $y=-\frac{1}{3}x+8$ oe	$y-5=-\frac{1}{3}(x-9)$ gets M2A1
12	$f=\frac{4d+3}{d+3}$	M1	for clearing the fraction eg $d(f-4)=3(1-f)$ or $df-4d=3-3f$	Condone error in expansion of RHS for this mark
		M1	(dep M1) for isolating f terms in a correct equation eg $df+3f=3+4d$	
		M1	(dep on two terms in f) for factorising eg $f(d+3)=3+4d$	
		A1	oe	
13 (a)	33	B1	cao	
(b)	27	M1	for f(9) = 12 ÷ √9 (=4) **and** a clear intention to find g("4") **or** for $3\times(2\times\frac{12}{\sqrt{9}}+1)$ **or** for stating gf eg $3(2\times\frac{12}{\sqrt{x}}+1)$ oe	
		A1	cao	
(c)	$\frac{1}{2}$	M1	for g^{-1} as $\frac{x-3}{6}$ oe **or** for starting to solve $3(2x+1)=6$	Accept $\frac{y-3}{6}$
		A1	for $\frac{1}{2}$ oe	

Question	Answer	Mark	Mark scheme	Additional guidance
14 (a)	p^{10}	B1	cao	
(b)	$2x^4y^2$	M1	for any two of $12 \div 6$ (= 2), x^{7-3} (= x^4), y^{3-1} (= y^2) in a single product or written as a fraction with complete and correct cancelling of at least two terms	
		A1	cao	
15	Mistake identified	C1	for a correct mistake identified **Acceptable examples** all three terms should be multiplied by 2 and not just two of them the 5 should be multiplied by 2 it should be $2 \times T = q + 2 \times 5$ should subtract 5 first (before multiplying by 2) **Not acceptable examples** Should remove the 5 first $2 \times T$ should be $2T$ should have got rid of the denominator	Accept answers showing a correct first step
16 (a)	$\frac{17x+2}{3x(x+1)}$	M1	for a correct common denominator with at least one correct numerator eg. $\frac{5\times3x}{3x(x+1)} + \frac{2(x+1)}{3x(x+1)}$	
		A1	for a single simplified fraction, eg. $\frac{17x+2}{3x(x+1)}$ or equivalent eg. $\frac{17x+2}{3x^2+3x}$	$\frac{15x+2(x+1)}{3x(x+1)}$ gets M1 only
(b)	$(x+y)(x+y+3)$	B1	cao	

Question	Answer	Mark	Mark scheme	Additional guidance
17	5	P1	for process to find the area of the triangle, eg. $0.5 \times (x + 4)(x - 2)$ oe OR for process to find the area of rectangle and 27.5×2, eg. $(x + 4)(x - 2)$ and 55	Trial and improvement methods must be fully correct identifying the value of x as 7 (3 marks) or the shortest side as 5 (4 marks)
		P1	(dep P1) for process to expand the brackets and derive a quadratic equation, eg. $x^2 + 4x - 2x - 8 = 55$ or $0.5(x^2 + 4x - 2x - 8) = 27.5$ oe	
		P1	(dep P2) for complete process to solve the quadratic equation $x^2 + 2x - 63 = 0$ eg $(x - 7)(x + 9)$ (= 0) or $\frac{-2 \pm \sqrt{2^2 - 4 \times 1 \times -63}}{2 \times 1}$ or $(x + 1)^2 - 1 - 63$ (= 0)	
		A1	cao SC: B1 for $x^2 + 4x - 2x - 8 = 27.5$	An answer of 5 with no supportive working gets no marks

Question	Answer	Mark	Mark scheme	Additional guidance
18 (a)	Shown	C1	for $f^{-1}(x) = \sqrt[3]{\frac{x+4}{2}}$ OR for $2x^3 - 4 = 50$ OR for substituting $x = 3$ to find f(3)	
		C1	for substituting $x = 50$ to show the result giving $f^{-1}(50) = 3$ OR solving for x to give $x = 3$ OR for showing that $f(3) = 50$	
(b)	$x = -1$ and $x = 2.5$	P1	for $hg(x) = (x + 2)^2$	
		P1	(dep) for start to a process to derive a quadratic equation eg. $x^2 + 4x + 4 = 3x^2 + x - 1$	$(x + 2)^2$ must be correctly expanded
		P1	for a process to solve the quadratic equation $2x^2 - 3x - 5 = 0$ eg $(2x - 5)(x + 1)$ (= 0) or $\frac{--3\pm\sqrt{(-3)^2-4\times2\times-5}}{2\times2}$ or $2\left[(x - \frac{3}{4})^2 - \frac{9}{16} - \frac{5}{2}\right]$ (= 0)	
		A1	for $x = -1$ and $x = 2.5$	2.5 or $2\frac{1}{2}$ or $\frac{5}{2}$ acceptable
19	$\frac{3}{4}$ oe	P1	for a first step to converting to a common base with one correct conversion, eg. $9^{-\frac{1}{2}} = 3^{-1}$ or $\frac{1}{3}$ or $27^{\frac{1}{4}} = 3^{\frac{3}{4}}$ oe	$9^{-\frac{1}{2}} = 3^{-1}$ (or $\frac{1}{3}$) oe or $27^{\frac{1}{4}} = 3^{\frac{3}{4}}$ oe seen alone gets the P1
		P1	(dep) for $3^{-1} = 3^{\frac{3}{4}} \div 3^{x+1}$ oe	
		A1	cao	

Question	Answer	Mark	Mark scheme	Additional guidance
20 (a)	graph	C2	for a translation of the graph by the vector $\begin{pmatrix}-1\\-3\end{pmatrix}$	Condone graph of $y = f(-x)$ also being drawn on the grid
		(C1	for a translation of the graph by the vector $\begin{pmatrix}-1\\b\end{pmatrix}$ where $b \neq -3$ or $\begin{pmatrix}a\\-3\end{pmatrix}$ where $a \neq -1$ **or** for a translation by the vector $\begin{pmatrix}-1\\-3\end{pmatrix}$ of 3 or 4 critical points)	Correct vector gets 1 mark
(b)	2, 1	B1	cao	
21	Sketch graph with TP at (2, -13) and intercepts at (0, -5), $(2+\sqrt{\frac{13}{2}}, 0)$ and $(2-\sqrt{\frac{13}{2}}, 0)$	B1	for a parabola drawn with intercept at the point (0, – 5)	
		M1	for the start of a method to find the roots of $y = 0$, eg. $2(x-2)^2 - 13 (= 0)$ oe or $(x =) \frac{--8 \pm \sqrt{(-8)^2-4\times2\times-5}}{2\times2}$	
		M1	(dep) for method to find the roots, eg. $2 \pm \sqrt{\frac{13}{2}}$ oe	
		B1	for turning point at $(2, -13)$	Turning point may be just seen and labelled on the sketch
		C1	for a fully correct parabola drawn with turning point at $(2, -13)$ and intercepts at $(0, -5)$, $(2+\sqrt{\frac{13}{2}}, 0)$ oe and $(2-\sqrt{\frac{13}{2}}, 0)$ oe clearly shown	

Question	Answer	Mark	Mark scheme	Additional guidance
22	$x = 2.2$ to 2.3 $y = -1.3$ to -1.4	M1 A1	for recognition of use of intersection point, one of the solutions given, solutions reversed or solutions given as a coordinate. x given in the range 2.2 to 2.3, y given in the range -1.3 to -1.4	
23	Proof shown	C2 (C1	for complete argument, eg $n(n - 1)$ is the product of two consecutive integers and must be even as either n or $n - 1$ must be even or gives correct reasoning for n odd and n even n odd: odd × odd = odd and odd – odd = even n even: even × even = even and even – even = even or n odd: $(2n + 1)^2 - (2n + 1) = 4n^2 + 2n = 2(2n^2 + n)$ n even: $(2n)^2 - (2n) = 4n^2 - 2n = 2(2n^2 - n)$ for factorising, eg $n(n - 1)$ OR gives correct reasoning for n odd or n even OR gives a partial explanation using n odd and n even, eg $\text{odd}^2 - \text{odd} = \text{even}$ and $\text{even}^2 - \text{even} = \text{even}$)	

Question	Answer	Mark	Mark scheme	Additional guidance
24	–1, 2.5	P1	for process to form an equation, eg $\frac{x^2}{3x+5}=\frac{1}{2}$ **or** $2x^2 = 3x + 5$	
		P1	for writing in a suitable form ready for solution, eg $2x^2 – 3x – 5$ (= 0) **or** $– 2x^2 + 3x + 5$ (= 0)	
		P1	(dep 1st P1) for process to solve quadratic equation of form $ax^2 + bx + c$ (= 0) eg $(2x – 5)(x + 1)$ (= 0) **or** $\frac{--3 \pm \sqrt{(-3)^2 - 4 \times 2 \times -5}}{2 \times 2}$	
		A1	for –1, 2.5 oe	
25 (i)	3, 8	M1	for $a = 3$, may be seen in working or as part of an expression, eg $(x – 3)^2 – 9$	9 does not have to be seen for this mark
		A1	for $a = 3$, $b = 8$	
(ii)	3, –8	B1	for 3, –8 **or** ft (i)	

Question	Answer	Mark	Mark scheme	Additional guidance
26 (a)	$\frac{x+1}{3}$	M1	first step to change the subject of $y = 3x - 1$ **or** $x = 3y - 1$, eg $y + 1 = 3x$	
		A1	oe	
(b)	Shown	M1	for method to find fg(x), eg fg(x) = $3(x^2 + 4) - 1$	
		M1	for method to find gf(x), eg gf(x) = $(3x - 1)^2 + 4$	
		M1	(dep on previous two M marks) for setting up equation, eg $3(x^2 + 4) - 1 = 2[(3x - 1)^2 + 4]$	
		M1	(dep 2nd M1) for correct expansion of $(3x - 1)^2$ eg $9x^2 - 3x - 3x + 1$	
		C1	for $15x^2 - 12x - 1 = 0$ from correct working	

Question	Answer	Mark	Mark scheme	Additional guidance
27 (a)	6 or –6	M1	for $12^2 + 2 \times -3 \times 18$ (= 36)	Terms may be partially evaluated.
		A1	for 6 or –6, accept ±6	Only one value is required for full marks
(b)	$s = \frac{v^2 - u^2}{2a}$	M1	for subtracting u^2 from both sides or dividing all terms by $2a$ as the first step	Must see this step carried out, not just the intention shown
		A1	$s = \frac{v^2 - u^2}{2a}$ oe	
28	$x = 4.5, y = -1.5$	M1	correct process to eliminate one variable (condone one arithmetic error)	
		M1	(dep) for substituting found value in one of the equations **OR** correct process after starting again (condone one arithmetic error)	
		A1	for $x = 4.5, y = -1.5$ oe	Fractions do not need to be in simplest form
29 (a)	$\frac{1}{5(x-1)}$	B1	for $\frac{1}{5(x-1)}$ or $\frac{1}{5x-5}$	
(b)	$2(5 + y)(5 - y)$	M1	for partial factorisation, eg $2(25 - y^2)$ oe or $(10 + 2y)(5 - y)$ oe or $(5+ y)(10 - 2y)$ oe or $-2(y^2 - 25)$ oe	
		A1	for $2(5 + y)(5 - y)$ or $-2(5 + y)(y - 5)$	

Question	Answer	Mark	Mark scheme	Additional guidance
30	(2, –9)	P1	substitutes $x = 0$, $y = –5$ into $y = x^2 + ax + b$ ($b = -5$) **or** substitutes $x = 5$, $y = 0$ into $y = x^2 + ax + b$ ($0 = 25 + 5a + b$) **or** starts process to find other intercept, eg writes $y = (x – 5)(x – k)$	
		P1	for complete process to find two intercepts, eg. substitutes the second point into $y = x^2 + ax + b$ and solves to find a ($= -4$) and b ($= -5$) **or** substitutes $x = 0$, $y = –5$ into $y = (x – 5)(x – k)$ and solves to find k ($= -1$)	
		P1	(dep on P2) for factorising or completing the square of $x^2 +$ "–4" $x +$ "–5" and identifying the x-coordinate of the turning point **or** for a complete process to find the x-coordinate of the turning point, eg (5 + "–1")/2	
		A1	cao	x-coordinate of 2 with no or incorrect working gets NO marks
31 (a)	sketch	B1	for appropriate sketch which crosses the x axis at (2,0) and (4,0), minimum point at (3,−1) and end points at (1,3) and (5,3)	Allow some tolerance on the points if the intention is clear.
(b)	$y = g(– x)$	B1	cao	
32 (a)	shown	C1	for first step, eg $2((x + 1)^2 – 1)$ or $2(x^2 + 2x + 1 – 1)$ oe	
		C1	for fully correct chain of reasoning	It is insufficient to state $gf(x) = 2x(x + 2)$ without showing the first step, and the following sequence of algebraic steps leading to it.
(b)	4.5	M1	process to find inverse of g, eg $g^{-1}(x) = \frac{1}{2}x + 1$ **or** for $2(x – 1) = 7$	Could be shown in the form of a flowchart, which must show inverse operations.
		A1	for 4.5 oe	

Question	Answer	Mark	Mark scheme	Additional guidance
33	Statement supported by algebra	B1	writing a general expression for an odd number eg $2n+1$	Could be $2n - 1$, $2n + 3$, etc
		M1	(dep) for expanding ("odd number")^2 with at least 3 out of 4 correct terms	Note that $4n^2 + 4n + 2$ or $2n^2 + 4n + 1$ in expansion of $(2n + 1)^2$ is to be regarded as 3 correct terms
		A1	for correct simplified expansion, eg $4n^2 + 4n + 1$	
		C1	(dep A1) for a concluding statement eg $4(n^2 + n) + 1$ (is one more than a multiple of 4)	
34 (a)	$(a - b)(a + b)$	B1	cao	Accept reversed brackets
(b)	$12(x^2 + 1)$	M1	for using 'a' = $x^2 + 4$ and 'b' = $x^2 - 2$	
			OR multiplying out both brackets, at least one fully correct	Correct 4 terms if not simplified or 3 terms if simplified
		M1	(dep) for a correct expression for ('a' + 'b')('a' – 'b') with no additional brackets, simplified or unsimplified eg $(x^2 + 4 + x^2 - 2)(x^2 + 4 - x^2 + 2)$ **or** $(2x^2 + 2) \times 6$	
			OR ft for a correct expression without brackets, simplified or unsimplified eg $x^4 + 8x^2 + 16 - x^4 + 4x^2 - 4$	
		A1	for $12(x^2 + 1)$ **or** $12x^2 + 12$ oe	

Question	Answer	Mark	Mark scheme	Additional guidance
35	$\frac{3x+1}{2x}$	M1	for $(3x + 1)(x – 3)$ **or** $2x(x – 3)$	Accept $(2x + 0)$ for the first two marks but not for the final answer
		A1	for $(3x + 1)(x – 3)$ **and** $2x(x – 3)$	
		A1	$\frac{3x+1}{2x}$ oe	
36	Graph drawn	C2	for graph translated by −2 in the y direction	Key points: (–180, –2), (–90, –3), (0, –2), (90, –1), (180, –2)
		(C1	for a graph translated in the y direction	
			OR for a correct graph through four of the five key points)	
37	$b = \frac{2}{3}a + 2$	P1	for process to rearrange the equation to give y in terms of x eg $y = \frac{7-3x}{2}$ **or** $y = -\frac{3}{2}x + \left(\frac{7}{2}\right)$ **or** $m = -\frac{3}{2}$	
		P1	for using their gradient in $mn = -1$	
		P1	for showing a process to find the gradient of PQ eg $\frac{b-4}{a-3}$ **OR** for substituting $x = 3$ and $y = 4$ in $y = \text{“}\frac{2}{3}\text{”}x + c$	
		P1	(dep P3) for forming an equation in a and b eg $\frac{b-4}{a-3} = \text{“}\frac{2}{3}\text{”}$ **or** $b = \text{“}\frac{2}{3}\text{”}a + \text{“2”}$ **OR** correct equation in terms of x and y eg $y = \frac{2}{3}x + 2$	$y – 4 = \frac{2}{3}(x – 3)$ gets P4
		A1	for $b = \frac{2}{3}a + 2$ oe	Accept 0.66 or 0.67 oe for 2/3

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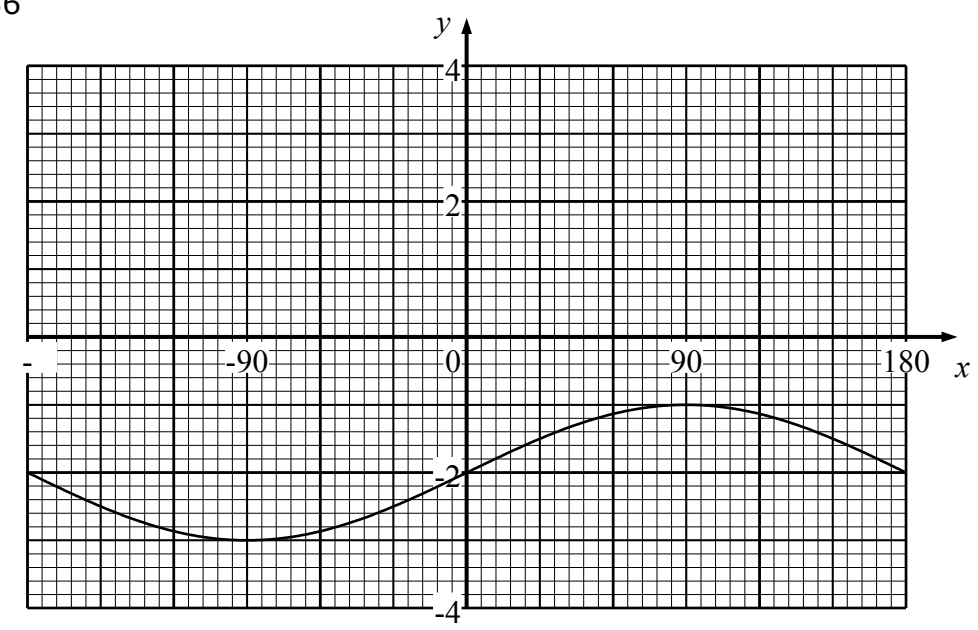


Question	Answer	Mark	Mark scheme	Additional guidance
38	2, 3, 4	M1	for method to solve $3n + 2 \leq 14$ eg $n \leq (14 - 2) \div 3$ oe	This could be shown within an equation rather than an inequality at this stage
		M1	for complete method to rearrange $\frac{6n}{n^2 + 5} > 1$ to the form $an^2 + bn + c$ (< 0)	For the 2rd and 3rd M marks condone no '< 0' and condone use of incorrect inequality signs or '='
		M1	for method to begin to solve $n^2 - 6n + 5$ (< 0) eg $(n \pm 5)(n \pm 1)$ (< 0)	Accept $\frac{--6 \pm \sqrt{(-6)^2 - 4 \times 1 \times 5}}{2 \times 1}$ (condone one sign error)
		M1	(dep on previous M2) for $n > 1$ and $n \leq 4$ **or** $1 < n < 5$	Must come from correct working Could be shown on a number line
		A1	(dep M4) cao	
			Alternative method	
		M1	for method to solve $3n + 2 \leq 14$ eg $n \leq (14 - 2) \div 3$ oe	This could be shown within an equation rather than an inequality at this stage
			OR for $3 \times 4 + 2 = 14$	
		M3	for trials with 1, 2, 3 and 4 in the quadratic inequality, correctly evaluated	The values from the trials may be given as improper fractions eg $\frac{24}{21}, \frac{18}{14}, \frac{12}{9}, \frac{6}{6}$
		(M2	for trials with three of 1, 2, 3 and 4, correctly evaluated)	
		(M1	for trials with two of 1, 2, 3 and 4, correctly evaluated)	
		A1	(dep M4) cao	

Question	Working	Answer	Mark	Notes		
39		Shows reasoning to reach $y=3$	M1 M1 M1 A1	forms equation eg $2x + 6 = 5x - 9$ isolates x and number terms $3x = 15$ substitutes "5" into side length eg $2 \times 5 + 6$ (=16) $48 \div 16 = 3$ **or** $16 \times 3 = 48$	$48 \div 3$ (=16) forms equation $2x+6=$"16" **or** $5x - 9 =$ "16" isolates x and number terms $2x =$ "10" **or** $5x =$ "25" shows $x=5$ for both solutions	$3(2x + 6) = 48$ **or** $3(5x - 9) = 48$, condone missing bracket Isolates x and number terms $6x =$ "30" **or** $15x =$ "75" forms the second equation $x=5$ from 2 different equations.
40		Comment	B1	for correct mathematical comment eg line segments not a curve **or** should draw freehand **or** should not use a ruler, **or** should be a curve NB Do not accept statements about scale or plotting accuracy.		
41		Tea £1.40 Coffee £1.80	P1 M1 M1 A1	for setting up two appropriate equations eg $3t + 2c = 7.80$, $5t + 4c = 14.20$ for method to eliminate one variable, condone one arithmetic error for method to substitute found variable or start again Tea £1.4(0) and Coffee £1.8(0) with amounts linked to correct drinks		
42		Completes proof	M1 C1	Expands both expressions eg $\frac{1}{2}(n^2 + n + n^2 + n + 2n + 2)$ **or** $n^2 + n$ and $n^2 + n + 2n + 2$ **or** factorises $\frac{1}{2}(n+1)(n+n+2)$ Completes proof with explanation and reference to $(n+1)^2$		

Question	Working	Answer	Mark	Notes
43		$y = 2x + 36$	P1	starts process, eg by rearranging to find gradient, eg $y = 6 - \frac{x}{2}$ **or** $\frac{-1}{2}$ **or** positions of B and E
			P1	complete process to find position of A **or** uses $\frac{-1}{m}$ to find the gradient of **M**
			P1	complete process to find equation of **M**
			A1	$y = 2x + 36$ oe
44		$x > 2$	P1	for process to derive algebraic expressions for area of both rectangle and triangle eg $(x - 1)(3x - 2)$ and $(2x \times x) \div 2$ (condone missing brackets)
			M1	for method to rearrange inequality to $2x^2 - 5x + 2 > 0$ oe providing in the form $ax^2 + bx + c > 0$
			M1	for a correct method to solve $2x^2 - 5x + 2 > 0$
			M1	for establishing critical values 2 and $\frac{1}{2}$
			A1	$x > 2$

Question	Working	Answer	Mark	Notes
45		$x^2 + 6x = 1$	M1	writes the area using algebraic terms e.g. $(x + 3) \times (x + 3)$ or at least two correct area expressions which may be written on the diagram or x given as $\sqrt{10} - 3$
			M1	expands and includes the given 10 e.g. $x^2 + 3x + 3x + 9 = 10$; condone one error in the four terms when expanding or $10 - 3\sqrt{10} - 3\sqrt{10} + 9 + 6\sqrt{10} - 18$ (=1) condone 1 error in the 6 terms
			A1	rearranges to give the given equation or shows surd expression simplifies to 1
46		comparison	M1	starts to manipulate expression e.g. $3y = 9x - 6$ or $3y = 9x - 5$
			A1	gives equation(s) which can be used to show that the gradients of the two lines are the same e.g. $y = 3x - 5/3$
47		$x^3+6x^2+11x+6$	M1	for method to find the product of any two linear expressions (3 correct terms) e.g. $x^2+x+2x+2$ or $x^2+2x+3x+6$ or $x^2+x+3x+3$
			M1	for method of multiplying out remaining products, half of which are correct (ft their first product) e.g. $x^3+x^2+2x^2+3x^2+2x+3x+6x+6$
			A1	cao
48 (a)		1, −3	B1	cao
(b)		−0.75, 2.75	B1	accept −0.7 to −0.8, 2.7 to 2.8
(c)		−2.8	B1	cao

Question	Working	Answer	Mark	Notes
49		$2(2n-3)$	C1	correct expansion of brackets to give at least 3 terms from $n^2-2n-2n+4$
		even	C1	arrives at n^2-2-n^2+4n-4 oe
			C1	reduces to $2(2n-3)$ or $4n-6$
			C1	for conclusion e.g. $2(2n-3)$ always even, $4n-6$ is always even since both are even numbers, they are multiples of 2.
50		$y=-2x+21$	P1	shows evidence of understanding that AC is perpendicular to DB, or states the gradient of DB as 0.5 oe
			P1	shows a process to find the gradient of a perp. line e.g. use of $-\frac{1}{m}$ or states $y=-2x+c$ or states the gradient of AC as -2
			P1	(dep on P2) for sub. of $x=5$, $y=11$ into $y=mx+c$ where m is their found gradient for AC.
			A1	oe
51		$x=-\frac{24}{5}$	M1	for substitution of a rearrangement of $y-3x=13$ e.g. $(3x+13)^2+x^2=25$
		$y=-\frac{7}{5}$	M1	(dep M1) for expansion of bracket after substitution (at least 3 terms correct out of the 4 terms) e.g. $9x^2+39x+39x+169$
		$x=-3,$	M1	for forming quadratic ready for solving e.g. $10x^2+78x+144\ (=0)$
		$y=4$	M1	for factorising e.g. $(5x+24)(x+3)\ (=0)$ oe
			A1	$x=-\frac{24}{5}, y=-\frac{7}{5}$ and $x=-3, y=4$ SC: B1 (if M0) for all 4 values mis-associated or one correct pair of values or values given as coordinates.

Question	Working	Answer	Notes
52		$m^2 + 10m + 21$	M1 for at least 3 terms out of a maximum of 4 correct from expansion A1
53		$5(2x + 1)(2x - 1)$	M1 for $5(4x^2 - 1)$ A1
54		$a = \frac{7 - 3r}{r - 2}$	M1 Remove fraction and expand brackets M1 Isolate terms in a A1
55		$x > 4$, $x < -1$	M1 rearrange quadratic and factorise M1 critical values of 4 and −1 found A1
56 (a)		25	C1 For interpretation eg.. area equated to 1750m P1 Process to solve equation A1
(b)		Description	C1 Start to interpret graph eg. describe or give acceleration for one stage of the journey or state that acceleration is constant in all 3 parts C1 Describe acceleration for all stages of the journey or give acceleration for all 3 stages (1.25 m/s^2 ; 0 m/s^2 ; –0.625 m/s^2)

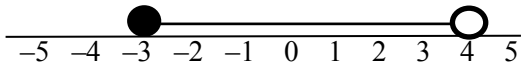
Question	Working	Answer	Notes
57		$3y - 4x = 11$	P1 process to start to solve problem eg. draw a diagram, find gradient of AB (0.5) P1 process to use gradients eg. find gradient of BC (-2) P1 Process to find y coordinate of C (9) P1 Process to find equation of AC A1

Question	Working	Answer	Notes	
58		$\sqrt[3]{4m^2-1}$ or $\sqrt[3]{(2m+1)(2m-1)}$	M1 M1 A1	clear fractions or remove sq rt sign as first step (dep) clear fractions and remove sq rt sign $(k=)\sqrt[3]{4m^2-1}$ or $\sqrt[3]{(2m+1)(2m-1)}$
59		$\frac{-2}{13}$	M1 M1 A1	multiplies all terms by 2 or 3 to reconcile fractions as first step complete process of expanding brackets and isolating x term cao

Question	Working	Answer	Notes
60		$\frac{2x-5}{x+5}$	M1 factorising to give $(2x - 5)(x + 1)$ M1 factorising to give $(x + 5)(x + 1)$ A1 cao
61		proof (supported)	M1 for any two consecutive integers expressed algebraically eg $n + 1$ and n M1 (dep) for the difference between the squares of "two consecutive integers" expressed algebraically eg $(n + 1)^2 - n^2$ A1 for correct expansion and simplification of difference of squares eg $2n + 1$ C1 for showing statement is correct (with supportive evidence) eg $n + n + 1 = 2n + 1$ and $(n + 1)^2 - n^2 = 2n + 1$ for sight of $p^2 - q^2 = (p - q)(p + q)$ for deduction that $p - q = 1$ for linking these two statements eg substitution of 1 for $p - q$ for fully stated proof and deduction eg $p^2 - q^2 = 1 \times (p + q) = p + q$
62		$y = -\frac{1}{2}x + \frac{3}{2}$	P1 for a process to find the gradient of the line AB P1 (dep) for a process to find the gradient of a perpendicular line eg use of $-1/m$ P1 (dep on P2) for substitution of x=5, y=−1 A1 equation stated oe

Question	Working	Answer	Notes
63 a		$y(y + 27)$	B1
b		t^6	B1
c		w^5	B1
64		$3 \pm \sqrt{17}$	M1 For $(x - 3)^2 - 9 - 8 (= 0)$ or $(x =) \frac{-(-6) \pm \sqrt{(-6)^2 - 4(1)(-8)}}{2(1)}$ allow sign error for b M1 For $x - 3 = \pm \sqrt{17}$ or $x = \frac{6 \pm \sqrt{68}}{2}$ A1 cao

Question	Working	Answer	Notes
65		$3x$	M1 Factorising numerator and denominator of first fraction $\frac{3(x+2)}{(x-5)(x+2)}$ $(=\frac{3}{(x-5)})$ M1 Factorising denominator of second fraction $\frac{x+5}{x(x+5)(x-5)}$ $(=\frac{1}{x(x-5)})$ M1 Multiplication by reciprocal $\frac{3(x+2)}{(x-5)(x+2)} \times \frac{x(x+5)(x-5)}{(x+5)}$ A1 Completing algebra to reach $3x$
66		$x < -3$, $x > 6$	M1 Rearrange to $x^2 - 3x - 18 > 0$ M1 Correct method to solve $x^2 - 3x - 18 = 0$ M1 Establish critical values -3 and 6 A1 $x < -3$, $x > 6$
67		60	P1 process to start problem eg draw diagram and find gradient of ***OA*** (= 3) P1 process to find equation of tangent with $m = -1/\text{'3'}$ P1 process to find x-axis intercept of tangent P1 process to find area of triangle A1 cao

Question	Answer	Mark	Mark scheme	Additional guidance
68 (a)	$x > -1$	B1	cao	
(b)	Diagram drawn	C2	for a fully correct diagram, eg 	
		(C1	for drawing a line from −3 to 4 **or** (indep) for an open circle at 4 **or** (indep) for a closed circle at −3)	Condone arrow heads or line ending to denote the 'end' of the line
69 (a)	(10), 5, (2), 1, 2, (5), 10	B2	for all 4 values correct	
		(B1	for 2 or 3 correct values)	
(b)	Graph	M1	ft (dep on B1) for plotting at least 5 of their points correctly	
		A1	for a fully correct curve drawn	Accept a freehand curve drawn that is not made of line segments
(c)	–0.65 to –0.8 and 2.65 to 2.8	M1	for $y = 4$ drawn **or** intersection with $y = 4$ **or** $y = x^2 - 2x - 2$ drawn **or** 1 correct value ft a quadratic graph	If answers stated as coordinates, award M1 for both coordinates and M0 for one coordinate
		A1	ft a quadratic graph **or** for answers in the range 2.65 to 2.8 **and** –0.65 to –0.8	

Question	Answer	Mark	Mark scheme	Additional guidance
70 (a)	(9, 7.5)	M1	for x coordinate = PO (6) $\times \frac{3}{2}$ (=9) **or** y coordinate = OQ (3) $\times \frac{5}{2}$ (= 7.5) **or** PO (6) $\times \frac{5}{2}$ (=15) **or** OQ (3) $\times \frac{3}{2}$ (= 4.5)	
		A1	cao	
(b)	$y = -2x + 3$	P1	for process to find the gradient of the line, eg 3 ÷ 6 (=0.5) **or** $y = mx + 3$	Could use P and R or Q and R as ft from (a)
		P1	for process to find gradient of perpendicular eg $-1 \div$ [gradient of PQ] ($= -2$)	
		A1	fo $y = -2x + 3$ oe	
71	$6x^3 + x^2 - 20x - 12$	M1	for method to find the product of any two linear expressions (3 out of no more than 4 terms correct with correct signs or 4 correct terms ignoring signs), eg. $6x^2 + 9x + 4x + 6$ or $3x^2 + 2x - 6x - 4$ or $2x^2 + 3x - 4x - 6$	Note that, for example, $6x^2 + 13x$ or $13x + 6$ are regarded as three terms in the expansion of $(x - 2)(3x + 2)$
		M1	for method of multiplying out remaining products, half of which are correct (ft their first product), eg. $6x^3 + 13x^2 - 12x^2 + 6x - 26x - 12$	First product must be quadratic but need not be simplified or may be simplified incorrectly.
		A1	cao	

Question	Answer	Mark	Mark scheme	Additional guidance
72 (a)	$x_1 = 1.817$ $x_2 = 1.853$ $x_3 = 1.846$	M1	for a correct method to find x_1 eg $\sqrt[3]{10-2\times 2}$ (= 1.8171……)	
		M1	(dep on M1) for substitution of x_1 to give x_2 **and** x_2 to give x_3	
		A1	for $x_1 = 1.81(71\ldots)$, $x_2 = 1.85(33\ldots)$ and $x_3 = 1.84(62\ldots.)$	Accept an accuracy of 2dp or more rounded or truncated
(b)	$a = 2$, $b = -10$	C1	cao	
73 (a)	37, 143, 397, 503	M1	for any two correct angles within the ranges below **or** for a correct method to find a solution beyond 360, eg. "angle read from 0 to 360" + 360	Accept given as coordinates for M1 only
		A1	for all 4 angles in the range, 35 to 40, 140 to 145, 395 to 400 and 500 to 505	
(b)	$y = -\sin x^o$	B1	for any acceptable equations, eg. $y = -\sin x^o$ or $y = \sin(-x^o)$ or $-y = \sin x^o$ or $y = \cos(x^o + 360n + 90)$ or for any positive integer n, $y = \sin(x^o - (2n-1)180)$ or $y = \cos(x^o + 360n)$	Quoted are just the more likely solutions but check all attempts Condone missing degrees sign
(c)	graph	C1	for correct graph shown translated 2 in the positive x-direction	

Question	Answer	Mark	Mark scheme	Additional guidance
74 (a)	13, (6), 5, 4, –3	B2	for all 4 values correct	
		(B1	for 2 or 3 correct values)	
(b)	Correct graph	M1	ft (dep on B1) for plotting at least 4 of the points from their table correctly	
		A1	for a fully correct curve drawn	Accept a freehand curve drawn that is not made of line segments Line sections outside the required range can be ignored.
75 (a)	1	B1	cao	
(b)	$\frac{8}{x-4}$	B1	cao	
(c)	$27n^{12}w^6$	B2	cao	
		(B1	for two of 27, n^{12}, w^6 in a product)	

Question	Answer	Mark	Mark scheme	Additional guidance
76	$3n^2 + 2n + 5$	M1	for a correct start to a method to find the nth term, eg equal 2nd differences imply a term in n^2	Need to see constant second difference found and n^2
		M1	for working with $3n^2$, eg $3n^2$ and sequence 7, 9, 11, …	$3n^2 + 2n$ implies M2
		A1	for $3n^2 + 2n + 5$	
77	– 12, – 7	B1	cao	
78	788.4	P1	for substituting values, eg $1040 = K \times 1200 + 20$	
		P1	for process to find K, eg $(1040 – 20) \div 1200$ oe (= 0.85)	
		P1	for complete process, eg 09 17: "0.85" × 1040 + 20 (= 904); 09 18: "0.85" × "904" + 20	
		A1	for 788.4 or 788 or 789	

Question	Answer	Mark	Mark scheme	Additional guidance
79 (a)	Graph drawn	C2	for graph reflected in the y-axis	Key points: (0, 0), (1, 2), (2, 1), (3, 0), (4, 2) Award C1 if line segments but goes through all key points
		(C1	for a graph reflected in the x-axis **or** for a correct graph through four of the five key points)	
(b)	$y = 5 + 2(x – 3) – (x – 3)^2$	C2	for $y = 5 + 2(x – 3) – (x – 3)^2$ oe eg $y = –x^2 + 8x – 10$, $y = –[(x–4)^2 –6]$	For either C mark accept equivalent expressions
		(C1	for $y = 5 + 2(x + 3) – (x + 3)^2$ **or** $y = 5 + 2(x – a) – (x – a)^2$, $a \neq 3$, $a \neq 0$) **or** $y = f(x – 3)$ **or** $y = (x – 4)^2 + 6$ **or** correct expression missing "$y =$"	If a correct answer for C2 is given and is then incorrectly simplified, award C1 a need not be positive

Question	Answer	Mark	Mark scheme	Additional guidance
80	$x^2 + y^2 = 80$	P1	for process to find gradient of tangent eg $\frac{10-0}{0--20}$ $(=\frac{1}{2})$ **or** for $20^2 + 10^2$ (= 500) **or** start to method to find angle between tangent and x axis, eg $\tan\theta = \frac{10}{20}$	
		P1	for process to find gradient of normal/radius eg $\frac{-1}{"0.5"}$ (=–2) **or** for $\sqrt{20^2+10^2}$ or $\sqrt{500}$ or 22.36... or 22.4 **or** completes process to find angle between tangent and x axis. eg $\theta = \tan^{-1}\left(\frac{10}{20}\right)$ (=26.565…)	
		P1	for equation of tangent eg $y =$ "0.5"x + 10 oe or for equation of radius eg $y =$ "–2"x oe **or** for using similar triangles eg $\frac{r}{10} = \frac{20}{"\sqrt{500}"}$ **or** for sin("26.565…) = $\frac{r}{20}$	
		P1	for process to find the x coordinate eg "0.5"x + 10 = "–2"x (x = –4) **or** for $r = \frac{20}{"\sqrt{500}"} \times 10$ **or** $r = 20 \times \sin("26.565…")$	
		A1	oe	Accept $(4\sqrt{5})^2$ for 80

Question	Answer	Mark	Mark scheme	Additional guidance
81 (a)	F	B1	cao	
(b)	D	B1	cao	
82	Shown (supported)	M1	for method to find at least two terms, eg $2 \times 4^2 - 1$ (= 31) **and** $40 - 3^2$ (= 31)	1 7 17 31 49 71 97 127 161 199 39 36 31 24 15 4 –9
		M1	for generating at least three correct terms of each sequence	
		A1	for generating at least the terms 1, 7, 17, 31, 49 of the first sequence **and** at least the terms 39, 36, 31, 24, 15, 4 of the second sequence	
83	$k = 2m - y^2$	M1	correct first step of showing an intention to square both sides with no algebraic ambiguity in any resulting statements, eg $y^2 = 2m - k$	
		A1	for $k = 2m - y^2$	

Question	Answer	Mark	Mark scheme	Additional guidance
84	$6x^3 - 23x^2 - 33x - 10$	M1	for method to find the product of any two linear expressions (3 out of no more than 4 terms correct with correct signs or 4 correct terms ignoring signs)	Note that, for example, $6x^2 + 7x$ or $7x + 2$ are regarded as three terms in the expansion of $(3x + 2)(2x + 1)$
		M1	for method of multiplying out remaining products, half of which are correct (ft their first product)	First product must be quadratic but need not be simplified or may be simplified incorrectly
		A1	cao	
85 (a)	52.5	P1	starts to find area under graph, eg $\frac{30\times12}{2}$ (=180) **or** 50×12 (=600) **or** $\frac{20\times12}{2}$ (=120)	
		P1	complete process to find area under graph, eg $\frac{30\times12}{2}+50\times12+\frac{20\times12}{2}$ (= 900)	
		P1	starts process to find half way time, eg (("900" ÷ 2) – 180) ÷ 12 (=22.5)	
		A1	52.5 oe	
(b)	Comparison	C1	acceptable comparison **Acceptable** (acceleration) during first part is positive but (acceleration) during last part is negative / deceleration (acceleration is) greater during the last part than during the first part gradient is steeper in the last part / longer to speed up than slow down speed / (acceleration) is increasing at start and decreasing at end (acceleration) is slower in the first part (acceleration) is ascending in the first part and descending in the last part 0.4 is the first part and –0.6 in the last part **Not acceptable** goes down in the last part speed is greater in last part than first part	

Question	Answer	Mark	Mark scheme	Additional guidance
86 (a)	Shown	C1	for a method to find the area of half of the parallelogram or of the whole parallelogram, eg ½(2x – 1)(10 – x) sin150 or ½(2x – 1)(10 – x)× ½ oe or (2x – 1)(10–x) sin150 or (2x – 1)(10–x) × ½ oe	
		C1	for a correct expansion of the whole area eg ½ (20x – 10 – 2x^2 + x) or ½ (–2x^2 + 21x – 10) or –x^2 + 10.5x – 5	
		C1	complete chain of reasoning with fully correct algebra dealing with the inequality eg $x^2 - 10.5x + 5 < -15$ or $x^2 - 10.5x + 20 < 0$ or $2x^2 - 21x + 10 < -30$ which lead to $2x^2 - 21x + 40 < 0$	
(b)	$2.5 < x < 8$	M1	for factorising, $(2x - 5)(x - 8)$	Could use the formula
		A1	for critical values, 2.5, 8	
		A1	for any statement that x is greater than 2.5 and x is less than 8	Need not be given as an inequality statement
87	9.75	P1	process to find the gradient of **L** $\left(=-\frac{3}{2}\right)$	
		P1	process to find the gradient of the perpendicular line **M** eg use of $-\frac{1}{m}$ or states gradient as $\frac{2}{3}$ **or** $y = \frac{2}{3}x + c$	
		B1	(indep) gives y coordinate of B = 8.5 oe	Could be indicated other ways, eg 8.5 on the y axis of a diagram
		P1	(dep P2) process to find x coordinate of C (= 3) or y coordinate of C (= 4) eg the first stage of solving equations or using elimination by substitution, to find a coordinate of C.	ft their linear equation for M with L; allow some error in manipulation of these linear equations as long as the overall process is correct.
		A1	9.75 oe	Award 0 marks for a correct answer with no supportive working.

Question	Answer	Mark	Mark scheme	Additional guidance
88 (a)	$n > 2$	M1	for a method to isolate terms in n in any inequality or equation eg $14n - 11n > 6$ or $n = 2$	Ignore incorrect inequality sign and accept "=" sign
		A1	cao	
(b)		M1	for $-2 - 3 < x \leq 4 - 3$ $(-5 < x \leq 1)$	A circle around −5 and 1 implies M1
		M1	for drawing a line from -5 to 1 or (indep) for an open circle at either -2 or -5 or (indep) for a closed circle at 4 or 1	A line from −5 to 1 implies M2 if no working shown
		A1	cao	
89	Graph	B3	for a correct line between $x = -2$ and $x = 4$	
		(B2	for a correct straight line segment through at least 3 of $(-2, -7), (-1, -5), (0, -3), (1, -1), (2, 1), (3, 3), (4, 5)$ **or** for all of these points plotted but not joined **OR** for a line drawn with a positive gradient through $(0, -3)$ **and** clear intention to use a gradient of 2, eg line through $(0,-3)$ going across 2 squares and up 4 squares)	Ignore any incorrect points. Points need not be plotted for a correct line (segment) drawn Table of values x | –2 | –1 | 0 | 1 | 2 | 3 | 4 y | –7 | –5 | –3 | –1 | 1 | 3 | 5
		(B1	for at least 2 correct points stated or plotted **OR** for a line drawn with a positive gradient through $(0, -3)$ **OR** a line with gradient 2)	Ignore any incorrect points Coordinates may be in a table or in working

Question	Answer	Mark	Mark scheme	Additional guidance
90	$\frac{7x-13}{x-2}$	B1	for factorising eg $(x+5)(x-2)$	
		M1	for a method to divide $(x+5)$ by the algebraic fraction eg $(x+5) \times \frac{(x-1)}{x^2+3x-10}$	Condone incorrect factorising
		M1	for finding 2 fractions with a common denominator or a single fraction eg $\frac{6(x-2)}{x-2}+\frac{(x-1)}{x-2}$ **or** $\frac{6(x-2)+(x-1)}{x-2}$ **or** $\frac{6(x^2+3x-10)}{x^2+3x-10}+\frac{(x+5)(x-1)}{x^2+3x-10}$ **or** $\frac{6(x^2+3x-10)+(x+5)(x-1)}{x^2+3x-10}$	Condone incorrect factorising
		A1	$\frac{7x-13}{x-2}$	

Question	Answer	Mark	Mark scheme	Additional guidance
91 (a)(i)	0.83	B1	for a tangent drawn at $t = 15$	Working: 7.5 ÷ 9 = 0.83.... No tangent scores 0 marks
		M1	full method to use the tangent to find the gradient (eg 7.5÷9)	This mark can be awarded if the tangent is drawn at $t \neq 15$ Working may be seen on the diagram
		A1	for answer in the range 0.6 to 1.0	
(ii)	Statement	C1	statement **Acceptable examples** acceleration rate of change of speed increase in speed over time **Not acceptable examples** rate of change m/s/s increase in speed	
(b)	220	P1	for splitting the area into strips and correct process to find the area of one strip, eg $\frac{5\times4}{2}$ (=10) **or** $\frac{(4+12)}{2}\times5$ (=40) **or** $\frac{(12+18)}{2}\times5$ (=75) **or** $\frac{(18+20)}{2}\times5$ (=95)	Working 4, 12, 18, 20
		P1	for a complete process using at least 4 strips to find the area under the curve eg, "10" + "40" + "75" + "95"	Allow one error in the reading of speeds
		A1	for answer in the range 215 to 225 from correct working using at least 4 strips	

Question	Answer	Mark	Mark scheme	Additional guidance
92	$m = \frac{f+4}{f-3}$	M1	for multiplying both sides by $m - 1$, eg. $f(m - 1) = 3m + 4$	Condone missing brackets for this mark only
		M1	(dep) for a method to rearrange the formula to isolate terms in m in a correct equation, eg. $fm - 3m = f + 4$ **or** $-fm + 3m = -f - 4$	
		A1	for $m = \frac{f+4}{f-3}$ oe, eg $m = \frac{-f-4}{-f+3}$	
93	$y = -\frac{3}{4}x - \frac{11}{4}$	M1	for identifying gradient of $\frac{4}{3}$	Ignore constant term
		M1	for beginning a method to find the gradient of the perpendicular line eg $\frac{4}{3} \times m = -1$ **or** identifies gradient of perpendicular line as $-\frac{3}{4}$	Can ft providing gradient is clearly stated
		A1	for $y = -\frac{3}{4}x - \frac{11}{4}$ or any equivalent equation	$4y + 3x = -11$ $y + 5 = -\frac{3}{4}(x - 3)$

Question	Answer	Mark	Mark scheme	Additional guidance
94	7	P1	process to use gradient eg $y = 3x + c$ **or** $c = -6$ **or** $\frac{15-9}{d-5}$ **or** $(15 - 9) \div 3$ **or** (6, 12)	Condone use of a letter other than d, for d
		P1	(dep) full process to rearrange equation formed to isolate d eg rearrangement of $15 = 3d - 6$ or $3 = \frac{15-9}{d-5}$ **or** for $5 + \frac{15-9}{3}$	Must show processes to get as far as $d =$ Award P2 for an answer of (7, 15)
		A1	cao	
95 (a)	$\frac{4x-6}{3x-9}$	M1	factorises numerator of $4x^2 - 9$ eg $(2x - 3)(2x + 3)$ oe	$\frac{2x(2x-3)(2x+3)}{3x(2x+3)(x-3)}$
		M1	factorises denominator eg $x(x-3)$ or $3(2x + 3)$ or for $3x(2x^2 - 3x - 9)$	
		A1	cancels to give $\frac{4x-6}{3x-9}$	Accept $a = 4$, $b = -6$, $c = 3$, $d = -9$
(b)	$\frac{-x+8}{x(x+1)(x-2)}$	M1	method to use a common denominator eg $x(x+1)(x-2)$ by multiplying terms	Method must involve finding equivalents for all three separate terms; may be done in several stages.
		M1	deduce numerator eg $3x(x-2) + x(x+1) - 4(x+1)(x-2)$	
		A1	oe	Equivalents must be algebraically equivalent and must have involved full simplification.

Question	Answer	Mark	Mark scheme	Additional guidance
96	curve	C1	sketch of graph which starts above x-axis for negative x, and makes an increasing exponential rise into positive x	Condone graph "touching" the x axis. Do not award from a graph for positive x only.
	(0,1) labelled	C1	for showing a label of (0,1) on the y axis	Do not award if a point is given for crossing the x-axis. Accept the coordinates shown as a label of "1" written on the y axis at the intersection.
97	6.5	B1	oe	Accept (eg) $6\frac{1}{2}$ and $\sqrt{42.25}$

Question	Answer	Mark	Mark scheme	Additional guidance
98	$\left(\frac{-16}{5}, \frac{48}{5}\right)$	P1	for a method to find gradient of $\mathbf{L}_1$ eg $\frac{6-2}{4-12}$ $(= -\frac{1}{2})$ or states $\mathbf{L}_2$ as $y = -3x$	Ignore sketches.
		P1	(dep on P1) for a method to find equation of $\mathbf{L}_1$ eg subs into $y =$ "$-\frac{1}{2}$"$x+c$ OR states $\mathbf{L}_1$ as $y =$ "$-\frac{1}{2}$"$x + 8$	
		P1	(dep on P2) complete method to equate both lines eg "$-\frac{1}{2}$"$x + 8 = -3x$	
		A1	oe	Accept equivalents eg $(-3.2, 9.6)$
99	$9 < m < 11$ $-11 < m < -9$	M1	for a correct method to begin rearranging to solve for m^2 eg $88 < m^2 + 7$ or $m^2 + 7 < 128$ or $81 < m^2 < 121$	It is insufficient to just multiply all three elements by 4; some rearrangement must occur such as showing as two separate inequalities or isolating m^2
		M1	for a complete method to $m^2 = 81$ or $m^2 = 121$ or better	Accept an inequality used in place of "=". m^2 must be isolated at this stage.
		M1	for a set of critical values: at least two out of $9, 11, -9, -11$	Do not award if other values are also given eg 10
		M1	for selecting a correct inequality for one set of critical values eg $9 < m$ and $m < -9$ **or** $m < 11$ and $-11 < m$ **or** $9 < m$ and $m < 11$ or a set of inequalities with some error eg $9 < m < 11$ and $-11 < m < -9$ where ? is an incorrect inequality symbol like $9 < m \leq 11$ or $9 \geq m \geq 11$ or answer given as $\pm 9 < m < \pm 11$	Could be shown as $9 < m < 11$ or $-11 < m < -9$ or $-11 < m < 11$
		A1	$9 < m < 11$ and $-11 < m < -9$ given as boundaries of m	Accept with an "and" or an "or" or neither

Question	Answer	Mark	Mark scheme	Additional guidance
100 (a)	m^7	B1	cao	
(b)	$125n^3p^9$	B2	cao	Allow multiplication signs
		(B1	for 2 of 3 terms correct in a single product)	$125n^3p^x$ or $125n^xp^9$ where $x \neq 0$ or an^3p^9 where a is a number
(c)	$8q^6r^3$	B2	cao	Allow multiplication signs
		(B1	for 2 of 3 terms correct in a single product)	$8q^6r^x$ or $8q^xr^3$ where $x \neq 0$ or aq^6r^3 where a is a number
101	$y = 3x - 6$	M1	for a correct method to find the gradient of the line, or $m = 3$ **OR** identifies -6 as the intercept in words or in a partial equation **OR** $y - b = m(x - a)$ where $m \neq 3$ and (a, b) is a correct coordinate	Just ringing –6 is insufficient
		M1	for $y = 3x + c$ **or** (L=) $3x - 6$ **or** $y =$ "3"$x - 6$ **OR** $y - y_1 = 3(x - x_1)$ **or** $y - b =$ "3"$(x - a)$ where (a, b) is a correct coordinate	Award of this mark implies the first M1 c must be seen either as a letter or a number
		A1	accept $y = 3x + -6$ oe	

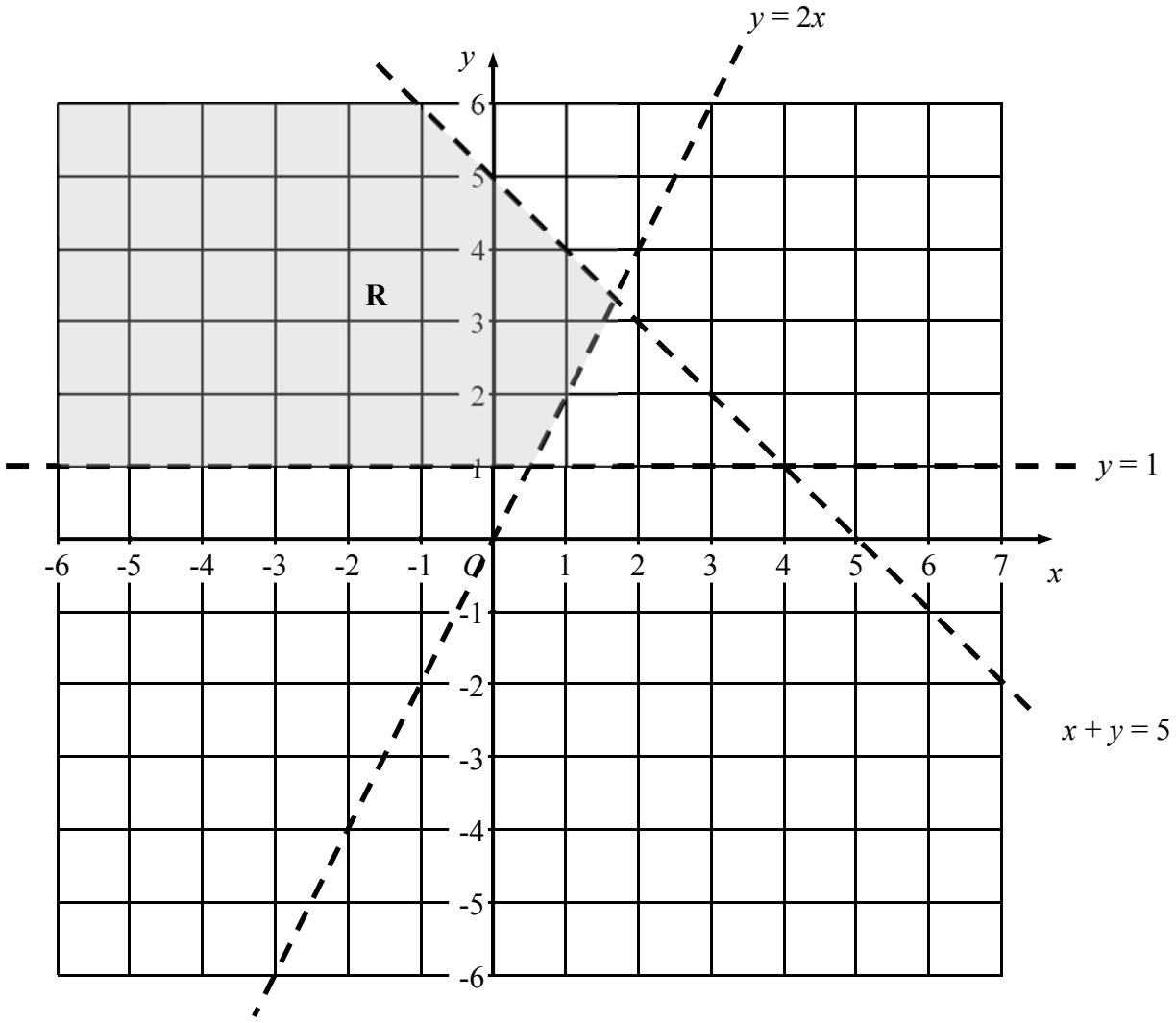
Question	Answer	Mark	Mark scheme	Additional guidance
102 (a)	0, –4, –6, –4, 0	B2 (B1	fully correct figures at least 2 correct figures)	
(b)	Graph	M1 A1	(dep B1) for at least 5 points correctly plotted ft from (a) fully correct graph	Must be a curve
(c)	2.6 and –1.6	M1	for $y = -2$ drawn **or** intersections with $y = -2$ **or** $y = x^2 - x - 4$ drawn **or** 1 correct value	If answers stated as coordinates, award M1 for both coordinates and M0 for one coordinate
		A1	ft a quadratic graph **or** for answers in the range 2.5 to 2.7 **and** –1.5 to –1.7	
103 (a)	$\frac{2}{25}$	B1	accept 0.08	
(b)	$\frac{1}{8}$	M1	$fg(x) = \frac{2}{(4x^3)^2}$ oe **or** $g(1) = 4$ **or** $\frac{2}{(4\times1^3)^2}$ oe	
		A1	oe	All powers and products must be evaluated
104	11 – 19	P1	for drawing a tangent to the curve at time = 5	
		P1	for process to find the gradient, eg 70 ÷ 5	Using their drawn tangent, eg change in y ÷ change in x
		A1	(dep on 1st P1) for answer in the range 11 - 19 m/s	Must come from gradient of a tangent.

Question	Answer	Mark	Mark scheme	Additional guidance
105 (a)	Correct graph	B2	for a circle radius 3.5, centre (0, 0)	Circle could be drawn freehand as long as it approximates to a circle
		(B1	for a circle centre (0, 0) of a different radius, **or** for a circle drawn of radius 3.5 centre not (0, 0) **or** incomplete correct circle)	
(b)	$x = 2.0$, $y = -2.9$ $x = -1.2$, $y = 3.3$	M1	for $2x + y = 1$ drawn, **or** for correctly eliminating one variable, eg $x^2 + 1 - 4x + 4x^2 = 12.25$ or $x^2 + (1 - 2x)^2 = 12.25$	
		A1	for the pair of x values, **or** the correct pair of y values, **or** one correct pair of x/y values ft from (a) (dep on B1)	$2x + y = 1$ does not have to be shown Use professional judgment
		A1	for both correct pair of x/y values, unambiguously matched ft from (a) (dep on B1)	Accept values given as coordinates. Check graph for answers

Question	Working	Answer	Mark	Notes
106		$1\frac{1}{2}$	M1	for correct expansion of the bracket or dividing all terms by 3 as a first step eg $3x - 3$ or $(5x - 6)/3 = 3(x - 1)/3$
			M1	for isolating terms in x on one side of an equation eg $5x - 6 - 3x = -3$ or both constants on one side of an equation, eg $5x = 3x - 3 + 6$, ft $5x - 6 = 3x - 1$
			A1	for $1\frac{1}{2}$ oe
107 (a)		6	B1	cao
(b)		5	B1	cao
(c)		Shown	M1	for writing 100^a or 1000^b as a power of 10 ($=10^{2a}$ or 10^{3b}) or $10^{2a + 3b}$ or $100 = 10^2$ and $1000 = 10^3$
			C1	for complete chain of reasoning leading to conclusion
108 (a)		0 to 20 seconds	B1	for between 0 seconds and 20 seconds
		with reason	C1	for reason given eg gradient is greatest oe
(b)		18	B1	ft from (a)

Question	Working	Answer	Mark	Notes
109		Region R shaded	M1	for two of the lines $y = 1$, $x + y = 5$, $y = 2x$ correctly drawn
			M1	for three lines correctly drawn
			A1	for fully correct region indicated with all lines correct
110	$\frac{--4 \pm \sqrt{(-4)^2 - 4 \times 1 \times 1}}{2 \times 1}$	0.268, 3.73	M1	for $x - 2 = \pm\sqrt{3}$ oe or one solution or use of $x^2 - 4x + 1 = 0$ to substitute into formula (allow one error in substitution)
			A1	0.267 – 0.27, 3.7 – 3.74
111		7, −1	P1	for strategy to use g(3) = 20, e.g. $3a + b = 20$
			P1	for g(1) = $a + b$
			P1	for a process to find inverse of f. e.g. $f^{-1}(x) = \frac{x-3}{5}$ or $f^{-1}(33) = 6$
			P1	for using $f^{-1}(33) = g(1)$ to find an equation e.g. $\frac{33-3}{5} = a + b$
			A1	for $a = 7$, $b = -1$

109



Question	Working	Answer	Mark	Notes
112 (a)		2	M1	for start to express the common ratio algebraically, eg $1/(\sqrt{x} - 1)$ or $(\sqrt{x} + 1)/1$ or $\sqrt{x} + 1 = k \times 1$ or $1 = k \times (\sqrt{x} - 1)$
			M1	for setting up an appropriate equation in x, eg $1/(\sqrt{x} - 1) = (\sqrt{x} + 1)/1$
			C1	for convincing argument to show $x = 2$
(b)		Shown	M1	for expressing the relationship between the common ratio, one of the first three terms of the sequence and the fifth term, eg 5^{th} term = 3^{rd} term × (common ratio)^2
			C1	for a complete explanation to include eg, $(\sqrt{2} + 1)(\sqrt{2} + 1)^2 = 7 + 5\sqrt{2}$

Question	Working	Answer	Mark	Notes
113		$9\frac{1}{3}$	M1	for writing at least 2 fractions with a common denominator eg. $\frac{3(3x-2)}{12}, \frac{4(2x+5)}{12}, \frac{2(1-x)}{12}$ with at least one correct numerator or for $\frac{3x}{4}-\frac{2}{4}-\frac{2x}{3}-\frac{5}{3}=\frac{1}{6}-\frac{x}{6}$ (accept $+\frac{5}{3}$ instead of $-\frac{5}{3}$)
			M1	(dep) for a method to eliminate all fractions in an equation, ignore errors in any expanded terms eg. $3(3x-2)-4(2x+5)=2(1-x)$ or $6\times[3(3x-2)-4(2x+5)]=12\times[1-x]$ or $3\times 3x-3\times 2-4\times 2x-4\times 5=2\times 1-2\times x$ OR for the correct expansion of brackets leading to $\frac{9x-6-8x-20}{12}=\frac{2-2x}{12}$
			M1	(dep on M2) for correctly isolating terms in x and number terms of their linear equation e.g. $9x - 8x + 2x = 2 + 6 + 20$
			A1	for $9\frac{1}{3}$ oe
114		C, F, A, H	B3 [B2 [B1	for a fully correct table for 2 or 3 correct] for 1 correct]

Question	Working	Answer	Mark	Notes
115		1.45	P1 P1 A1 P1 A2	for converting to a common base with at least one correct conversion, eg. (16 =) 2^4 or (8 =) 2^3 (dep) for correct use of index laws to derive an equation, eg. $4 \times \frac{1}{5} + x = 3 \times \frac{3}{4}$ oe for 1.45 oe (accept $2^{1.45}$) OR for a process to find the value of 2^x , eg. $8^{\frac{3}{4}} \div 16^{\frac{1}{5}} = 2.73\ldots$ for 1.45 oe (accept $2^{1.45}$)
116		$a = 4$, $b = -42$	M1 M1 M1 A1	for at least two terms from $2(x-3)(x+3)$, $(x+2)(x+3)$, $(x-6)(x-3)$ (dep) for the correct expansion of at least two expressions, irrespective of signs, eg. $2x^2 - 18$, $x^2 + 2x + 3x + 6$, $x^2 - 6x - 3x + 18$ oe for $2x^2 - 18 - x^2 - 5x - 6 - x^2 + 9x - 18$ for $a = 4$, $b = -42$ (accept $4x - 42$)

Question	Working	Answer	Mark	Notes
117 (a)		–0.4 to –0.2 and 3.2 to 3.4	M1 A1	for ($y =$) $x + 4$ for answers in the range –0.4 to –0.2 and 3.2 to 3.4
(b)		1.6 to 2.5	M1 M1 A1	for drawing a tangent to the curve at $x = 2$ for method to find gradient of their tangent for answer in the range 1.6 to 2.5
118		$2n^2 + n + 1$	M1 M1 A1	for a correct start to a method to find nth term, eg. equal 2nd differences imply a term in n^2 or sight of $an^2 + bn + c$ for a method leading to $2n^2$ and either n or 1 for $2n^2 + n + 1$ oe
119		$y = \frac{-3}{\sqrt{7}}x + \frac{8}{\sqrt{7}}$	M1 M1 A1	for method to find gradient of OP, eg $\frac{\sqrt{7}}{2} \div \frac{3}{2}\left(= \frac{\sqrt{7}}{3} \text{ or } 0.88 \ldots\right)$ oe (dep) for method to find gradient of tangent, m, eg. $\frac{\frac{\sqrt{7}}{2}}{\frac{3}{2}} \times m = -1 \left(m = \frac{-3}{\sqrt{7}} \text{ or } -1.13..\right)$ for $y - \frac{\sqrt{7}}{2} = \frac{-3}{\sqrt{7}}\left(x - \frac{3}{2}\right)$ or $y = \frac{-3\sqrt{7}}{7}x + \frac{8\sqrt{7}}{7}$ oe or $y - 1.32.. = -1.13..(x - 1.5)$

Question	Working	Answer	Notes
120 (a)		$4n+2$	M start to deduce nth term from information given eg $4n+k$ where $k \neq 2$
			A1 cao
(b)		No (supported)	M1 starts method that could lead to a deduction eg uses inverse operations
			C1 for a convincing argument eg 34 is 107 so NO; (108ġ5)ò3 is not an integer
121 (a)		(1, 4)	B1
(b)		−0.4, 2.4	B1
(c)		3.75	B1 accept 3.7 – 3.8

Question	Working	Answer	Notes
122	$(4n^2+2n+2n+1)$ $-(2n+1)=$ $4n^2+4n+1-2n-1$ $= 4n^2 + 2n$ $= 2n(2n + 1)$	proof (supported)	M1 for 3 out of 4 terms correct in the expansion of $(2n + 1)^2$ **or** $(2n + 1)\{(2n+1)-1\}$ P1 for $4n^2 + 2n$ or equivalent expression in factorised form C1 for convincing statement using $2n(2n + 1)$ or $2(2n^2 + n)$ or $4n^2 + 2n$ to prove the result
123		$\frac{2x+1}{3x+5}$	M1 for $(3x \pm 5)(2x \pm 1)$ or $(2x + 1)(2x - 1)$ M1 $\frac{1}{(3x\pm5)(2x\pm1)}\times(2x+1)(2x-1)$ A1

Question	Working	Answer	Notes
124 (a)		Sketch	P1 Parabola passes through all three of the points (0, 4), (2,0), (4, 4)
(b)		Sketch	P1 Parabola passes through all three of the points (−4, −1), (−2,2), (0, −1)
125		x=0, y=5 x=−4, y=−3	M1 Initial process of substitution eg $x^2 + (2x + 5)^2$ (=25) M1 for expanding and simplifying eg $x^2 + 4x^2 + 10x + 10x + 25$ (=25) M1 Use of factorisation or correct substitution into quadratic formula or completing the square to solve an equation of the form $ax^2 + bx + c = 0$, $a \neq 0$ A1 correct values of x or y C1 $x = 0$, $x = -4$, $y = 5$, $y = -3$ correctly matched x and y values

Question	Working	Answer	Notes	
126		$t = \frac{w - 11}{3}$	M1	For isolating term in t, eg. $3t = w - 11$ or dividing all terms by 3, eg. $\frac{w}{3} = \frac{3t}{3} + \frac{11}{3}$
			A1	for $t = \frac{w-11}{3}$ oe
127	$(3x - 1)(4x^2 + 20x - 3x - 15)$ $(x + 5)(12x^2 - 4x - 9x + 3)$ $(4x - 3)(3x^2 - x + 15x - 5)$	Fully correct algebra to show given result	M1 M1 A1	for method to find the product of any two linear expressions; eg. 3 correct terms or 4 terms ignoring signs (dep) for method of 6 products, 4 of which are correct (ft their first product) for fully accurate working to give the required result

Question	Working	Answer	Notes
128		$n^2 - n + 1$ oe	M1 for correct deduction from differences, eg. 2nd difference of 2 implies $1n^2$ or sight of $1^{2,}\ 2^2, 3^2, ..$ M1 for sight of $1^{2,}\ 2^2, 3^2, ..$ linked with 1, 2, 3, ... A1 for $n^2 - n + 1$ oe OR M1 for $a + b + c = 1$ or $4a + 2b + c = 3$ or $9a + 3b + c = 7$ oe M1 for a method to eliminate one unknown leaving simultaneous equations in the other two A1 for $n^2 - n + 1$ oe
129		$3x^2 + 10x$	M1 start a chain of reasoning, eg. $3(x+2)^2 - 2(x+2) - 8$ M1 continue chain by expanding brackets correctly, eg. $3x^2 + 12x + 12 - 2x - 4 - 8$ A1 for $3x^2 + 10x$ ($a = 3$, $b = 10$)

Question	Working	Answer	Notes	
130		$y = -\frac{4}{3}x + \frac{25}{3}$ oe	M1	for method to find gradient of tangent, eg. $-1 \div \frac{3}{4} = -\frac{4}{3}$
			M1	(dep) for method to find y-intercept using $y =$ "$-\frac{4}{3}$"$x + c$
			A1	$y = -\frac{4}{3}x + \frac{25}{3}$ oe

Question	Working	Answer	Notes
131 (a)		$13y - 1$	M1 for expansion of one bracket A1 for full simplification
(b)		$35u^3w^7$	B1 for 2 of 35, u^3 and w^7 correct B1 cao
132 (a)		explanation	C1 for "incorrect expansion of brackets" oe
(b)		explanation	C1 for "has not obtained both solutions" oe
133		119	M1 for 1.06×100 oe M1 for $1.06^3 \times 100$ oe A1 accept 119.1016
134	$(\sqrt{a} + 2\sqrt{b})(\sqrt{a} - 2\sqrt{b})$ $\sqrt{a} \times \sqrt{a} - 2\sqrt{a}\sqrt{b} +$ $2\sqrt{b}\sqrt{a} - 2\sqrt{b} \times 2\sqrt{b}$	$a - 4b$	M1 for expansion of brackets or $\sqrt{4b} = 2\sqrt{b}$ M1 for a or $(-4b)$ A1 cao
135 (a)		sketch	B1 for correct shape for $0 \leqslant x \leqslant 360$ B1 for fully correct sketch with labels
(b)(i)		sketch	B1 cao
(ii)		sketch	B1 cao

Question	Answer	Mark	Mark scheme	Additional guidance
136	12	P1	for a process to find the fifth term, eg $3a + 5a$ (= 8a)	
		P1	for setting up the equation eg $a + 2a + 3a + 5a + [8a] = 228$	allow use of what is clearly indicated as the missing term $\frac{228}{19}$ or $\frac{228}{1+2+3+5+8}$ scores P1 P1 $\frac{228}{1+2+3+5+[8]}$ scores P0P1
		A1	cao	

Question	Answer	Mark	Mark scheme	Additional guidance
137	49, 2	P1	for setting up $6 \div n = 3$ oe **or** $7^n = a$ oe **or** one correct answer	
		A1	cao	Accept the figures written as a complete statement eg $\left(49x^6\right)^{\frac{1}{2}}$
138	(9, 8)	P1	for setting up an equation for one dimension (width) of the pattern eg $2b - a = 8$ oe **or** $2x + y = 8$ oe	a and b are the width and length x is the difference between the length and width, y is the width of the rectangle
		P1	for setting up an equation for the other dimension (height) of the pattern eg $2b + a = 16$ oe **or** $2x + 3y = 16$ oe	
		P1	(dep P2) for a full process to solve for both variables eg $4b = 24$ $b = 6$ and $12 - a = 8$ $a = 4$ **or** $8 = 2y$ $y = 4$ and $8 = 2x + y$ $x = 2$	Both values correct implies this mark
		P1	(dep P3) for a full process to find one of the coordinates of C eg $3 + 6$ (= 9) or $4 + 4$ (= 8) **or** $3 + 2 + 4$ (= 9) or $4 + 4$ (= 8)	
		A1	cao	Award 0 marks for a correct answer with no supportive working.

Question	Answer	Mark	Mark scheme	Additional guidance
139	Shown (supported)	M1	for eliminating y or x, eg $x^2 + 3x - 3 = 5x - 4$	
		M1	for rearranging, collecting terms and setting to 0 eg $x^2 - 2x + 1\ (= 0)$	
		M1	for factorising or solving eg $(x - 1)^2\ (= 0)$	
		C1	for statement confirming only 1 point in common eg only 1 root **or** only 1 value of x so only 1 set of coordinates	There must be a statement in words for the award of this mark
140 (a)	19.1	M1	for a method to find an estimate for the area of at least 1 trapezium under the curve eg $0.5 \times 1 \times (4 + 6)$ or $0.5 \times 1 \times (6 + 7.2)$ or $0.5 \times 1 \times (7.2 + 7.8)$	
		M1	for a complete method eg $0.5 \times 1 \times (4 + 6) + 0.5 \times 1 \times (6 + 7.2) + 0.5 \times 1 \times (7.2 + 7.8)$ or $0.5\ \{(4 + 7.8) + 2(6 + 7.2)\}$	Allow a maximum of 2 errors in y values used
		A1	cao	Ignore any reference to units
(b)	Statement	C1	eg distance (travelled)	If units are given they must be correct
141	$\frac{1}{x(x+4)}$	M1	inverting the fraction and multiplying eg $\frac{6x^3}{(9x^2-144)} \times \frac{3(x-4)}{2x^4}$	
		M1	for factorising $9x^2 - 144$, eg $(3x - 12)(3x + 12)$	
		A1	cao	

Question	Answer	Mark	Mark scheme	Additional guidance
142 (a)	n^8	B1	cao	
(b)	cd^3	M1	for partial simplification, eg c or d^3	May be seen as simplification in original fraction
		A1	for cd^3	Accept c^1d^3
(c)	$x > \frac{14}{5}$	M1	for $5x > 14$ or $5x = 14$ or critical value, $\frac{14}{5}$ oe	Must see carried out correctly, ie at least $5x > 7 \times 2$ not just intention seen. Allow other signs for this mark.
		A1	$x > \frac{14}{5}$ or $x > 2\frac{4}{5}$ or $x > 2.8$	
143 (a)	−2, 4	B1	cao	
(b)	0.55 to 0.65, 3.35 to 3.45	M1	for correct method, eg marking intercepts with x-axis or one correct answer or both solutions given as a coordinate eg (0.6, 3.4) or (0.6, 0) (3.4, 0)	If answers are stated as coordinates, award M1 for both coordinates and M0 for one coordinate.
		A1	for answers in the ranges 0.55 to 0.65 and 3.35 to 3.45	With no extras

Question	Answer	Mark	Mark scheme	Additional guidance
144 (a)	$\frac{3x^2}{(x-4)(x+2)}$	M1	for method to identify a common denominator, eg $(x-4)(x+2)$	
		M1	for method to combine the fractions, eg $\frac{2x(x+2)+x(x-4)}{(x-4)(x+2)}$	Accept $\frac{2x(x+2)}{(x-4)(x+2)}+\frac{x(x-4)}{(x-4)(x+2)}$
		A1	for $\frac{3x^2}{(x-4)(x+2)}$ or $\frac{3x^2}{x^2-2x-8}$	
(b)	$8x^3-2x^2-51x-45$	M1	for method to find the product of two linear expressions, eg 3 correct terms out of 4 terms or 4 terms ignoring signs	Note that, for example, $-3x-9$ in expansion of $(x-3)(2x+3)$ is to be regarded as 3 correct terms.
		M1	for a complete method to obtain all terms, half of which are correct (ft their first product) eg $8x^3-12x^2-15x+10x^2-36x-45$	First product must be quadratic with at least 3 terms but need not be simplified or may be simplified incorrectly
		A1	cao.	
145 (a)	region identified	M1	for 2 of lines $x=2$, $y=x+3$, $2x+3y=6$ correctly drawn	Accept use of full or broken lines for all marks
		M1	for all 3 lines $x=2$, $y=x+3$, $2x+3y=6$ correctly drawn	
		M1	for region which satisfies at least 2 of the inequalities $x\le 2$, $y\le x+3$, $2x+3y\ge 6$	Award for clear intention, shading not needed.
		A1	for correct region identified	Award for clear intention, shading not needed.
(b)	no supported with reason	B1	for no and reason, eg (2, 4) does satisfy $x+y\le 6$ or (2, 4) lies on the boundary of the region satisfying the equality sign.	

Question	Answer	Mark	Mark scheme	Additional guidance
146 (a)	129 to 160	M1	for a method to find an estimate for the area under the curve eg $0.5 \times 30 \times 9$	Do not accept 30×9
		A1	for value in the range 129 to 160 (If M0, SC B1for 126 or 127.5)	Award full marks for any correct method leading to a better estimate.
(b)	underestimate with reason	C1	(dep M1) for "underestimate" and appropriate reason linked to their method, eg area between triangle and curve not included	
(c)	Explanation	C1	for explanation, **Acceptable examples** method gives average acceleration (in first 60 seconds) he has not used/drawn a tangent (at time 60 seconds) he has not worked out the gradient (at time 60 seconds) **Not acceptable examples** he has not used strips he has calculated it accurately rather than using an estimate the estimate of 13 should be about 4.4 the answer should be approximately 0.073	

Question	Answer	Mark	Mark scheme	Additional guidance
147 (a)	$x^2 - 4x - 45$	M1	for 3 of 4 terms correct **or** 4 terms correct ignoring signs	3 terms correct can be implied, eg $x^2 - 4x + c$
		A1	cao	
(b)	$3x(3x + 2)$	B2	for $3x(3x + 2)$	
		(B1	for $3(3x^2 + 2x)$ **or** $x(9x + 6)$ **or** $3x(ax + b)$ where a and b are integers **or** $(3x + 2)$ as a factor)	
148 (a)	8.5	M1	for multiplying both sides by 7 as a first step eg $9 + x = 7(11 - x)$ **or** dividing each term on the left hand side by 7 eg $\frac{9}{7} + \frac{x}{7} = 11 - x$	× 7 written near the equation is not enough for this mark
		M1	(dep M1) for method to isolate the x terms on one side	
		A1	oe	
(b)	$4(y + 3)$	B1	$4(y + 3)$ **or** $4y + 12$	
149	Proof	M1	for correct expressions for two consecutive even numbers eg $2n$ and $2n+2$	$(2n)^2 + (2n + 2)^2$ $= 4n^2 + 4n^2 + 8n + 4$ $= 8n^2 + 8n + 4 = 4(2n^2 + 2n + 1)$
		M1	(dep M1) for expanding both expressions with at least one expansion fully correct eg $4n^2$ and $4n^2 + 4n + 4n + 4$ **or** for factorising both terms and intention to square correctly eg $(2n)^2$ and $2^2(n+1)^2$	**Or** $(2n)^2 + (2n - 2)^2$ $= 4n^2 + 4n^2 - 8n + 4$ $= 8n^2 - 8n + 4 = 4(2n^2 - 2n + 1)$
		A1	complete proof	**Or** $(2n)^2 + (2n + 2)^2$ $= 4(n)^2 + 4(n + 1)^2$ $= 4(n^2 + (n + 1)^2)$

Question	Answer	Mark	Mark scheme	Additional guidance
150	2.7 and −0.7	M1	for $x^2-3 = 2x-1$ oe **or** $x^2-3-2x+1$ (=0) **or** completing the square eg $(y=)(x-1)^2-1-2$	
		M1	(dep M1) draws graph of $y = 2x-1$ **or** drawing the translated graph **or** describing the translation in words **or −1.7 + 1 (= −0.7)** **or** 1.7 + 1 (=2.7)	Line segments required For 1.7 allow from 1.6 to 1.8 For −1.7 allow from −1.8 to −1.6
		M1	shows the points of intersection clearly for the given quadratic graph and linear graph **or** for one correct solution from appropriate supportive working	Points indicated or attempt to read off x-axis at the appropriate points – maybe indicated by dashes
		A1	for x in the range 2.6 to 2.8 **and** −0.6 to −0.8 SCB2 for plotting $y = 2x + 1$ **and** values for x in the range −1.1 to −1.3 **and** 3.1 to 3.3	No marks will be awarded for correct answers only
151	$n^2 - 2n$	M1	for correct deduction from differences, eg 2nd difference of 2 implies $1n^2$ **or** gives a quadratic expression which includes the term $1n^2$ **or** states 1,4,9,16,25 and deduces 2,4,6,8,10	
		A1	oe	
152	$7x$	M1	multiplication by reciprocal, eg $\frac{7(x-2)}{(x-2)(x+6)} \times \frac{x(x+6)(x-6)}{x-6}$	Independent mark, may be awarded at any point
		M1	for factorising the numerator or denominator of the 1st fraction, eg $\frac{7(x-2)}{(x-2)(x+6)}$ **or** $\frac{7(x-2)}{x^2+4x-12}$ **or** $\frac{7x-14}{(x-2)(x+6)}$	
		M1	for factorising the denominator of the second fraction, eg $\frac{x-6}{x(x+6)(x-6)}$ $(=\frac{1}{x(x+6)})$	
		A1	completing the algebra to reach $7x$	

Question	Answer	Mark	Mark scheme	Additional guidance
153	(−7, −1)	M1 A1	for a method which shows understanding of the type of transformation eg reflection in the y axis or translation $\begin{pmatrix}0\\-3\end{pmatrix}$ or "(0 units right and) 3 units down" **or** for x coordinate as −7 **or** y coordinate as −1 for (−7, −1)	"Reflection" or "Translation" alone is insufficient. Note that the −7 or the −1 may appear in the working space, not necessarily in the final answer.
154	$2n^2 - 3$	M1 M1 A1	begins to work with 2nd differences identifies $2n^2$ as part of the expression eg gives the sequence 2, 8, 18, 32, ... or gives a quadratic expression which includes the term $2n^2$ oe	6 10 14 18 22 4 4 4 4 A quadratic expression of the form $2n^2 + bn + c$ can be awarded the first 2 marks
155	B, A, D, C	B2 (B1	for all correct for two or three correct)	

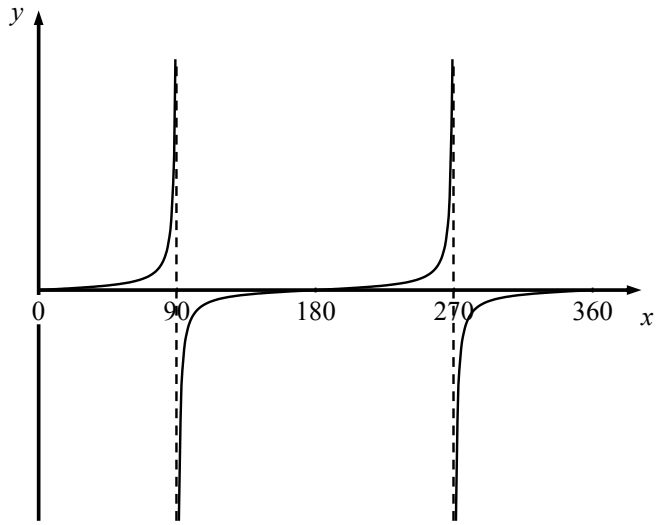
Question	Answer	Mark	Mark scheme	Additional guidance
156 (a)	$6x^3 + 35x^2 + 58x + 21$	M1	for a method to find the product of two linear expressions, 3 correct terms out of 4 terms e.g. $2x^2 + x + 6x + 3$ or $3x^2 + 7x + 9x + 21$ or $6x^2 + 14x + 3x + 7$	Note that, for example, $7x + 3$ is regarded as three terms in the expansion of $(2x + 1)(x + 3)$
		M1	for a complete method to obtain all terms, at least half of which are correct (ft their first product) e.g. $6x^3 + 32x^2 + 42x + 3x^2 + 16x + 21$	First product must be a 3 or 4 term quadratic but need not be simplified or may be simplified incorrectly
		A1	cao	Accept $a = 6$, $b = 35$, $c = 58$, $\boldsymbol{d} = 21$
(b)	$\frac{2}{5} < x < 1\frac{3}{5}$	M1	for first step of finding the square root of both sides eg $1 - x < \pm\frac{3}{5}$ **OR** for writing in the form $ax^2 + bx + c$ (< 0) eg $x^2 - 2x + \frac{16}{25}$(< 0) or $25x^2 - 50x + 16$ (< 0)	Condone use of an "=" sign; accept one square root (eg $\frac{3}{5}$) only shown.
		M1	for showing critical values $\frac{2}{5}$ (= 0.4) and $1\frac{3}{5}$ (= 1.6) oe	Critical values can be stated, or shown in an expression (which may have incorrect inequality symbols)
		A1	for $\frac{2}{5} < x < 1\frac{3}{5}$ oe	Could be written as two separate expressions eg $x > \frac{2}{5}$ and $x < 1\frac{3}{5}$ oe

Question	Answer	Mark	Mark scheme	Additional guidance
157	$x = 3\frac{2}{5}, y = -\frac{4}{5}$	M1	for substitution of a rearrangement eg $x = \frac{7-4y}{3}$ or $y = \frac{7-3x}{4}$ into $x^2 - 4y^2 = 9$ **or** expansion of $\left(\frac{7-4y}{3}\right)^2 = \frac{49-56y+16y^2}{9}$ or $\left(\frac{7-3x}{4}\right)^2 = \frac{49-42x+9x^2}{16}$	Expansion may not be in simplest form but must be correct
	$x = 5, y = -2$	M1	for correct expansion **and** substitution eg $\frac{49-56y+16y^2}{9} - 4y^2 = 9$ **or** $x^2 - 4\left(\frac{49-42x+9x^2}{16}\right) = 9$	
		A1	for forming quadratic ready for solving eg $-20y^2 - 56y - 32 (= 0)$ or $5y^2 + 14y + 8 (= 0)$ oe **or** $5x^2 - 42x + 85 (= 0)$ oe	Note we do not need to see "= 0"; just the LHS is sufficient.
		M1	ft a 3 term quadratic , factorising eg $(5y + 4)(y + 2) (= 0)$ **or** $(5x - 17)(x - 5) (= 0)$ or correct use of formula eg $(y =) \frac{-14 \pm \sqrt{14^2 - 4\times5\times8}}{2\times5}$ **or** $(x =) \frac{--42 \pm \sqrt{42^2 - 4\times5\times85}}{2\times5}$ **or** completing the square, eg $(y + \frac{7}{5})^2 - \frac{9}{25} (= 0)$ or $(x - \frac{21}{5})^2 - \frac{16}{25} (= 0)$	Can be implied by both x values correct or both y values correct.
		A1	correctly pairs x and y values: $x = 3\frac{2}{5}, y = -\frac{4}{5}$ oe , $x = 5, y = -2$	Answers must be correctly paired. Accept coordinate pairs

Question	Answer	Mark	Mark scheme	Additional guidance
158 (a)	2, −4, 2, 8	B2	all 4 values correct	
		(B1	for 2 or 3 correct values)	
(b)	Graph	M1	(dep B1) for at least 5 points plotted correctly ft from part a	
		A1	for a fully correct curve drawn	Accept freehand curves drawn that are not line segments; there must be some attempt to draw the minimum point below $y = -4$
(c)	−2.6 or 1.6	B1	for 1 correct value, ft a non linear graph	Award for −2.6 or 1.6 or both values but do not award the mark if a correct value is given with an incorrect value. Accept 1.56 or −2.56 Note for ft to be applied if the graph may be joined by line segments

Question	Answer	Mark	Mark scheme	Additional guidance
159 (a)	$2x^3 + x^2 - 7x - 6$	M1	for a method to find the product of two linear expressions eg 3 correct terms out of 4 terms or 4 terms ignoring signs	Note that (eg) $-x-6$ in expansion of $(x-2)(2x+3)$ is to be regarded as 3 correct terms.
		M1	for a complete method to obtain all terms, half of which are correct (ft their first product) eg $2x^3 - x^2 - 6x + 2x^2 - x - 6$	First product must be quadratic but need not be simplified or may be simplified incorrectly
		A1	cao	
(b)	-5	M1	for beginning to combine indices eg $4+n$ or y^{-3+2}	
		A1	cao	
(c)	1.27 and −0.472	M1	for substitution into the formula	Condone one sign error in the substitution Accept -4^2 or $(-4)^2$
		M1	for simplifying to the form $\frac{-b\pm\sqrt{N}}{k}$ eg $\frac{4\pm\sqrt{76}}{10}$ **or** 1.27 to 1.28 **or** −0.48 to −0.47	
		A1	for 1.27 to 1.28 **and** −0.48 to −0.47	

Question	Answer	Mark	Mark scheme	Additional guidance
160 (a)	1.56	B1	1.56 to 1.563	
(b)	3.63	M1	for a complete method to find fg(34) eg 4 sin 65(=3.625..) **or** fg(x) eg 4 sin ($2x-3$)	
		A1	for answer in the range 3.6 to 3.63	If an answer in the range is seen in working and then incorrectly rounded award full marks.
(c)	Statement	C1	for statement eg positive and negative square root required. **Acceptable examples** The other answer is −9 The quadratic should have 2 solutions. **Not acceptable examples** He has not expanded the brackets. He needed to (x+4) twice as there is a squared sign. (x+4)² is 16 not 25. Didn't expand the bracket.	
161	Graph drawn	C2	for fully correct sketch between 0° and 360°	
		(C1	for a graph with clear asymptotes at 90° and 270° only **or** the correct graph translated along the x-axis must have a period of 180)	



Question	Answer	Mark	Mark scheme	Additional guidance
162	proof	C1	for writing an expression for an odd number, eg $2n + 1$ or $2n - 1$ (assuming n is any integer) **or** states n is even and eg $(n + 1)$ or $(n + 3)$ as odd numbers	
		C1	for a correct expression of the form $(2n + 1)^2 - (2n - 1)^2$ expanded eg $4n^2 + 12n + 9 - (4n^2 + 4n + 1)$ or $4n^2 + 4n + 1 - (4n^2 - 4n + 1)$ **or** $(2n + 1 + 2n - 1)(2n + 1 - (2n - 1))$ **or** when n is even and eg $(n^2 + 6n + 9) - (n^2 + 2n + 1)$ $(=4n + 8)$	Expansion of $(2n - 1)^2 - (2n + 1)^2$ oe is acceptable
		C1	for a correct simplified expression as a multiple of 8 eg $8n + 8$ or $8n$ **or** when n is even **and** eg $4n + 8$ **and** full explanation as to why $4(n+2)$ is always a multiple of 8	

Question	Answer	Mark	Mark scheme	Additional guidance
163	$x= -\frac{23}{7}, y=\frac{15}{7}$	M1	for substitution of a rearrangement eg for $2(1-2y)^2 - y^2 = 17$ **or** $2x^2 - \left(\frac{1-x}{2}\right)^2 = 17$ **or** expansion of $(1-2y)^2 = 1-4y+4y^2$ **or** $\left(\frac{1-x}{2}\right)^2 = \frac{1-2x+x^2}{4}$	
	$x = 3, y = -1$	M1	for expansion of bracket **and** substitution eg $2(1-4y+4y^2) - y^2 (= 17)$ **or** $8x^2 - (1-2x+x^2) (= 68)$	
		A1	for forming quadratic ready for solving eg $7y^2 - 8y - 15 (= 0)$ **or** $7x^2 + 2x - 69 (= 0)$	
		M1	ft a 3 term quadratic, factorising eg $(7y-15)(y+1) (= 0)$ **or** $(7x+23)(x-3) (= 0)$ **or** correct use of formula eg $\frac{8 \pm \sqrt{64+420}}{14}$ or $\frac{-2 \pm \sqrt{4+1932}}{14}$ **or** completing the square	Can be implied by both x values correct or both y values correct.
		A1	$x = -\frac{23}{7}$ oe, $y = \frac{15}{7}$ oe **and** $x = 3, y = -1$	Answers must be correctly paired. (Maybe in the body of the working) Accept for x between -3.29 and -3.28 and for y between 2.14 and 2.15 Answers only award 0 marks

Question	Answer	Mark	Mark scheme	Additional guidance
164	$9p + 13$	M1	for method to expand one bracket, eg $5 \times p + 5 \times 3$ $(= 5p + 15)$ or $2 \times 1 - 2 \times 2p$ $(= 2 - 4p)$ or $-2 \times 1 - 2 \times -2p$ $(= -2 + 4p)$	If an attempt is made to multiply by -2 in the second brackets then it must be done consistently.
		A1	cao	
165	3.8	M1	for a correct first step, eg $5 - x = 2(2x - 7)$ or $5 - x = 4x - 14$ or $\frac{5}{2} - \frac{x}{2} = 2x - 7$	Method must show LHS $\times 2$ and both terms on RHS $\times 2$ or $5 - x$ and both terms on RHS $\times 2$
		M1	(dep) for isolating terms in x eg $4x + x = 14 + 5$ or $-\frac{x}{2} - 2x = -7 - \frac{5}{2}$	eg $-4x$ both sides with -5 both sides or $+x$ both sides with $+14$ both sides
		A1	oe	Accept $\frac{19}{5}$, $3\frac{4}{5}$ oe but not $\frac{-19}{-5}$ oe
166 (a)	1.5	M1	for method to find the gradient of the line, eg $\frac{12}{8}$	Must see use of scales.
		A1	for 1.5 oe	
(b)	Explanation	C1	Explanation relating to rate of change of volume with time, eg rate at which the container fills or change in number of litres per second or number of litres added per second	Ignore any quantities given. Award the mark for an explanation involving rate.
(c)	Explanation	C1	Explanation relating to volume (amount) of liquid in the container at the start eg number of litres in the container when $t = 0$, amount of liquid in the container to start with	

Question	Answer	Mark	Mark scheme	Additional guidance
167 (a)	488 to 507	M1	for method to find area of one strip using trapezia, eg $\frac{1}{2} \times 5 \times 22$ (= 55) or $\frac{1}{2} \times 5 \times (22 + 28)$ (= 125) or $\frac{1}{2} \times 5 \times (28 + 32)$ (= 150) or $\frac{1}{2} \times 5 \times (32 + 35)$ (= 167.5) **OR** for a method to find an estimate for the area using rectangles eg 5×22 or 5×28 or 5×32 or 5×35	May use area of triangle + area of rectangle for the second, third and fourth strips – lengths must be correct. May use triangle for first strip, $\frac{1}{2} \times 5 \times 22$
		M1	for complete and correct method to find the area using four strips, eg $\frac{1}{2} \times 5 \times 22 + \frac{1}{2} \times 5 \times (22 + 28) + \frac{1}{2} \times 5 \times (28 + 32)$ $+ \frac{1}{2} \times 5 \times (32 + 35)$ or $5 \times 22 + 5 \times 28 + 5 \times 32 + 5 \times 35$	May use triangle for first strip, $\frac{1}{2} \times 5 \times 22$
		A1	for answer in the range 488 to 507 (SC B1 for using area under the curve)	
(b)	Underestimate (supported)	C1	(dep M1) for underestimate since parts not included below the graph **OR** ft their method	

Question	Answer	Mark	Mark scheme	Additional guidance
168 (a)	42	P1	for process to find an equation in a and b, eg $a \times 2^2 + b \times 2 = -2$ ($4a + 2b = -2$) or $a \times 4^2 + b \times 4 = 12$ ($16a + 4b = 12$)	
		P1	for process to find a pair of simultaneous equations and eliminate one unknown, eg $16a + 8b = -8$ and $16a + 4b = 12$ and subtraction or $16a + 4b = 12$ and $8a + 4b = -4$ and subtraction	Allow one arithmetic error in elimination, eg $16a + 8b = -8$ and $16a + 4b = 12$ leading to $4b = 20$ but no subtraction sign seen
		A1	for $a = 2$ and $b = -5$	
		A1	cao	
(b)	$n^2 - n$	M1	for correct method, eg n^2 seen as a term	
		A1	for $n^2 - n$ oe	

Question	Answer	Mark	Mark scheme	Additional guidance
169 (a)	Correct statement	C1	for substituting both 1 and 2 into $x^3 + x$ or into $x^3 + x - 7$	All arithmetic shown must be correct. Ignore any additional trials shown.
		C1	for values 2 and 10 plus explanation that these are above and below 7, or for values -5 and 3 plus explanation that there is a change of sign, thus implying a solution lies between 1 and 2	
(b)	Correct rearrangement	C1	for correct algebraic rearrangement	
(c)	1.74	M1	for substitution of 2 into the formula eg $\sqrt[3]{7-2}$ (= 1.70997…)	$x_1 = 1.70997\ldots$ $x_2 = 1.74241\ldots$ $x_3 = 1.73884\ldots$
		M1	for a substitution of x_1 to give x_2 (= 1.74241...)	Accept an accuracy of 2 dp or more rounded or truncated for values of x_1 and x_2
		A1	for answer in the range 1.738 to 1.74	Award the marks for 1.7 on the answer line provided correct iterations are shown in the working space.

Question	Answer	Mark	Mark scheme	Additional guidance
170	$\frac{5}{3}$	P1	for process to derive an equation in x, eg $\frac{x}{4x-1}=\frac{6x+5}{12x+31}$	
		P1	for complete process to remove fractions, eg $x(12x + 31) = (6x + 5)(4x – 1)$	Must be correct use of brackets
		P1	for process to reduce to a quadratic equation, eg $12x^2 – 17x – 5 = 0$	Award for correct LHS only.
		P1	for process to solve the quadratic equation by factorisation or use of quadratic formula, eg $(4x + 1)(3x – 5) = 0$	Award for correct LHS only. Accept substitution into the formula; $\frac{--17\pm\sqrt{(-17)^2-4\times12\times-5}}{2\times12}$
		A1	for $\frac{5}{3}$ oe	Accept answers in the range 1.66 to 1.67 as equivalent

Question	Working	Answer	Mark	Notes
171		147	P1	starts process, eg uses x and $x + 7$
			P1	starts to work with at least 6 correct sides, may be on the diagram or in an expression
			P1	(dep on previous P1) gives a correct expression for the perimeter, eg $x + x + 7 + x + 7 + x + 7 + x + x + 7 + x + 7 + x + 7$ or adds at least 6 correct sides and equates to 70
			A1	for width = 3.5 oe **and** length = 10.5 oe
			B1	ft (dep P2) for correct area for their x
172		$(x + 3)^2 - 16$	M	for $(x + 3)^2$ or $(x^2 + 6x - 7 =) x^2 + 2ax + a^2 + b$
			A1	cao

Question	Working	Answer	Mark	Notes
173 (a)		Shown	M1	for method to establish at least one root between $x = 0$ and $x = 1$, eg f(0) = – 5 and f(1) = 3
			C1	for correct values and a deduction about the roots eg as there is a sign change there must be at least one root between $x = 0$ and $x = 1$ (as f is continuous)
(b)		Shown	C1	for a correct first step in rearrangement, eg $x(x^2 + 7) – 5 = 0$ or $x^3 + 7x = 5$
			C1	for clear and correct steps showing complete rearrangement
(c)	$x_1 = 0.625$ $x_2 = 0.6765327696$ $x_3 = 0.6704483001$	0.6704(483001)	M1 M1 A1	for substitution of 1 into the formula (to get 0.625) for substitution of "$x_1 = 0.625$" and "$x_2 = 0.6765327696$" to give x_2 and x_3 0.6704(483001)
(d)		Comment	M1 C1	substitutes answer to (c) into expression (to get –0.00549...) appropriate comment, eg accurate as answer is close to 0
174 (a)	values 0, 2, 5, 10,18	130	M1	for starting to find area under the curve, eg 0.5×5×2 (= 5)
			M1	for a complete method to find the area under the curve using 4 strips of equal width, eg "5" + 0.5×5×(2+5) (= 17.5) + 0.5×5×(5+10) (= 37.5) + 0.5×5×(10+18) (= 70)
			A1	for 130 or answer in range 130.1 to 132 supported by accurate working
(b)		overestimate with reason	C1	for "overestimate" and appropriate reason linked to method eg area between trapeziums and curve also included
175		Proof	M1	starts process to find point of intersection by substituting, eg $(10 + 2y)^2 + y^2$ (= 20)
		(supported)	M1	for expanding, eg $4y^2 + 20y + 20y + 100$ (3 out of 4 terms correct)
			M1	(dep M2) for 3-term quadratic equation ready for solving, eg $5y^2 + 40y + 80 = 0$
			M1	(dep on previous M1) for method to solve an equation of the form $ay^2 + by + c = 0$, eg by factorising or correct substitution into quadratic formula
			C1	fully correct method leading to $y = –4$ or $x = 2$ or $(y + 4)^2 = 0$ or $(x – 2)^2 = 0$ and statement, eg only one point of intersection so the line is a tangent to the circle

Question	Working	Answer	Mark	Notes
176		$x = -\frac{2}{3}$	M1	for a method to eliminate one variable (condone one arithmetic error)
		$y = -2$	M1	(dep) for substituting found value in one of the equations or appropriate method after starting again (condone one arithmetic error)
			A1	$x = -\frac{2}{3}$ oe and $y = -2$
177		$y \geq -2, y \geq x$ and $y \leq 0.5x + 1$	M1 M1 M1 A1	$y = -2$ indicated; accept any inequality for "=" $y = x$ oe indicated; accept any inequality for "=" $y = 0.5x + 1$ oe indicated; accept any inequality for "=" $y \geq -2, y \geq x$ and $y \leq 0.5x + 1$
178 (a)		$\frac{x+4}{2x+3}$	M1 M1 A1	Factorising the denominator $(2x \pm 3)(x \pm 4)$ or $2\left(x \pm 1\frac{1}{2}\right)(x \pm 4)$ Factorising the numerator $(x-4)(x+4)$ oe
(b)		$v = \frac{15t}{w+30}$	M1 M1 A1	A correct step towards solution e.g. expanding brackets to get $15t - 30v$ or multiply both sides by v For a method to rearrange the formula to isolate terms in v eg $vw + 30v = 15t$ oe

Question	Working	Answer	Mark	Notes
179		$x < -2, x > \frac{1}{2}$	M1 A1 A1	for a first step to solve the quadratic e.g. factorisation: $(2x+4)(x-\frac{1}{2})$ or $(2x-1)(x+2)$ or using the formula $\frac{-3\pm\sqrt{3^2-4\times2\times(-2)}}{2\times2}$ for -2 and $\frac{1}{2}$
180 (a)		(0,1)	B1	(0,1)
(b)		Circle radius 4 Centre (3,0) and (−1,0) and (7,0) labelled	M1 M1 A1	For centre (3,0) implied by drawing or label or a circle of radius 4 or intersections on the x-axis at −1or 7 implied by drawing or labels for 2 of centre (3,0) implied by drawing or label intersections on the x-axis at −1 and 7 implied by drawing or label circle drawn with radius 4 for a fully correct answer

Question	Working	Answer	Notes
181 (a)	8, 13, 21,	34	B1 cao
(b)	$a, b, a+b, a+2b, 2a+3b$	Shown	M1 Method to show by adding pairs of successive terms $a+2b, 2a+3b$ shown C1
(c)	$3a + 5b = 29$ $a + b = 7$ $3a + 3b = 21$ $b = 4$, $a = 3$	$a = 3$ $b=4$	P1 Process to set up two equations P1 Process to solve equations A1

Question	Working	Answer	Notes
182 **(a)**		$(y+6)(y+1)$	M1 for $(y \pm 6)(y \pm 1)$
			A1
(b)	$6x - x > 17 - 4$	2.6	M1 for method to isolate terms in x in an inequality or an equation
			A1 oe eg. $\frac{13}{5}$
(c)		$-2, -1, 0, 1, 2, 3$	M1 for **or** $-2.5 < n \leq 3$ **or** $-4, -2, 0, 2, 4, 6$ **or** $-4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6$
			A1
183 (a)		$\frac{x+1}{4}$	M1 start to method eg. $y = 4x - 1$ or $x = \frac{y+1}{4}$
			A1 oe
(b)		$\frac{13}{16}$	P1 for start to process eg. $f(4k) = 16k - 1$ or $g(2) = \frac{12+1}{4}$
			A1

Question	Working	Answer	Notes
184	$x = \frac{--5 \pm \sqrt{(-5)^2 - 4\times1\times3}}{2}$ = $\frac{5 \pm \sqrt{13}}{2}$	4.30 or 0.697	M1 Substitute into quadratic formula - allow sign errors M1 Evaluate as far as $\frac{5 \pm \sqrt{13}}{2}$ A1
185 (a)	F(x) = $x^3 + 4x - 1$ F(0) = −1, F(1) = 4	Shown	M1 Method to establish at least one root in [0,1]e.g $x^3 + 4x - 1$ (=0) and F(0)(= −1), F(1) (= 4) oe A1 Since there is a sign change there must be at least one root in $0 < x < 1$ (as F is continuous)
(b)	$4x = 1 - x^3$ Or $\frac{x^3}{4} + x = \frac{1}{4}$	Shown	C1 C1 for at least one correct step and no incorrect ones
(c)	$x_1 = \frac{1}{4} - \frac{0}{4} = \frac{1}{4}$ $x_2 = \frac{1}{4} - \frac{\left(\frac{1}{4}\right)^3}{4} = \frac{1}{4} - \frac{1}{256}$	0.246(09375) Or $\frac{63}{256}$	B1 $x_1 = \frac{1}{4}$ M1 M1 for $x_2 = \frac{1}{4} - \frac{'\left(\frac{1}{4}\right)^{'3}}{4}$ A1 A1 for 0.246(09375) or $\frac{63}{256}$ oe

Question	Working	Answer	Notes
186		$y = 2x + 1$	M1 for a method to find the gradient M1 for a method to find the c in $y = mx + c$ A1 $y = 2x + 1$
187		$(x - 1)(x + 4)$	M1 $(x \pm 1)(x \pm 4)$ A1 $(x - 1)(x + 4)$ oe
188		A and D	C1 in any order
189		Region R	M1 for one line correctly drawn M1 for two lines correctly drawn M1 for three lines correctly drawn A1 fully correct region indicated with all lines correct
190		$(x + 1)^2 - 9$	M1 for $(x + 1)^2$ or $m = 1$ A1 cao
191		$\frac{3x + 10}{x + 2}$	B1 for factorising to get $(x + 3)(x + 2)$ M1 for dealing with the division of $(x + 3)$ by $\frac{x^2+5x+6}{x-2}$ M1 for two correct fractions with a common denominator or a correct single fraction prior to subtracting eg $\frac{4(x+2)-(x-2)}{x+2}$ or $\frac{4(x+2)}{(x+2)} - \frac{(x-2)}{(x+2)}$ A1 $\frac{3x+10}{x+2}$
192		(6, –1)	M1 for a method showing the translation or reflection in the x-axis of a graph or a correct coordinate A1 cao
193 (a)		Rearrangement	M1 for re arranging to $x^3 =$ C1 a clear step to show re arrangement
(b)	$x_1 = 3.29296875$ $x_2 = 3.276659786$ $x_3 = 3.279420684$	Values	M1 for substitution of 3.2 into the iterative formula A1 for $x_1 = 3.292(96875)$ A1 for $x_2 = 3.276(659786)$ and $x_3 = 3.279(420684)$
(c)		Statement	C1 Statement eg estimates of a solution to the original equation

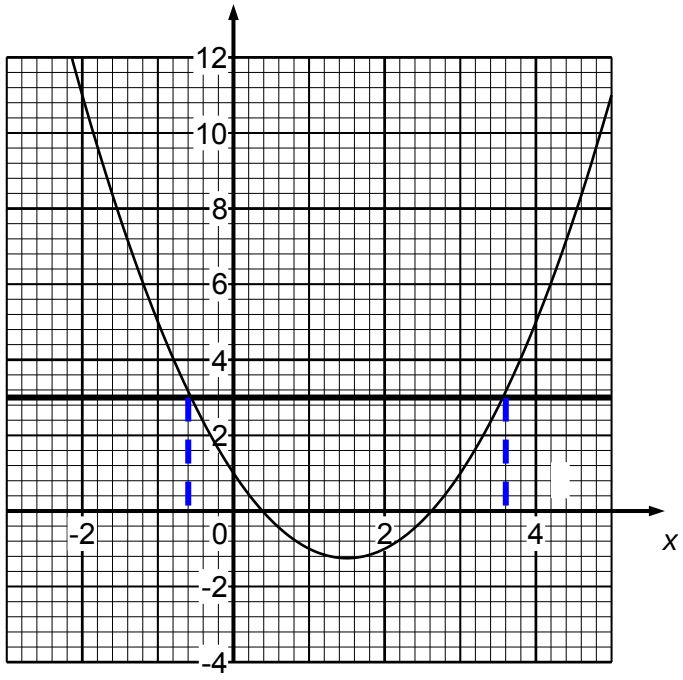
Question	Working	Answer	Notes
194		Proof	B1 state the difference of two squares in algebraic notation eg $p^2 - q^2$ M1 for writing down expressions for two different terms from the sequence eg $6n + 1$ and $6m + 1$ M1 for expanding one squared bracket to obtain 4 terms with all 4 correct without considering signs or for 3 terms out of 4 correct with correct signs A1 for $36(m^2 - n^2) + 12(m - n)$ oe M1 (dep M2) for factorising their expression by 12 C1 for fully correct working with statement justifying $(m - n)$ $(3(m + n) + 1)$ is even eg considering odd and even combinations

Question	Working	Answer	Notes
195		$t = 3(y + 2a)$	M1 adding $2a$ to both sides or multiplying each term by 3 A1 $t = 3(y + 2a)$ or $t = 3y + 6a$
196		$x = 4.5$ $y = –2.5$	M1 for a correct process to eliminate one variable (condone one arithmetic error) A1 cao for either x or y M1 (dep) for substituting found value into one of the equations or appropriate method after starting again (condone one arithmetic error) A1 cao
197		shown	C1 for $\frac{a(b+1)-a}{(b+1)^2}$ or $\frac{a(b+1)^2-a(b+1)}{(b+1)^3}$ oe C1 complete chain of reasoning
198		proof	C1 starts proof eg $n(n+1)$ or $(n Đ1)Ò n$ C1 $n(n+1) + n+1$ or $(n Đ1)Ò n + n$ C1 for convincing proof including $(n+1)^2$ or n^2
199		$2(x + 4)^2 + 3$ (–4, 3)	P1 process to find a, eg $2x^2 + 16x + 35 = 2(x^2 + \ldots)$ or $a = 2$ P1 for $2((x + 4)^2 + \ldots))$ or $b = 4$ A1 for $2(x + 4)^2 + 3$ or $a = 2$, $b = 4$, $c = 3$ B1 ft from answer of form $a(x + b)^2 + c$

Question	Working	Answer	Mark	Notes
200 (a)		x^{12}	1	B1 cao
(b)		2	1	B1cao
(c)		18	1	B1cao
(d)		example given	1	B1 for stating a value of n for which $6n + 1$ is not prime eg 4, 8, 9, 14, 19, ... ,1000 etc
201		−2	3	M1 for expanding brackets eg $4x + 12$ $(= 2x + 8)$ or dividing by 4 as a first step eg $x + 3 = \frac{2x}{4} + \frac{8}{4}$ M1 ft their equation of the form $ax + b = 2x + 8$ or $x + 3 = ax + b$ for isolating terms in x and numbers e.g. $4x - 2x = 8 - 12$ seen as part of their solution oe A1 cao
202 (a)		$3n - 1$	2	B2 for $3n - 1$ oe (B1 for $3n + k$, k an integer $\neq -1$ or absent)
(b)		Yes	2	M1 for $3n - 1 = 299$ ft if B1 earned in (a) A1 for eg Yes and $n = 100$ oe
(c)		$3(n+1)-1$	1	B1 oe eg $3n + 2$ or ft (a) providing at least B1 earned
203		(102, 104)	3	B1 for $(P=)$ (106, 107) M1 for a complete method eg [104 − ("106" − 104), 105.5 − ("107" − 105.5)] or $(A=)$ $(102, y)$ or $(A=)$ $(x, 104)$ A1 cao

Question	Working	Answer	Mark	Notes
204 (a)		5, −1, 5	2	B2 for all 3 correct (B1 for 1 or 2 correct)
(b)		Correct graph	2	M1 ft for 5, 6 or 7 points plotted correctly, provided at least B1 awarded in (a) A1 for a fully correct graph (no line segments)
(c)		−0.6, 3.6	2	M1 for use of $y = 3$ A1 for −0.5 to −0.7, 3.5 to 3.7 (ft quadratic graph)
205		130	4	M1 for setting up two correct equations eg 3p + 4c = 440 4p + 3c = 470 M1 for adding the two equations eg 7p + 7c = 910 or for a correct method to eliminate one variable (allow one error) M1 for a method to find p + c eg 910 ÷ 7 or for a complete method to find both p and c (p = 80, c = 50) A1 for 130 or £1.30(p) **NB:** Allow any letters for variables. Allow a non-algebraic approach eg 7 kg potatoes and 7 kg carrots costs a total of 910
206		0.5	4	M1 for identifying a common denominator in a correct expression or equation eg $\frac{4(x+1)}{12} + \frac{3(2x+5)}{12}$ (= 2) M1 (dep on M1) for expanding both brackets in an equation eg $\frac{4x+4}{12} + \frac{6x+15}{12} = 2$ eg $4x + 4 + 6x + 15 = 12 \times 2$ M1 (dep on M1) for isolating "like terms" on each side of an equation eg $4x + 6x = 24 - 15 - 4$ A1 for 0.5 oe

204



Question	Working	Answer	Mark	Notes
207 (a)		x^6	1	B1 cao
(b)		$(2y + 1)(y - 3)$	2	M1 for $(2y \pm 1)(y \pm 3)$ or $(2y \pm 3)(y \pm 1)$ A1 cao
208		$16\sqrt{2}$	4	M1 for method to expand $(\sqrt{8} + 2)^2$ with at least 3 correct terms out of 4 terms M1 for method to expand $(\sqrt{8} - 2)^2$ with at least 3 correct terms out of 4 terms M1 (dep on M2) for a method to subtract the two expressions and use of $\sqrt{8} = 2\sqrt{2}$ A1 cao OR M1 for factorising $a^2 - b^2 = (a + b)(a - b)$ M1 for substituting for a and b with simplification (at least 1 of the two terms correct) M1 (dep on M2) for multiplying the 2 terms together and use of $\sqrt{8} = 2\sqrt{2}$ A1 cao

Question	Working	Answer	Mark	Notes
209 (a)		Diagram	2	B2 for fully correct solution with all three aspects with no ambiguity Aspect 1: circle at 3 Aspect 2: circle not shaded Aspect 3: arrow pointing left indicating extension beyond −4 or line extending beyond −4 (B1 for any two aspects)
(b)		$x \geq 5$	2	M1 for intention to add 7 to both sides (of inequality or equation) or to divide all 3 terms by 4 as a first step, or ($x =$) 5 A1 for $x \geq 5$ oe

Question	Working	Answer	Mark	Notes
210 (a)		75	2	M1 for $3 \times 5 \times 5$ oe A1 cao
(b)	$108 = 3t^2$ $t^2 = \frac{108}{3} = 36$	± 6	2	M1 for $(t^2 =) \frac{108}{3} (= 36)$ A1 for 6 or –6 or both
(c)		$a = \frac{v-u}{t}$	2	M1 for subtracting u from both sides or dividing both sides by t as a first step A1 for $a = \frac{v-u}{t}$ oe

Question	Working	Answer	Mark	Notes
211 (a)		–3, 8	2	M1 for 3 + (3 – 9) (= –3) oe or 5 + (5 – 2) (= 8) oe or $\frac{x+9}{2} = 3$ or $\frac{y+2}{2} = 5$ A1 cao
(b)		$y = –0.5x + 6.5$	3	M1 for a correct method to find the gradient (= –0.5), ft the possible use of coordinates in part (a) M1 for method to find c eg substituting into $y =$ "–0.5"$x + c$ A1 for $y = –0.5x + 6.5$ oe

Question	Working	Answer	Mark	Notes
212 (a)	<table><tr><td>x</td><td>–2</td><td>–1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>y</td><td>0.25</td><td>**0.5**</td><td>**1**</td><td>2</td><td>**4**</td><td>**8**</td></tr></table>	0.5, 1, 4, 8	2	B2 for all 4 correct (B1 for 2 or 3 correct)
(b)		Correct graph	2	M1 for at least 5 points plotted correctly from their table, provided at least B1 scored in part (a) A1 cao for a correct graph drawn from (–2, 0.25) to (3, 8)
213	$4x - 2y = 26$ $x - 2y = 11$ $3x = 15$ $2x - y = 13$ $2x - 4y = 22$ $3y = -9$	$x = 5$ $y = -3$	3	M1 for correct process to eliminate one variable (condone one arithmetic error) M1 (dep) for substituting found value in one of the equations or appropriate method after starting again (condone one arithmetic error) A1 for $x = 5$ and $y = -3$

Question	Working	Answer	Mark	Notes
214 (a)		p^7	1	B1 cao
(b)		g^2	1	B1 cao
(c)		k^6	1	B1 cao
(d)		$-5m + 10$	2	M1 for $3m + 12$ or $-8m - 2$ or $8m + 2$ A1 for $-5m + 10$ or $10 - 5m$ or $-5(m - 2)$ or $5(2 - m)$ oe
(e)		$n(n - 7)$	1	B1 cao
215		$T = 5x + 20y$	3	B3 for $T = 5x + 20y$ oe (B2 for $5x + 20y$ or $T = 5x + y$ or $T = x + 20y$ or $T = 20x + 5y$) (B1 for $T =$ a two term linear expression in x and y, or $5x + y$ or $x + 20y$)
216		$-3, -2$	2	M1 for $x = -3$ or $y = -2$; for finding the difference between the x or y coordinates of and P (eg ± 4 or ± 4.5); for $\frac{x+5}{2} = 1$ or for $\frac{y+7}{2} = 2.5$ A1 for $x = -3$, $y = -2$

Question	Working	Answer	Mark	Notes
217 (a)		$x < 7$	2	M1 for isolating term in x eg $3x < 16 + 5$ or $3x < 21$ or for $(x =) 7$ or $x>7$ etc A1 cao
(b)		$\frac{7}{5}$	3	M1 for multiplying by 4 or adding $\frac{w}{4}$ or subtracting $\frac{11}{4}$ or subtracting 1 [all applied to both sides and as a first step] M1 for isolating terms in w on one side and number terms on the other side of the equation A1 for $\frac{7}{5}$ oe
218 (a)(i)		–0.4 to –0.5 4.4 to 4.5	3	B1 for value in range –0.4 to –0.5 and value in range 4.4 to 4.5 NB: condone values given as part of coordinates.
(ii)		–1.0 to –1.2 5.0 to 5.2		M1 for $x^2 - 4x - 2 = 4$ or line $y = 4$ drawn on graph or points marked with a y coord. of 4 or a value in range –1.0 to –1.2 or a value in range 5.0 to 5.2 A1 for value in range –1.0 to –1.2 and value in range 5.0 to 5.2; do not accept coordinates.
(b)		–1.6 to –1.8 4.6 to 4.8	3	M1 for $x + y = 6$ drawn on graph A2 for value in range –1.6 to –1.8 and value in range 4.6 to 4.8 (A1 for one correct value or both values given as coordinates)

Question	Working	Answer	Mark	Notes
219		2, 6	3	M1 for $(x^2 =)\quad 4(x^2 - 6x + 9)$ or $4x^2 - 24x + 36$ oe or for $\frac{x^2}{4} = x^2 - 6x + 9$ M1 (dep) for $3x^2 - 24x + 36 = 0$ or $3(x^2 - 8x + 12) = 0$ or $(x - 2)(x - 6) = 0$ or $(3x - 6)(x - 6) = 0$ oe A1 cao OR M1 for $x = (\pm)2(x - 3)$ or $\frac{x}{2} = (\pm)(x - 3)$ M1(dep) for correct solution of one equation A1 cao

Question		Working	Answer	Mark	Notes
220	(a)		$6n + 5$	2	B2 for $6n + 5$ (B1 for $6n + k$ where k is an integer or absent)
	(b)		No with explanation	2	M1 for "$6n + 5$" = 121 or any other valid method, e.g. counting on 6s (to get to 119 or more) A1 for No with complete explanation, e.g. $6n$=116 will not give a whole number
221	(a)		$x^2 + 2x$	1	B1 cao
	(b)		$3y + 4x + 2$	2	M1 for a method to expand a bracket, e.g. $3y + 6$ or $4x - 4$ A1 cao
	(c)	$2t^2 + 10t - 3t - 15$	$2t^2 + 7t - 15$	2	M1 for 4 terms correct ignoring signs or 3 out of no more than 4 terms with signs correct unless ambiguous A1 cao
	(d)		$4a(2a + 3)$	2	M1 for $4a(na+c)$ or $2a(4a+6)$ or $a(8a+12)$ [n,c integers, $c \neq 0$] A1 cao
	(e)		$(y + 1)(y - 2)$	2	M1 for $(y \pm 1)(y \pm 2)$ unless ambiguous A1 cao
222	(a)		2, 0, 0, 6	2	B2 for 2, 0, 0, 6 (B1 for at least two of 2, 0, 0, 6); could be taken from graph
	(b)		Correct curve	2	M1 (ft) for at least 5 points plotted correctly A1 for a fully correct curve
	(c)		−0.6, 3.6	2	M1 (ft if M1 awarded in (b) and at least B1 in (a)) for indicating a point or line drawn at y=4, or one solution given A1 (ft) for both solutions

Question		Working	Answer	Mark	Notes
223			$x = 3\frac{1}{3}$ $y = -2$	4	M1 for a correct process to eliminate either variable (condone one arithmetic error) or to rearrange and substitute for elimination A1 cao for either x or y M1 (dep on M1) for correct substitution of found value into one of the equation or appropriate method after starting again (condone one arithmetic error) A1 cao
224	(a)		$\frac{9x-8}{x(2-x)}$	3	M1 for method to use a common denominator, e.g. $\frac{5(x)-4(2-x)}{x(2-x)}$ M1 (dep on M1) for correct expansion of brackets and combination of numerators e.g. $5x-8+4x$ $(=9x-8)$ A1 for $\frac{9x-8}{x(2-x)}$ or $\frac{9x-8}{2x-x^2}$
	(b)		$y = \frac{2-2t}{t+3}$	4	M1 for intention to multiply both sides by $y + 2$ as a first step e.g. $t \times y + 2 = 2 - 3y$ M1 for intention to correctly isolate their y terms on one side and the other terms on the other side, e.g. $ty+3y=2-2t$ M1 for intention to factorise, e.g. $y(t+3)$ (=š2 t) A1 for $y = \frac{2-2t}{t+3}$ oe

Question		Working	Answer	Mark	Notes
225	(a)		36	1	B1 cao
	(b)		2.5 oe	2	M1 for collecting the terms in x or the number terms in an equation, eg. $5x - x + 4 = 14$ or $5x = 14 - 4 + x$ A1 for 2.5 oe (accept $\frac{10}{4}$)
226	(a)		$2g - 3h$	2	M1 for $2g$ or $-3h$ A1 for $2g - 3h$ or $-3h + 2g$
	(b)		$y(y - 2)$	1	B1
	(c)		p^5	2	M1 for $\frac{p^{3+4}}{p^2}\left(= \frac{p^7}{p^2}\right)$ or $p^{3-2} \times p^4$ $(= p^1 \times p^4)$ or $p^3 \times p^{4-2}$ $(= p^3 \times p^2)$ A1 cao

Question		Working	Answer	Mark	Notes
227	(a)		(3, 6.5)	2	M1 for a method to find either the x coordinate or the y coordinate of the midpoint or $x = 3$ or $y = 6.5$ oe A1 cao [SC: B1 for (6.5, 3)]
	*(b)		No and correct working	3	M1 for a method to work out a gradient between any relevant pair of points (ie 2 of points A, B, C or D), eg. $\frac{9-4}{8--2}\left(=\frac{5}{10}\right)$ M1(dep) for a method to work out the gradient between another pair of points which can be used for comparison; one gradient must be through D. C1 for "no" and a correct explanation based on two correct gradients OR M1 for a method to work out a gradient between any relevant pair of points (ie 2 of points A, B, C or D), eg. $\frac{9-4}{8--2}\left(=\frac{5}{10}\right)$ M1 (dep) for using their gradient to work out an equation of a straight line in the form $y = mx + c$ and substituting in an appropriate point C1 for "no" and a correct explanation based on correct working OR M2 for (100, 55) or (102, 56) C1 for "no" and a correct explanation based on correct coordinates.

Question		Working	Answer	Mark	Notes
228			Region identified	4	M1 for the graph of $x + y = 7$ or $y = 2x$ drawn M1 for the graphs of $x + y = 7$, $y = 2x$ and $y = 3$ drawn M1 for any correct shading (in or out), satisfying at least two correct inequalities where the shading must extend from the appropriate lines. A1 for correct region identified by either shading in, or shading out; the letter R is not required. Accept without shading only with the correct region indicated by R. NB accept lines that are solid or dotted/dashed etc or lines defined by unambiguous shading
229			$a = \frac{4p - 5}{3 + p}$ or	4	M1 for multiplying both sides by $4 - a$ as the first step M1 (dep) for isolating their two terms in a M1 (dep) for factorising their two term expression in a A1 for $a = \frac{4p - 5}{3 + p}$ or $a = \frac{5 - 4p}{-p - 3}$
230	(a) (i) (ii) (iii) (b)		(0, 5) (3, 10) (1, 5) Translation of $\begin{pmatrix} 0 \\ -4 \end{pmatrix}$ oe	3 1	B1 cao B1 cao B1 cao B1 for a correct transformation, eg. translation of $\begin{pmatrix} 0 \\ -4 \end{pmatrix}$ or translation of 4 units in the negative y-direction, oe.

Question		Working	Answer	Mark	Notes
231			$T = 6x + 8y$	3	M1 for $6x$ **or** $8y$ oe **or** $T=$ (a linear expression in x and y) M1 for $6x + 8y$ oe or $T = 6x$ $(+ay)$ oe or $T = 8y$ $(+bx)$ oe A1 for $T = 6x + 8y$ oe
232	(a)		$y > 0.5$	2	M1 for clear intention to subtract 5 from both sides of inequality or equation **or** divide all terms of the inequality or equation by 6 **or** $6y > 3$ **or** 0.5 oe seen A1 for $y > 0.5$ oe as final answer
	(b)		$-3 < x \leq 4$	2	B2 for $-3 < x \leq 4$ oe (B1 for one correct inequality, eg $-3 < x$ **or** $x > -3$ **or** $x \leq 4$ **or** $4 \geq x$ **or** $-3 \leq x < 4$) NB Accept the use of any letter

Question		Working	Answer	Mark	Notes
233	(a)		$e(3e + 5)$	1	B1 for $e(3e + 5)$
	(b)		4	3	M1 for intention to expand brackets, eg $7k - 21$ or division of all terms on RHS by 7 as first step, eg $\frac{3}{7}k - \frac{5}{7}$ M1 for correct method to isolate terms in k in an equation A1 cao
	(c)		$2x^2 - 13x - 24$	2	M1 for 4 terms correct ignoring signs or 3 out of no more than 4 terms correct A1 cao
	(d)		$-\frac{1}{3}$	3	M1 for clear intention to multiply both sides by 4 or split into individual fractions on LHS M1 for correct method to isolate term in f in an equation, ft from equations of form $a + bf = c$, where $a, b, c \neq 0$ A1 cao
234	(a)		8, (4), (2), 1, 0.8, 0.5	2	B2 all 4 correct Accept $\frac{4}{5}$ in place of 0.8 and $\frac{1}{2}$ in place of 0.5 (B1 for 2 or 3 correct)
	(b)		correct graph	2	M1 (ft dep on B1) for 5 or 6 points plotted correctly from their table (overlay) A1 cao for correct curve drawn from (0.5,8) to (8, 0.5)

Question		Working	Answer	Mark	Notes
235	(a)		1	1	B1 cao
	(b)		$\frac{5y}{8x^3}$	2	M1 for correct square root or correct use of reciprocal eg $\frac{8x^3}{5y}$ **or** $\frac{25y^2}{64x^6}$ A1 for $\frac{5y}{8x^3}$ **or** $\frac{5}{8}yx^{-3}$ oe
	(c)		$\frac{x+27}{(x-3)(x+3)}$	3	M1 for denominator $(x-3)(x+3)$ **or** x^2-9 M1 for $\frac{5(x+3)}{(x-3)(x+3)}$ oe **or** $\frac{4(x-3)}{(x-3)(x+3)}$ oe (NB The denominator must be $(x-3)(x+3)$ or x^2-9 **or** another suitable common denominator) A1 for $\frac{x+27}{(x-3)(x+3)}$ **or** $\frac{x+27}{x^2-9}$
*236		$2y = 3x - 4$ $y = \frac{3}{2}x - 2$; $m = \frac{3}{2}$ $\frac{3--1}{1-4} = -\frac{4}{3}$ $\frac{3}{2} \times -\frac{4}{3} = -2$	No with reason	4	M1 for $\frac{3}{2}$ oe or $y = \frac{3}{2}x\left(-\frac{4}{2}\right)$ oe M1 for method to find gradient of AB, eg $\frac{3--1}{1-4}$ **or** $\frac{-1-3}{4-1}$ **or** $-\frac{4}{3}$ oe A1 for identifying gradients as $\frac{3}{2}$ oe **and** $-\frac{4}{3}$ oe C1 (dep on M1) for a conclusion with a correct reason, eg No as product of $\frac{3}{2}$ and $-\frac{4}{3}$ is not −1, ft from their two gradients
237	(i)		(3, −1)	3	B1 cao
	(ii)		(1.5, −4)		B1 for (1.5, −4) accept 1.5 or $1\frac{1}{2}$ or $\frac{3}{2}$ for x coordinate
	(iii)		(−3, −4)		B1 cao

Question		Working	Answer	Mark	Notes
238	(a)		$2m^2 + 6m$	1	B1 for $2m^2 + 6m$
	(b)		$3xy(y - 2)$	2	B2 for $3xy(y - 2)$ (B1 for $3x(y^2 - 2y)$ or $3y(xy - 2x)$ or $xy(3y - 6)$ or $3xy$(a two term algebraic expression))
239	*(a)		No, temp is 25°C	3	M1 for substitution of 77 into the RHS of the formula A1 for 25 cao or for 225/9 and 180/9 cao C1 (dep on M1) for conclusion (ft) following from working shown OR M1 for substitution of 20 into LHS of formula and correct process to find F A1 for 68 cao C1 (dep on M1) for conclusion (ft) following from working shown
	(b)		$F = \frac{9C}{5} + 32$	3	M1 for expansion of the brackets (eg $5 \times F - 5 \times 32$) or an attempt to multiply both sides by 9, or divide both sides by 5 as the first step. M1 (dep) for a correct second step A1 for $F = \frac{9C}{5} + 32$ oe

Question		Working	Answer	Mark	Notes
240	(a)		2, –1, 2, 7	2	B2 for all correct (B1 for 2 or 3 correct)
	(b)		Correct graph	2	M1 (dep on at least B1) for at least 6 points from their table plotted correctly A1 cao for fully correct graph
	(c)	$x^2 - 3x - 4 = 0$ $(x - 4)(x + 1) = 0$	–1, 4	2	M1 for line $y = x + 3$ drawn correctly or for reduction to correct 3 term quadratic (=0) and : $(x \pm 1)(x \pm 4)$ or formula using $a = 1$, $b = -3$ and $c = -4$, allow one sign error in the formula, or $\left(x - \frac{3}{2}\right)^2 = 4 + \left(\frac{3}{2}\right)^2$ A1 cao
241			$x = 7$ $y = -3$	3	M1 for correct process to eliminate one variable (condone one arithmetic error) M1 (dep) for substituting found value in one of the equations or appropriate method after starting again (condone one arithmetic error) A1 for $x = 7$ and $y = -3$
242			$y = \frac{1}{2}x - 5$	3	M1 for method to find gradient of L_1 e.g $\frac{6-3}{6-0}$ $\left(=\frac{1}{2}\right)$ M1 for $y =$ "$\frac{1}{2}$"$x + c$ or $y = mx - 5$ (c, m do not have to be numerical, or correct numerical values) or for $(L =)\frac{1}{2}x - 5$ A1 $y = \frac{1}{2}x - 5$ oe

Question		Working	Answer	Mark	Notes
243	(a)		$27x^6y^{12}$	2	B2 cao (B1 for any two terms correct in a product, e.g. $9x^6y^{12}$)
	(b)		$\frac{x-3}{2x-1}$	3	M1 for $(x-3)(x+3)$ M1 for $(2x-1)(x+3)$ A1 for $\frac{x-3}{2x-1}$ cao
244	(a)		180, 0	1	B1 for 180, 0 Accept π, 0
	(b)		270, –1	1	B1 for 270, –1 accept $\frac{3\pi}{2}$, –1
	(c)		$a = 2$ $b = 3$ $c = 1$	3	B1 cao B1 cao B1 cao

Question		Working	Answer	Mark	Notes
245	(a)		$4y + 5x + 5$	2	M1 $5x$ or 5 seen A1 cao
	(b)		$3x(3x - 2y)$	2	B2 for $3x(3x - 2y)$ (B1 for $x(9x - 6y)$ or $3(3x^2 - 2xy)$ or $3x(ax - by)$ where a and b are integers not equal to zero)
	(c)		$4x + 8$	1	B1 cao
	(d)		$x^2 - 2x - 15$	2	M1 for 4 terms correct with or without signs or 3 out of no more than 4 terms correct with correct signs A1 cao
246		<table><tr><td>x</td><td>–2</td><td>–1</td><td>0</td><td>1</td><td>2</td></tr><tr><td>y</td><td>–4</td><td>–1</td><td>2</td><td>5</td><td>8</td></tr></table>	$y = 3x + 2$ drawn	4	B1 for axes scaled and labelled **(Table of values)** M1 for at least 2 correct attempts to find points by substituting values of x M1 ft for plotting at least 2 of their points (any points from their table must be correctly plotted) A1 for correct line between $x = –2$ and $x = 2$ **(No table of values)** M1 for at least 2 correct points with no more than 2 incorrect points M1 for at least 2 correct points (and no incorrect points) plotted OR line segment of $y = 3x + 2$ drawn A1 for correct line between $x = –2$ and $x = 2$ **(Use of $y = mx + c$)** M1 for line drawn with gradient of 3 **OR** line drawn with y intercept at 2 M1 for line drawn with gradient of 3 **AND** with y intercept at 2 A1 for correct line between $x = –2$ and $x = 2$ SC B2 (indep of B1) for correct line segment between $x = 0$ and $x = 2$ (ignore any additional incorrect line segment(s))

Question		Working	Answer	Mark	Notes
247		$6x + 8y = 10$ $6x - 9y = 27$ $y = -1$ $3x - 4 = 5$ $3x = 9$ $x = 3$ OR $9x + 12y = 15$ $8x - 12y = 36$ $x = 3$ $9 + 4y = 5$ $4y = -4$ $y = -1$	$x = 3$, $y = -1$	4	M1 for a correct process to eliminate either variable (condone one arithmetic error) A1 cao for either x or y M1 (dep on M1) for correct substitution of found value into one of the equations or appropriate method after starting again (condone one arithmetic error) A1 cao OR M1 for full method to rearrange and substitute to eliminate either variable (condone one arithmetic error) A1 cao for either x or y M1 (dep on M1) for correct substitution of found value into one of the equations or appropriate method after starting again (condone one arithmetic error) A1 cao Trial and improvement scores 0 marks unless both x and y are correct
248		(3,6,7) to (–2,2,5) (–5, –4, –2) (–2– 5, 2 – 4, 5 – 2)	(–7, –2, 3)	2	M1 for midpoint plus change or complete method for 2 out of 3 coordinates, can be implied by 2 correct values A1 cao

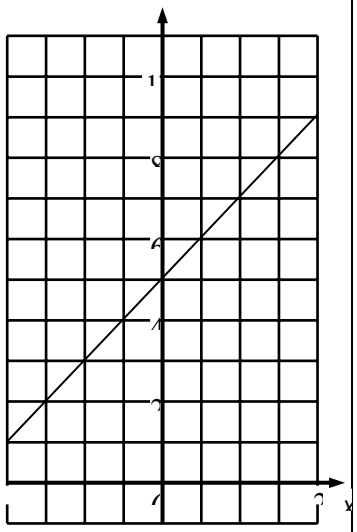
Question		Working	Answer	Mark	Notes
249	(a)		4	3	M1 for correct expansion to $32x - 8$ or multiplying both sides by $3x$ or dividing both sides by 4 M1 for a compete and correct method to isolate the x terms and the number terms (condone one arithmetic error in multiplying out the bracket) A1 cao
	(b)	$\frac{2(y-6)-(y+3)}{(y+3)(y-6)}$	$\frac{y-15}{(y+3)(y-6)}$	3	M1 for common denominator of $(y+3)(y-6)$ M1 for $\frac{2(y-6)}{(y+3)(y-6)} - \frac{y+3}{(y+3)(y-6)}$ oe or $\frac{2(y-6)-(y+3)}{(y+3)(y-6)}$ oe A1 for $\frac{y-15}{(y+3)(y-6)}$ or $\frac{y-15}{y^2-3y-18}$

Question		Working	Answer	Mark	Notes
250	(a)		$6 + 3t$	1	B1 for $6 + 3t$
	(b)		$6x^2 + 15x$	2	B2 for $6x^2 + 15x$ (B1 for $6x^2$ or $15x$)
	(c)	$m^2 + 10m + 3m + 30$	$m^2 + 13m + 30$	2	M1 for all 4 terms (and no additional terms) correct with or without signs or 3 out of no more than four terms correct with signs A1 for $m^2 + 13m + 30$
251		x – 2 -1 0 1 2 3 4 y 4 4.5 5 5.5 6 6.5 7	$y = ½ x + 5$ drawn	3	**(Table of values/calculation of values)** M1 for at least 2 correct attempts to find points by substituting values of x. M1 ft for plotting at least 2 of their points (any points plotted from their table must be plotted correctly) A1 for correct line between $x =$ -2 and $x = 4$ **(No table of values)** M1 for at least 2 correct points with no more than 2 incorrect points M1 for at least 2 correct points (and no incorrect points) plotted OR line segment of $y = ½ x + 5$ drawn A1 for correct line between $x =$ -2 and $x = 4$ **(Use of y=mx+c)** M1 for line drawn with gradient 0.5 **OR** line drawn with y intercept at 5 M1 for line drawn with gradient 0.5 **AND** line drawn with y intercept at 5 A1 For correct line between $x =$ -2 and $x = 4$ SC B2 for a correct line from $x = 0$ to $x = 4$

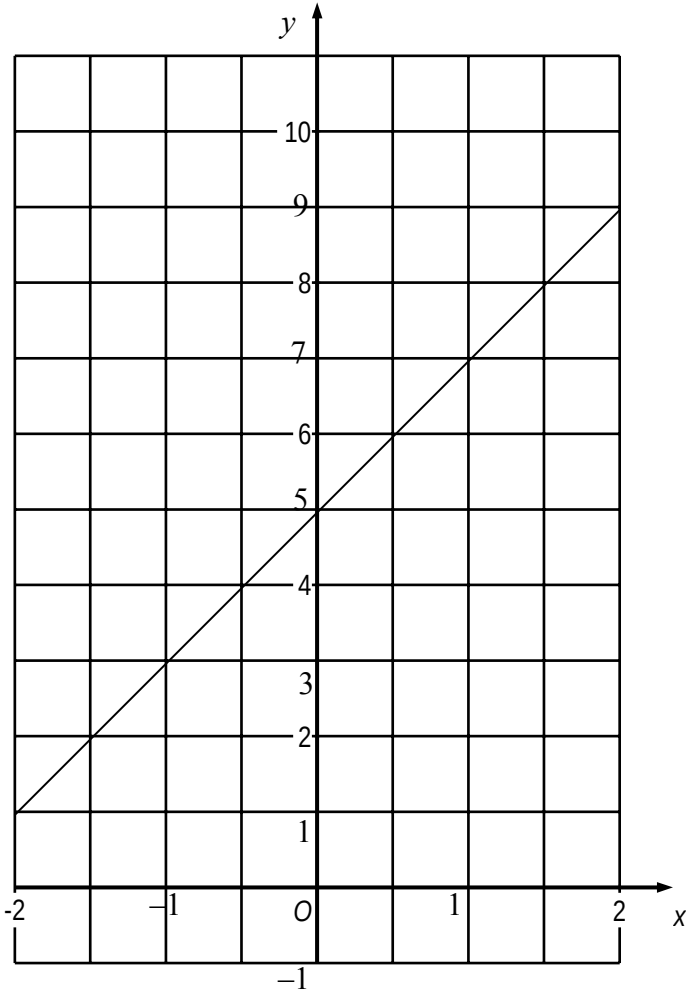
Question		Working	Answer	Mark	Notes
252	(a)	Line joins an empty circle at -2 to a solid circle at 3	diagram	2	B2 cao (B1 for line from -2 to 3)
	(b)	$2x \geq 7$	$x \geq 3.5$	2	M1 for correct method to isolate variable and number terms (condone use of =, >, ≤, or <) or (x =) 3.5 A1 for $x \geq 3.5$ oe as final answer

Question		Working	Answer	Mark	Notes
253		$12x + 21y = 3$ $12x + 40y = 60$ $19y = 57$ $y = 3$ $3x + 10\times 3 = 15$ $3x = -15$ Alternative method $x = \left(\frac{1-7y}{4}\right)$ $3\left(\frac{1-7y}{4}\right) + 10y = 15$ $3 - 21y + 40y = 60$ $19y = 57$ $x = \left(\frac{1-7\times 3}{4}\right)$	$x = -5$, $y = 3$	4	M1 for a correct process to eliminate either x or y or rearrangement of one equation leading to substitution (condone one arithmetic error) A1 for either $x = -5$ or $y = 3$ M1 (dep) for correct substitution of their found value A1 cao

Question		Working	Answer	Mark	Notes
254		$\frac{4(x+5)}{(x+5)(x-3)}$	$\frac{4}{x-3}$	2	M1 for $(x \pm 5)(x \pm 3)$ A1 for $\frac{4}{x-3}$
255	(a)		$a = 4$, $b = 5$	3	M1 for sight of $(x-4)^2$ M1 for $(x-4)^2 - 16 + 21$ A1 for $a = 4$, $b = 5$ OR M1 for $x^2 - 2ax + a^2 + b$ M1 for $-2a = -8$ and $a^2 + b = 21$ A1 for $a = 4$, $b = 5$
	(b)		(4, 5)	1	B1 ft
256	(a)		(90, 0)	1	B1 for (90, 0) (condone $(\frac{\pi}{2}, 0)$)
	(b)		Correct graph	1	B1 for graph through (0, 2) (90, 0) (180, -2) (270, 0) (360, 2) professional judgement

Question		Working	Answer	Mark	Notes
257	(a)	<table><tr><td>***x***</td><td>–2</td><td>–1</td><td>0</td><td>1</td><td>2</td></tr><tr><td>***y***</td><td>(1)</td><td>3</td><td>(5)</td><td>7</td><td>9</td></tr></table>	3, 7, 9	2	B2 for all three values correct in the table (B1 for 2 values correct)
	(b)		graph of $y = 2x + 5$	2	**(From their table of values)** M1 ft for plotting at least 2 of their points (any points from their table must be correctly plotted) A1 for correct line from $x = –2$ to $x = +2$ **(Use of $y = mx + c$)** M1 for line drawn with gradient of 2 **or** line drawn with a y intercept of 5 **and** a positive gradient) A1 for correct line from $x = –2$ to $x = +2$

257.

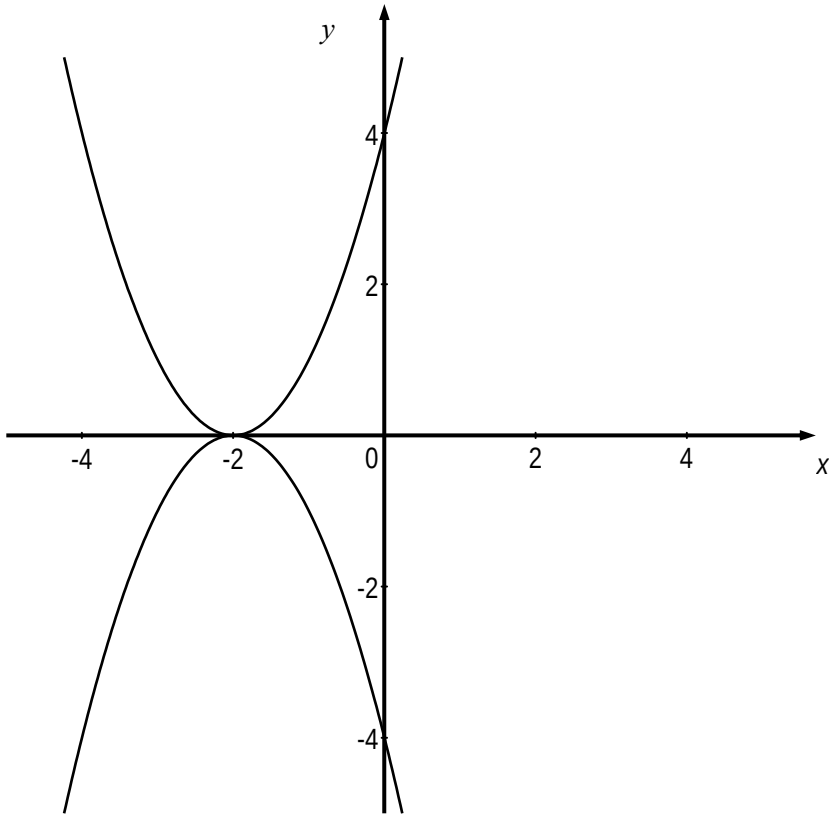


Question		Working	Answer	Mark	Notes
258	(a)		$6n - 3$	2	M1 for attempt to establish linear expression in n with coefficient of 6 e.g. $6n + k$ where k is an integer (accept $n = 6n - 3$ for one mark) A1 cao
	(b)		No + Reason	1	C1 ft from their answer to part (a) for decision and explanation eg " stating no and because all the terms in the sequence are odd **and** 150 is even" **or** "no and '$6n - 3$' = 150, $n = 153/6$ ... so n is not an integer" **or** Continuing the sequence to show terms 147 **and** 153 and state "no as 150 is not in the sequence" oe
259	(a)		$6x - 3y$	2	M1 for an attempt to combine terms in x **or** terms in y correctly eg $5x + x(= 6x)$, $4y - 7y(= -3y)$ A1 for $6x - 3y$ oe
	(b)	$7x + 14 = 7$ or $x + 2 = 1$ $7x = -7$	$x = -1$	2	M1 for correctly expanding the bracket or an attempt to divide both sides by 7 e.g. $7x + 14$ or $x + 2 = 7 \div 7$ oe A1 cao
260	(a)		a^9	1	B1 for a^{4+5} or a^9
	(b)		$9e^5f^6$	2	B2 cao (B1 for two of 9, e^{6-1}, f^{8-2} as a product)
	(c)		3	1	B1 (accept ± 3 but not just –3)

Question		Working	Answer	Mark	Notes
261			$\frac{12}{13}$	3	M1 for multiplying throughout by 10 oe or writing LHS as a single fraction e.g $2(4x - 1) + 5(x + 4) = 3\times 10$ or $\frac{2(4x-1)+5(x+4)}{10}$ or $\frac{2(4x-1)}{10} + \frac{5(x+4)}{10}$ M1 (dep) for a complete correct method to obtain linear equation of the form $ax = b$ (condone one arithmetic error in multiplying out the bracket) A1 for $\frac{12}{13}$ oe (decimal equivalent is 0.923…)

Question		Working	Answer	Mark	Notes
262	(a)(i)		$(x-9)(x-3)$	3	M1 for $(x \pm 9)(x \pm 3)$ A1 for $(x-9)(x-3)$
	(ii)		$x = 9$, $x = 3$		B1 cao
	(b)		$(y+10)(y-10)$	1	B1 for $(y+10)(y-10)$
*263		$(n+1)^2 - n^2$ $= n^2 + 2n + 1 - n^2 = 2n + 1$ $(n+1) + n = 2n + 1$ OR $(n+1)^2 - n^2$ $= (n + 1 + n)(n + 1 - n)$ $= (2n + 1)(1) = 2n + 1$ $(n+1) + n = 2n + 1$ OR $n^2 - (n+1)^2 = n^2 - (n^2 + 2n + 1) =$ $-2n - 1 = -(2n + 1)$ Difference is $2n + 1$ $(n+1) + n = 2n + 1$	proof	4	M1 for any two consecutive integers expressed algebraically eg n and $n+1$ M1(dep on M1) for the difference between the squares of 'two consecutive integers' expressed algebraically eg $(n+1)^2 - n^2$ A1 for correct expansion and simplification of difference of squares, eg $2n + 1$ C1 (dep on M2A1) for showing statement is correct, eg $n + n + 1 = 2n + 1$ and $(n+1)^2 - n^2 = 2n + 1$ from correct supporting algebra
264	(a)		sketch		M1 for inverting the parabola, so maximum is at $(-2, 0)$ A1 for parabola passing through all three of the points $(-2, 0)$, $(0, -4)$, $(-4, -4)$
	(b)		$y = f(x-6)$	1	B1 for $y = f(x-6)$ or $y = (x-4)^2$ oe

264.

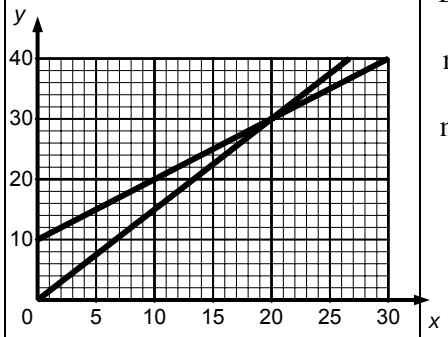


Question		Working	Answer	Mark	Notes
265	(a)		$12x + 20$	1	B1 cao
	(b)		$5x + 7$	2	M1 for $2\times x - 2\times 4$ or $3\times x + 3\times 5$ A1 cao
	(c)		$x^2 + 10x + 24$	2	B2 cao (B1 for 4 correct terms with or without signs, or 3 out of no more than 4 terms, with correct signs. The terms may be in an expression or in a table)
266	(a		m^2	1	B1 for m^2 or m^{5-3}
	(b)		$5x^6y^4$	2	M1 for $x^{4+2}y^a$ or x^by^{3+1} A1 cao
267			(4,3), (4,4), (4,5), (5.4) marked	3	M2 for identifying the correct region or at least 3 correct points with no more than 3 incorrect points (M1 for drawing $x = 3$ (solid or dashed line) or at least 1 correct point with no more than 3 incorrect points) A1 cao

Question		Working	Answer	Mark	Notes
268		$12x+8y=16$ $12x+15y=51$ $7y=35$ $3x+2\times5=6$ Alternative method $x=\frac{4-2y}{3}$ $4\left(\frac{4-2y}{3}\right)+5y=17$ $16-8y+15y=51$ $7y=35$ $x=\frac{4-2\times5}{3}$	$x=-2$ $y=5$	4	M1 for a correct process to eliminate either x or y or leading to substitution (condone one arithmetic error) A1 for either $x=-2$ or $y=5$ M1 (dep) for correct substitution of their found value A1 cao SC If M0 scored B1 for $y=-2$ and $x=5$

Question		Working	Answer	Mark	Notes
269			7.5	4	B1 for identifying A at 3 or D at 6 or A(3, 0) or D(0, 6) oe eg may be seen as labels on the diagram M1 fo $0 = \frac{-1}{-2} \times 3 + c$ M1 (de on previous M1) for 6 + '1.5' A1 ca **OR** B1 for identifying A at 3 or D at 6 or A(3, 0) or D(0, 6) oe eg may be seen as labels on the diagram M1 fo 3/6 = *OP*/3 or 1.5 oe seen (from similar triangles) M1 fo 6 + '1.5' A1 ca **OR** B1 for identifying A at 3 or D at 6 or A(3, 0) or D(0, 6) oe eg may be seen as labels on the diagram M1 for $6+OP)^2 = (6^2+3^2) + (3^2+OP^2)$ oe (from Pythagoras) M1 fo 6 + '1.5' A1 ca
270			$t = \frac{3-4p}{p+2}$	4	M1 for ntention to multiply both sides by 4+*t* eg $p \times 4 + t = 3 - 2t$ M1 for intention to correctly move their *t* terms to one side, and correctly move their other terms to the other side eg $p \times 4 + t - 4p + 2t = 3 - 2t + 2t - 4p$ M1 for in ntion to factorise eg $t(p \pm 2)$ A1 for $t = \frac{3-4p}{p+2}$ oe

Question		Working	Answer	Mark	Notes
271	(a)		Circle, centre O, radius 2	2	B2 cao (B1 for a circle radius 2 any centre or for a circle or part of a circle centre (0, 0) any radius)
	(b)		Cosine curve crossing at (0, 1), (90, 0), (270, 0) and (360, 1)	2	B2 cao (ignore if sketch outside region) (B1 for a curve with correct intercepts but incorrect amplitude OR for a curve starting at (0,1) with correct amplitude but incorrect intercepts; curves must have a shape that approximates to a cosine curve)

<table>
<tr><th colspan="2">Question</th><th>Working</th><th>Answer</th><th>Mark</th><th>Notes</th></tr>
<tr><td>272</td><td>(a)</td><td></td><td>10</td><td>1</td><td>B1 cao</td></tr>
<tr><td></td><td>(b)</td><td> 

<table>
<tr><th>Miles</th><th>0</th><th>10</th><th>20</th><th>30</th><th>40</th><th>50</th></tr>
<tr><td>Ed</td><td>0</td><td>15</td><td>30</td><td>45</td><td>60</td><td>75</td></tr>
<tr><td>Bill</td><td>10</td><td>20</td><td>30</td><td>40</td><td>50</td><td>60</td></tr>
</table></td><td>Ed is cheaper up to 20 miles, Bill is cheaper for more than 20 miles</td><td>3</td><td>M1 for correct line for Ed intersecting at (20,30) ±1 sq tolerance or $10 + x = 1.5x$ oe
C2 (dep on M1) for a correct full statement ft from graph
eg. Ed cheaper up to 20 miles and Bill cheaper for more than 20 miles
(C1 (dep on M1) for a correct conclusion ft from graph
eg. cheaper at 10 miles with Ed ; eg. cheaper at 50 miles with Bill
eg. same cost at 20 miles; eg for £5 go further with Bill OR
A general statement covering short and long distances eg. Ed is cheaper for shorter distances and Bill is cheaper for long distances)

OR
M1 for correct method to work out Ed's delivery cost for at least 2 values of n miles where $0 < n \leq 50$ OR
for correct method to work out Ed and Bill's delivery cost for n miles where $0 < n \leq 50$
C2 (dep on M1) for 20 miles linked with £30 for Ed and Bill with correct full statement
eg. Ed cheaper up to 20 miles and Bill cheaper for more than 20 miles
(C1 (dep on M1) for a correct conclusion
eg. cheaper at 10 miles with Ed; eg. cheaper at 50 miles with Bill
eg. same cost at 20 miles; eg for £5 go further with Bill OR
A general statement covering short and long distances eg. Ed is cheaper for shorter distances and Bill is cheaper for long distances)

SC : B1 for correct full statement seen with no working
eg. Ed cheaper up to 20 miles and Bill cheaper for more than 20 miles

QWC: Decision and justification should be clear with working clearly presented and attributable</td></tr>
<tr><td>273</td><td></td><td>$c = \dfrac{30 \times 40}{150}$</td><td>8</td><td>2</td><td>M1 for $\dfrac{30 \times 40}{150}$ or 1200 seen
A1 cao</td></tr>
</table>

Question		Working	Answer	Mark	Notes
274	(a)		$6y - 15$	1	B1 cao
	(b)		$4x(2x + y)$	2	B2 cao (B1 for $x(8x + 4y)$ **or** $2x(4x + 2y)$ **or** $4(2x^2 + xy)$ **or** $4x(ax + by)$ where a, b are positive integers **or** $ax(2x + y)$ where a is a positive integer **or** $4x(2x - y)$)
	(c)	$10t = gh$ $h = \frac{10t}{g}$	$\frac{10t}{g}$	2	M1 for clear intention to multiply both sides of the equation by 10 (eg. ×10 seen on both sides of equation) **or** clear intention to divide both sides of the equation by g (eg. ÷g seen on both sides of equation) **or** $10t = gh$ **or** $\frac{t}{g} = \frac{h}{10}$ **or** fully correct reverse flow diagram eg. ← ×10 ← ÷g ← A1 for $\frac{10t}{g}$ oe
275	(a		m^{-10}	1	B1 for m^{-10} or $\frac{1}{m^{10}}$
	(b)		$(x + 5)(x - 2)$	2	M1 for $(x \pm 5)(x \pm 2)$ **or** $x(x - 2) + 5(x - 2)$ **or** $x(x + 5) - 2(x + 5)$ A1

Question		Working	Answer	Mark	Notes
276		$15x + 6y = 33$ $8x - 6y = 36$ $23x = 69$ $5\times 3 + 2y = 11$ **OR** $x = \frac{11-2y}{5}$ $4\times\left(\frac{11-2y}{5}\right) - 3y = 18$ $44 - 8y - 15y = 90$ $-46 = 23y$ $y = -2$	$x = 3$ $y = -2$	4	M1 for coefficients of x or y the same followed by correct operation (condone one arithmetic error) A1 cao for first solution M1 (dep on M1) for correct substitution of found value into one of the equations or appropriate method after starting again (condone one arithmetic error) A1 cao for second solution **OR** M1 for full method to rearrange and substitute to eliminate x or y, (condone one arithmetical error) A1 cao for first solution M1 (dep on M1) for correct substitution of found value into one of the equations or appropriate method after starting again (condone one arithmetic error) A1 cao for second solution Trial and improvement 0 marks unless both x and y correct values found

Question		Working	Answer	Mark	Notes
277	(a)	$\frac{(x+4)(x-1)}{(2x-3)(x-1)}$	$\frac{x+4}{2x-3}$	3	M1 for $(x + 4)(x - 1)$ M1 for $(2x - 3)(x - 1)$ A1 cao
	(b)	$\frac{4(x-2)}{(x+2)(x-2)}+\frac{3(x+2)}{(x+2)(x-2)}$	$\frac{7x-2}{(x+2)(x-2)}$	3	M1 for denominator $(x + 2)(x - 2)$ oe **or** $x^2 - 4$ M1 for $\frac{4(x-2)}{(x+2)(x-2)}$ oe **or** $\frac{3(x+2)}{(x+2)(x-2)}$ oe (NB. The denominator must be $(x + 2)(x - 2)$ **or** $x^2 - 4$ **or** another suitable common denominator) A1 for $\frac{7x-2}{(x+2)(x-2)}$ **or** $\frac{7x-2}{x^2-4}$ SC: If no marks awarded then award B1 for $\frac{4(x-2)}{x^2-2}+\frac{3(x+2)}{x^2-2}$ oe
278	(a)		Parabola through (4, –1), (2, 3), (6, 3) (3, 0) (5, 0)	2	B2 for a parabola with min (4, –1), through (2, 3), (6, 3),(3, 0), (5, 0) (B1 for a parabola with min (4, –1) **or** a parabola through (2, 3) and (6, 3) **or** a parabola through (3, 0) and (5, 0) **or** a translation of the given parabola along the *x*-axis by any value other than +3 **with** the points (–1, 3) (0, 0) (1, –1) (2, 0) (3, 3) all translated by the same amount)
	(b)		Parabola through (1, –2), (0, 0), (2, 0)	2	B2 parabola with min (1, –2), through (0, 0) and (2, 0) (B1 parabola with min (1, –2) **or** parabola through (0, 0), (2, 0) (-1, 6) and (3, 6))

Question		Working	Answer	Mark	Additional Guidance
279	(i)		$30x - 10y$	5	B2 cao (If no marks then B1 $30x$, B1 $10y$)
	(ii)	$6 - 12x - 3x - 3 = 0$ $3 - 15x = 0$ $15x = 3$	$\frac{1}{5}$		M1 for correct multiplication of brackets to get $6 - 12x - 3x - 3$ A1 $3 - 15x = 0$ B1 ft for "$\frac{1}{5}$"
					Total for Question: 5 marks
280	(a)	$5p = 20$	$p = 4$	2	M1 add 16 to both sides A1 cao
	(b)	$-9 = 3q$	$q = -3$	2	M1 correct method to isolate $\pm 3q$ A1 cao
	(c)	$6x - 3 - 10 - 6x =$	-13	2	M1 at least one expansion correct A1 -13 or a statement that the answer is indep of x depending on correct working
					Total for Question: 6 marks
281	(i)		32	1	B1 cao
	(ii)	$2n^2 = 400$, $n^2 = 200$, n not a whole number	No + explanation	2	M1 sets $2n^2 = 400$ C1 and concludes correctly **OR** M1 14th term is (392), 15th term is (450) C1 and concludes correctly
					Total for Question: 3 marks

Question		Working	Answer	Mark	Additional Guidance
282	(a) (i)		a^2	3	B1 cao
	(ii)		$6x^4y^3$		B2 $6x^4y^3$ (B1 for 2 out of 3 terms correct in a product)
	(b)	$x^2 + 3x + 7x + 21$	$x^2 + 10x + 21$	2	M1 3 or 4 terms out of 4 correct in a 4 term expansion A1 cao
	(c)		$3p(q - 4p)$	2	B2 cao (B1 $p(3q - 12p)$, $12p(\frac{1}{4}q - p)$, $p(aq + bp)$ where a and b are numbers)
	(d)(i)	$(3(x+2)-1)(x+2-3)$	$(3y-1)(y-3)$	4	B2 cao (B1 $(3y - m)(y - n)$ where $mn = \pm 3$ or $m + n = \pm 10$
	(ii)	**OR** $3x^2 + 12x + 12 - 10x - 20 + 3$ $= 3x^2 + 2x - 5$	$(3x+5)(x-1)$		M1 use of the factorised form with y replaced twice by $3x + 2$ A1 cao **OR** B1 $3x^2 + 2x - 5$ B1 cao
					Total for Question: 11 marks
283		$\frac{(3x+5)(x-7)}{(3x-5)(3x+5)}$	$\frac{x-7}{3x-5}$	3	B1 $(3x+5)(x-7)$ B1 $(3x-5)(3x+5)$ B1 $\frac{x-7}{3x-5}$
					Total for Question: 3 marks

Question		Working	Answer	Mark	Additional Guidance
284	(a)		Smooth curve	2	B1 correct plot of their values B1 smooth curve through their points
	(b)		$x = 3$ $y = 0$	3	M1 attempts to draw circle at origin M1 uses radius 3 cm (using graph scale correctly) A1 cao **OR** B1 for substituting a value of x into $y = x(x-3)$ and $x^2 + y = r^2$ B1 for substituting y into $x = 3$ into $x(x-3)$ and $x^2 + y = r^2$ B1 cao
					Total for Question: 5 marks
285 QWC ii, iii		$(2n+1)^2-(2n-1)^2$ = $4n^2 + 4n + 1 - (4n^2 - 4n + 1)$ = $8n$ **OR** $(2n+1)^2-(2n-1)^2$ = $((2n+1)-(2n-1))(2n+1+2n-1))$ = 2 × $4n$ = $8n$	Fully algebraic argument, set out in a logical and coherent manner	6	B2 the nth term for consecutive odd numbers is $2n-1$ oe (B1 $2n+k$, $k \neq -1$ or $n = 2n-1$ or $2x-1$ B1 use of $2n+1$ and $2n-1$ oe M1 $(2n+1)^2-(2n-1)^2$ M1 $4n^2 + 4n + 1 - (4n^2 - 4n + 1)$ C1 conclusion based on correct algebra QWC: Conclusion should be stated, with correct supporting algebra. **OR** B1 use of $2n+1$ and $2n-1$ oe M1 $(2n+1)^2-(2n-1)^2$ M1 $((2n+1)-(2n-1))(2n+1+2n-1))$ C1 conclusion based on correct algebra QWC: Conclusion should be stated, with correct supporting algebra.
					Total for Question: 6 marks

Question	Working	Answer	Mark	Notes
286 (a)		$6ab - 7g$	2	M1 for $6ab$ or $-7g$ A1 cao
(b)		$3(2m - 3)$	1	B1 cao
(c)		t^5	1	B1 cao
(d)		$2xy(x + 2y)$	2	B2 cao (B1 for $xy(2x + 4y)$ or $2x(xy + 2y^2)$ or $2y(x^2 + 2xy)$ or $2xy(\ldots)$ where $(\ldots)$ has two terms one of which is correct)
(e)	$w^2 - 5w - 5w + 25$	$w^2 - 10w + 25$	2	M1 for all 4 terms (and no additional terms) correct with or without signs or 3 out of no more than 4 terms correct with signs A1 cao
287		72	4	M1 for "x" + 24 or "x" – 24 or for "g" and 5"g" M1 for forming an appropriate equation eg $x + 24 = 5(x - 24)$ or for $(5g - g) \div 2 = 24$ or $g = 12$ M1 for correct operations to isolate x terms and non-x terms in an equation of the form $ax + b = cx + d$ or $ax + b = c(x + d)$ or $x = 36$ or for $6 \times$ "12" oe A1 cao

Question	Working	Answer	Mark	Notes
288 (a)		$\frac{3}{x+1}$	1	B1 oe
(b)		–2.	3	M1 for attempting to multiply both sides by 5 as a first step and cancelling the LHS (can be implied by equations of the form $15 - x = 15x + ?$ or $15 - x = ?x + 55$) M1 for method to isolate terms in x and number terms from $ax + b = cx + d$ A1 for –2.5 oe OR M1 for splitting the LHS correctly into two parts $\frac{15}{5} - \frac{x}{5} = 3x + 11$ M1 for method to isolate terms in x and number terms from $ax + b = cx + d$ A1 for –2.5 oe
(c)		$m = \frac{2E}{v^2}$	3	M1 for a method to remove square root or clear fraction as a first step M1 for a method to remove square root **and** clear fraction A1 for $m = \frac{2E}{v^2}$
289	$\frac{-3 \pm \sqrt{3^2 - 4 \times 2 \times -7}}{2 \times 2}$	1.27, −2.77	3	M1 for substitution of $a = 2$, $b = 3$, $c = -7$ (condone one sign error) M1 for $\frac{-3 \pm \sqrt{65}}{4}$ A1 for solutions in range 1.26 to 1.27 **and** –2.76 to –2.77
290		$y = \frac{1}{4}x + 5$	4	B1 for $m = -4$ M1 (indep) for gradient of perpendicular $= -\frac{1}{"-4"}$ or $\frac{1}{4}$ M1 (dep on previous M1) for substituting $x = -8$, $y = 3$ into $y =$ " $\frac{1}{4}$ "$x + c$ A1 for $y = \frac{1}{4}x + 5$ oe SC If M0 is scored then B2 for $y = -\frac{1}{4}x + 1$

Question	Working	Answer	Mark	Notes
291	x -1 0 1 2 3 4 y 10 8 6 4 2 0	$y = 8 - 2x$ drawn	3	B3 for a correct line between $x = -1$ and $x = 4$ OR B2 for a correct straight line segment through at least 3 of $(-1, 10)$, $(0, 8)$, $(1, 6)$, $(2, 4)$, $(3, 2)$, $(4, 0)$ **or** for all of these points plotted but not joined **or** for a line drawn with a negative gradient through $(0, 8)$ **and** clear intention to use of a gradient of -2, eg line through $(0,8)$ and $(0.5, 6)$ OR B1 for at least 2 correct points stated or plotted **or** for a line drawn with a negative gradient through $(0, 8)$ **or** a line with gradient -2
292 (a)		n^4	2	M1 for $\frac{n^{10}}{n^6}$ oe or $\frac{n^7}{n^3}$ oe or $n \times n^3$ oe A1 cao
(b)		$3x^2 + 4x$	2	B2 for $3x^2 + 4x$ or $x(3x + 4)$ (B1 for $x^2 - 2x$ or $2x^2 + 6x$ or $3x^2 + nx$ or $px^2 + 4x$)
(c)		$5(y - 3)$	1	B1 cao
(d)		$9ab(2 + 3b)$	2	B2 for $9ab(2 + 3b)$ (B1 for $9a(2b + 3b^2)$ or $9b(2a + 3ab)$ or $ab(18 + 27b)$ or $3ab(6 + 9b)$ or $3a(6b + 9b^2)$ or $3b(6a + 9ab)$ or $9ab$(a two term algebraic expression))

Question	Working	Answer	Mark	Notes
293		$\frac{8}{17}$	5	M1 for $5x + 4$ or $10 - x$ M1 (dep) for "$5x + 4$" = $\frac{2}{3}$ "$(10 - x)$" M1 for expanding the bracket or multiplying both sides by 3 in an equation of the form $(ax + b) = \frac{2}{3}(cx + d)$ A1 for correct equation with terms in x and number terms isolated, eg $15x + 2x = 20 - 12$ or $5x + \frac{2x}{3} = \frac{20}{3} - 4$ A1 for $\frac{8}{17}$ oe accept 0.47(0588...)
294 (a)		$y^2 + 7y + 10$	2	M1 for all 4 terms (and no additional terms) correct ignoring signs **or** 3 terms correct A1 for $y^2 + 7y + 10$
(b)		$(e - 3)(e + 4)$	2	M1 for $(e \pm 3)(e \pm 4)$ A1 for $(e - 3)(e + 4)$
(c)		0.77, –0.43	3	M1 for $\frac{--1 \pm \sqrt{(-1)^2 - 4 \times 3 \times -1}}{2 \times 3}$ (condone one sign error) M1 for $\frac{1 \pm \sqrt{13}}{6}$ A1 for one answer in the range 0.767 to 0.77 and one answer in the range –0.43 to –0.4343
295 (a)	$2 = k^{-1}$	½	2	M1 for reading off and substituting a pair of values from the graph (excluding 0, 1) into the equation, eg $x = -1$, $y = 2$ A1 for ½ oe
(b)		correct graph	2	B2 cao (B1 for correct general shape, eg $y = -\sin x°$)

Question	Working	Answer	Mark	Notes
*296	$(n^2 + 4n + 4) - (n^2 + 2n + 1)$ $\frac{2n+3}{2n^2+3n}$ $\frac{2n+3}{n(2n+3)}$	Proof	4	M1 for correct method to expand $(n + 2)^2$ or $(n + 1)^2$ M1 for correct simplification of numerator M1 for factorisation of $2n^2 + 3n$ **or** for clearing the fractions on both sides correctly C1 for complete and correct proof OR M1 for $\{(n+2)-(n+1)\}\{(n+2)+(n+1)\}$ M1 for $1 \times (2n+3)$ M1 for factorisation of $2n^2 + 3n$ **or** for clearing the fractions on both sides correctly C1 for complete and correct proof OR M1 for $n\{(n+2)^2-(n+1)^2\} = (2n^2 + 3n) \times 1$ M1 for $n(n+2)^2 - n(n+1)^2$ or for correct expansion of $(n+2)^2-(n+1)^2$ M1 for correct expansion of $n\{(n+2)^2-(n+1)^2\}$ C1 for complete and correct proof (must include statement recognising the equality of LHS and RHS)

Question		Working	Answer	Mark	Notes
297	(a)		$30abc$	1	B1
	(b)		$3(y + 2)$	1	B1
	(c)		$x^2 - 3x$	1	B1
298	(a)		20.3	2	M1 for $\frac{50}{1.57^2}$ oe A1 for answer in range 20.2 to 20.3
	(b)		68.04	2	M1 for (m =) $1.8^2 \times 21$ oe A1 for 68.04
	(c)		2.61	3	M2 for a complete method to find 145% of 1.8, eg. $\frac{145}{100} \times 1.80$ oe (M1 for a method to find 45% of 1.8, eg. $\frac{45}{100} \times 1.80$ (= 0.81) or for a multiplication factor of 1.45) A1 cao
299	(a)		–1, 1, –1	2	B2 for all correct (B1 for 1 or 2 correct)
	(b)		Correct graph	2	M1 ft for 4 or 5 points from their table plotted correctly, provided at least B1 awarded in part (a) A1 for a fully correct graph (no line segments)

Question		Working	Answer	Mark	Notes
300	(a)		$10a^5b^4$	2	B2 cao (B1 for any two of 10, a^5, b^4 in a product)
	(b)		$y = 5p^2 - x$	3	M1 for a correct first step to either remove the square root, eg. $p^2 = \frac{x+y}{5}$ or clear the fraction, eg. $\sqrt{5}p = \sqrt{x+y}$ M1 (dep) for a method to remove the square root **and** a method to clear the fraction , eg. $5p^2 = x + y$ A1 for $y = 5p^2 - x$
301		$\frac{-6 \pm \sqrt{6^2 - 4\times3\times-2}}{2\times3}$ $(x+1)^2 - 1 - \frac{2}{3} = 0$	0.29 and – 2.29	3	M1 for substitution of $a = 3$, $b = 6$, $c = -2$ into the formula or for completing the square (condone **one** sign error) M1 for $\frac{-6 \pm \sqrt{60}}{6}$ or $-1 \pm \sqrt{\frac{5}{3}}$ or in simplified form A1 for answers in the range 0.29 to 0.292 and – 2.292 to – 2.29
302	(a)		$\frac{-1}{3x+4}$	2	M1 for $(3x \pm 4)(x \pm 3)$ or $(-3x \pm 4)(-x \pm 3)$ A1 for $\frac{-1}{3x+4}$, accept $\frac{1}{-3x-4}$
	(b)		$\frac{2x}{x^2-1}$	3	M1 for common denominator $(x-1)(x+1)$ or $x^2 - 1$ M1 for $\frac{x(x+1)}{(x-1)(x+1)} - \frac{x(x-1)}{(x-1)(x+1)}$ oe or $\frac{x(x+1)-x(x-1)}{(x-1)(x+1)}$ oe (NB: The denominator must be $(x-1)(x+1)$ or $x^2 - 1$ or another suitable common denominator) A1 for $\frac{2x}{(x-1)(x+1)}$ or $\frac{2x}{x^2-1}$

Question		Working	Answer	Mark	Notes
303			32 64 29	4	M1 for $2y$ or $y - 3$ M1 for adding their three expressions and setting equal to 125 M1 for correct method to solve $ay + b = 125$ A1 Ali 32, Bhavara 64 and Ceris 29
304	(a		±7	2	M1 for intent to divide both sides by 3 as a first step or answer of 7 or -7 A1 ±7
	(b)		0.125 or $\frac{1}{8}$	1	B1 cao
	(c)		$27x^6$	2	M1 for either 27 or x^6 in a two term product A1 cao
	(d)		$p = \frac{w + 16}{4}$	2	M1 for ÷ 4 throughout or adding 16 to both sides as a first step A1 $p = \frac{w+16}{4}$ oe
305	(a		5 and 6	2	M1 for evidence that (x =) 4, 5, 6 or evidence that (y =) 5,6,7, 8 A1 cao
	(b)		Region identified	4	M1 for two of the lines $y = -1$,$y = 3x - 1$ and $y = 4 - x$ drawn M1 for three of the lines $y = -1$, $y = 3x - 1$ and $y = 4 - x$ drawn M1 any correct shading(in or out) satisfying at least two of the inequalities where the shading must extend from the appropriate line A1 Fully correct region shown by either shading in, shading out or the use of R Accept lines that are solid or dashed
306			$y = 3x-5$	3	M1 for recognition that the gradient of $\mathbf{L_2}$ is 3 M1 for substitution of x=3 and y=4 into y= "m"x+c A1 $y = 3x-5$ oe (SC B2 for '$3x - 5$ ' or $L_2 = 3x - 5$)
307			$2x^2 + 7x + 4 = 0$	3	M1 for finding a correct coefficient M1 for a method to find a and c or b and c A1 $2x^2 + 7x + 4 = 0$ or $a = 2$, $b = 7$, $c = 4$

Question		Working	Answer	Mark	Notes
308	(a)		Graph drawn	2	B2 correct graph drawn (B1 for a graph translated up/down)
	(b)		Graph drawn	2	B2 for correct graph drawn (B1 for a graph reflected in the x axis or stretched by sf 2 parallel to the y axis)

Question		Working	Answer	Mark	Notes
*309		1155 ÷ 15 = 77 $x + 2x + x - 7 = 77$ $4x - 7 = 77$ $4x = 84;\ x = 21$ OR $15x + (15 \times 2x) + 15(x - 7) = 1155$ $60x - 105 = 1155$ $60x = 1260$ $x = 21$	Redlands 21 St Samuels 42 Francis Long 14	5	M1 for $2x$ or $x-7$ M1 for 1155 ÷ 15 (= 77) M1 (dep M2) for equation summing their three expressions to "77" A1 for 21, 42 and 14 C1 for fully correct answer with correct labels OR M1 for an expression for the cost of the pupils from Redlands M1 for expression for the cost of the pupils from either St Samuels or Francis Long M1 (dep M2) for equation summing their three expressions to 1155 A1 for 21, 42, and 14 C1 for fully correct answer with correct labels
310	(a)		$7x + 35$	1	B1 cao
	(b)		$12y^2 - 9y$	1	B1 cao
	(c)	$t^2 + 2t + 4t + 8$	$t^2 + 6t + 8$	2	M1 for all 4 terms (and no additional terms) correct with or without signs or 3 out of no more than 4 terms correct with signs A1 for $t^2 + 6t + 8$
311			$p = 8,\ q = 10$	3	M1 for finding the difference between the x or y coordinates eg $4 - 2$ (= 2) or $17 - 5$ (= 12) M1 for a complete method to find the value of p or the value of q A1 cao
312		Gradient of N = 3 Gradient of perpendicular to line N = $-\frac{1}{3}$	$y = -\frac{1}{3}x + 1$	3	M1 for complete method to find gradient of line N or for drawing a perpendicular line M1 for method to find the gradient of a perpendicular line A1 $y = -\frac{1}{3}x + 1$ oe

Question		Working	Answer	Mark	Notes
313			Shown	3	M1 for correct expansion of $(n+3)^2$ or $(n-3)^2$ eg $(n+3)^2 = n^2 + 6n + 9$ or $(n-3)^2 = n^2 - 6n + 9$ M1 for correct expansion of complete expression, eg $(n^2+6n+9) - (n^2-6n+9)$ A1 for $12n$ and conclusion OR M1 for $[n+3+n-3][n+3-(n-3)]$ M1 for $2n \times 6$ A1 for conclusion
314		$\frac{-4 \pm \sqrt{4^2 - 4 \times 3 \times -12}}{2 \times 3}$	1.44 and −2.77	3	M1 for substitution of $a = 3$, $b = 4$, $c = -12$ into the formula (condone one sign error) or for completing the square M1 for $\frac{-4 \pm \sqrt{160}}{6}$ or in simplified form A1 for answers in the ranges 1.43 to1.45 and −2.76 to −2.78
315	(a)		Circle drawn	2	B2 fully correct circle drawn (B1 for circle drawn with centre (0,0) or circle drawn with radius 4) OR M1 at least 5 correct points calculated and plotted A1 fully correct circle drawn
	(b)		$x = 1.4$, $y = 3.8$ $x = -2.2$, $y = -3.4$	3	M1 for $y = 2x + 1$ drawn or for elimination of one variable A1 for one correct pair of values given or for $x = 1.4, -2.2$ (± 0.2) or ft from graph provided 2 marks in (a) A1 for second correct pair of values given (±0.2) or ft from graph provided 2 marks in (a)

Question		Working	Answer	Mark	Notes
316	(a)		-1	2	M1 for $3 \times -5 + 7 \times 2$ A1 cao
	(b)		$3(x + 2)$	1	B1 cao
	(c)		$7y - 16$	2	M1 for intention to expand a bracket eg $5y - 10$ or $2y - 6$ A1 cao
	(d)		m^8	1	B1 cao
	(e)		p^4	1	B1 cao
317	(a)		$4n - 2$	2	B2 for $4n - 2$ oe (B1 for $4n + k$, $k \neq -2$ or k is absent, or $n = 4n - 2$)
	*(b)		Yes + reason	1	C1 ft from (a) for decision and explanation, e.g. equating 86 with nth term **and** "Yes, its the 22nd term" or continuing the sequence up to 86 **and** "Yes, 86 is in the sequence" oe

Question		Working	Answer	Mark	Notes
318		<table><tr><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>-7</td><td>-5</td><td>-3</td><td>-1</td><td>1</td><td>3</td></tr></table>	Straight line from (–2, –7) to (3, 3)	4	**(Table of values)** C1 for axes scaled and labelled M1 for at least 2 correct attempts to find points by substituting values of x M1 ft for plotting at least 2 of their points (any points plotted from their table must be plotted correctly) A1 for correct line between $x = -2$ and $x = 3$ **(No table of values)** C1 for axes scaled and labelled M1 for at least 2 correct points with no more than 2 incorrect points M1 for at least 2 correct points (and no incorrect points) plotted OR line segment of $y = 2x - 3$ drawn A1 for correct line between $x = -2$ and $x = 3$ **(Use of $y = mx+c$)** C1 for axes scaled and labelled M1 for line drawn with gradient of 2 OR line drawn with a y intercept of –3 M1 for line drawn with gradient of 2 AND with a y intercept of –3 A1 for correct line between $x = -2$ and $x = 3$ SC : B2 for the correct line from $x = 0$ to $x = 3$
319		$3x + y = 30$ $x + 3y = 22$	8.50 4.50	4	M1 for forming two algebraic equations M1 for a correct process to eliminate one variable (condone one arithmetic error) M1 (dep) for substituting found value in one of the equations or appropriate method after starting again (condone one arithmetic error) A1 for 8.5(0) and 4.5(0)

Question		Working	Answer	Mark	Notes
320			1.85 and – 0.180	3	M1 for $\frac{--5\pm\sqrt{-5^2-4\times3\times-1}}{2\times3}$ (condone one sign error) M1 for $\frac{5\pm\sqrt{37}}{6}$ (=1.8 to1.85 or −0.18 to −0.181) A1 for answers in the ranges 1.8 to1.85, and −0.18 to −0.181
321	(a)	$\frac{(2x-3)(x-1)}{(x+6)(x-1)}$	$\frac{2x-3}{x+6}$	3	M1 for $(2x-3)(x-1)$ M1 for $(x+6)(x-1)$ A1 cao
	(b)	$\frac{mb-tv}{vb}=\frac{m-t}{R}$ $mbR-tvR=mvb-tvb$ $mbR-mvb=tvR-tvb$ $m(bR-vb)=tvR-tvb$ OR $\frac{m}{v}-\frac{t}{b}=\frac{m}{R}-\frac{t}{R}$ $\frac{m}{v}-\frac{m}{R}=\frac{t}{b}-\frac{t}{R}$ $\frac{mR-mv}{vR}=\frac{tR-tb}{bR}$ $\frac{m(R-v)}{vR}=\frac{tR-tb}{bR}$	$m=\frac{tv(R-b)}{b(R-v)}$	4	M1 for putting LHS over a common denominator with at least one correct numerator (ignore signs) or for showing an intention to multiply each term on both sides by R or v or b M1 for rearranging correctly to isolate terms in m M1 for factorising with common factor m from 2 terms A1 for $m=\frac{tv(R-b)}{b(R-v)}$ oe

Question		Working	Answer	Mark	Notes
322			(4, 5½)	2	M1 for $\frac{2+6}{2}$ or $\frac{3+8}{2}$ or 4, 5½ without brackets A1 for (4, 5½) oe NB: (4,5) gets 0 without working
323			2.064(285714…)	2	M1 for substitution of 0.7 into expression or 2.89 or 2.06 seen A1 for 2.064(285714…) or $\frac{289}{140}$
324	(a)		p^6	1	B1 cao
	(b)		t^5	1	B1 cao
	(c)		6	1	B1 cao
	(d)		4	1	B1 cao
325	(a)		$5n - 1$	2	B2 for $5n - 1$ oe (B1 for $5n + c$ ($c \neq -1$ or absent) or $n = 5n - 1$)
	(b)		$2(3n - n^2)$	1	B1 for $2(3n - n^2)$ oe
326	(a)		−4, −3, −2, −1, 0	2	B2 for all 5 correct values; ignore repeats, any order (B1 for 4 correct (and no incorrect) values or all 5 correct values and −5)
	(b)		$x > 4½$	2	M1 for an attempt to expand brackets (eg $6\times x - 6\times 2$) or $6x - 12$ or for an intention to divide both sides by 6 as the first step or for 4½ oe seen A1 for $x > 4½$ oe

Question		Working	Answer	Mark	Notes
327	(a)	$y^2 - 2y - 5y + 10$	$y^2 - 7y + 10$	2	M1 for all 4 terms correct (condone incorrect signs) or 3 out of 4 terms correct with correct signs A1 cao
	*(b)	$(4n^2 + 2n + 2n + 1)$ $- (2n + 1)$ $= 4n^2 + 4n + 1 - 2n - 1$ $= 4n^2 + 2n$ $= 2n(2n + 1)$	Proof	3	M1 for 3 out of 4 terms correct in the expansion of $(2n + 1)^2$ or $(2n + 1)\{(2n+1) - 1\}$ A1 for $4n^2 + 2n$ or equivalent expression in factorised form C1 for convincing statement using $2n(2n + 1)$ or $2(2n^2 + n)$ or $4n^2 + 2n$ to prove the result
328		$y(5y + 24) = 0$ $\frac{-24 \pm \sqrt{(24^2)}}{10}$	$x = 6, y = 0$ $x = -3.6, y = -4.8$	5	M1 for substitution for elimination eg $(2y + 6)^2 + y^2 = 36$ M1 (dep on M1) for expansion eg $4y^2 + 12y + 12y + 36$ (3 out of 4 terms correct) A1 for $4y^2 + 24y + 36 + y^2 = 36$ oe M1 for a correct attempt to solve a 2 or 3 term quadratic equation eg by factorising or correct substitution into a quadratic formula A1 for $x = 6$, $y = 0$ and $x = -3.6$ oe, $y = -4.8$ oe SC: B1 (if M0 scored) for all 4 values mis-associated or one correct pair of values.

Question	Working	Answer	Mark	Notes
329 (a)		$7n - 4$	2	B2 for $7n - 4$ (B1 for $7n + d$ where d is an integer)
(b)		explanation	2	M1 for '$7n - 4$' = 150 or any other valid method, eg. counting on 7s (to get 150) A1 for a complete explanation eg. the 22nd term is 150 or $n = 22$ from solution of equation or a clear demonstration based on 22 or complete sequence
330 (a)		x^{10}	1	B1 cao
(b)		m^{12}	1	B1 cao
(c)		$3a^{-4}f^6$	2	B2 for $3a^{-4}f^6$ **or** $\frac{3f^6}{a^4}$ (B1 for any two from 3, a^{-4} or $\frac{1}{a^4}$, f^6 in a product)
331 (a)		6.25	3	M1 for clear intention to expand bracket **or** divide both sides of the equation by 5 as first step M1 for correct method to isolate terms in f A1 for 6.25 oe
(b)		−0.75	4	M1 for correct method to clear fractions eg. multiply all terms by 6 M1 for expansion of brackets oe M1 (dep on M1) for isolating the terms in ***h*** **and** the constant terms A1 for −0.75 oe
332 (a)		**-15, 0**, 3, 0 ,**-3**, **0**, 15	2	B2 for all correct (B1 for any 2 or 3 correct)
(b)		Correct graph	2	M1 for at least 5 points plotted correctly (ft from table if at least B1 awarded in (a)) A1 for a fully correct curve

Question	Working	Answer	Mark	Notes
333 (a)		$(2x + 3)(2x - 3)$	1	B1 cao
(b)		$m = \frac{g-5}{a+3}$	3	M1 for correct processes to isolate terms in m from other terms M1 for taking m out as a common factor A1 for $m = \frac{g-5}{a+3}$ **or** $m = \frac{5-g}{-a-3}$
*334		Yes with explanation	3	M1 For **Line A**: writes equation as $y = 1.5x + 4$ or gives the gradient as 1.5 or constant term of 4 OR for **Line B**: shows a method which could lead to finding the gradient or gives the gradient as 2 or constant term of 4 or calculates a sequence of points including (0,4) or writes equation of line as $y = 2x + 4$ M1 Shows correct aspects relating to an aspect of Line A and an aspect of Line B that enables some comparison to be made eg gradients, equations or points. C1 for gradients 1.5 **and** 2 **and** Yes **with** explanation that the gradients are different or states the lines intersect at (0,4) or explanation that interprets common constant term (4) from equations OR M1 for a diagram that shows both lines drawn and intersecting at (0,4) M1 for a diagram that shows both lines and their intersection point identified as (0,4) C1 for Yes and states the intersection point as (0,4)

Question		Working	Answer	Mark	Notes
335	(a)	$3x - 6 = x + 7$ $2x = 13$	6.5	3	M1 for $3\times x - 3\times 2$ ($=3x - 6$) or $\frac{x}{3} + \frac{7}{3}$ seen M1 for correct method to isolate the terms in x or the number terms on opposite sides of an equation A1 for 6.5 oe
	(b)	$2 - y = 1 \times 5$	-3	2	M1 for intention to multiply both sides by 5 (to give $2 - y = 1 \times 5$) A1 cao
336	(a)		(3, 3.5) oe	2	M1 for a correct method to find the value of either the x coordinate or the y coordinate of the midpoint **or** $x = 3$ **or** $y = 3.5$ A1 cao
	(b)		-1.8 oe	2	M1 for correct method to find the gradient OR (+)1.8 A1 for -1.8 oe
337	(a)		-2 -1 0 1 2 3 4 **8** 3 0 **-1** **0** 3 **8**	2	B2 for 8, -1, 0, 8 (B1 for at least two of 8, -1, 0, 8)
	(b)		Correct curve	2	M1 (ft) for at least 5 points plotted correctly A1 for a fully correct curve
	(c)	$x^2 - 2x - 3 = 0$ OR $(x - 3)(x + 1) = 0$	3 and −1	2	M1 for the straight line $y = 3$ drawn to intersect the "graph" from (a) A1 for both solutions **OR** M1 for identifying $y = 3$ from the table A1 for both solutions **OR** M1 for $(x \pm 3)(x \pm 1)$ A1 for both solutions

Question		Working	Answer	Mark	Notes
338		$3p^2 = y + 4$ $p^2 = \frac{y+4}{3}$	$p = \sqrt{\frac{y+4}{3}}$	3	M1 for clear intention to add 4 to both sides or divide all terms by 3(with at least 3 terms) M1 for clear intention to find the square root from p^2 = (expression in y) A1 for $p = \sqrt{\frac{y+4}{3}}$ oe (accept ± a correct root)
339	(a)		$3(2 + 3x)$	1	B1 for $3(2 + 3x)$
	(b)		$(y + 4)(y – 4)$	1	B1 for $(y + 4)(y – 4)$
	(c)		$(2p – 5)(p + 2)$	2	M1 for $(2p \pm 5)(p \pm 2)$ A1 for $(2p – 5)(p + 2)$
340			$x = 2.87, y = -0.87$ and $x = -0.87, y = 2.87$	6	M1 for $x^2 + (2 – x)^2 = 9$ M1 for $4 – 4x + x^2$ A1 for $2x^2 – 4x – 5 = 0$ oe 3 term simplified quadratic M1 for a correct method to solve their quadratic Eg $x = \frac{4 \pm \sqrt{(16 – 4\times2\times-5)}}{4}$ A1 for $x = 2.87, y = -0.87$ or better A1 for $x = -0.87, y = 2.87$ or better Award marks for equivalent algebraic expressions. Apply the same scheme as above for y first.

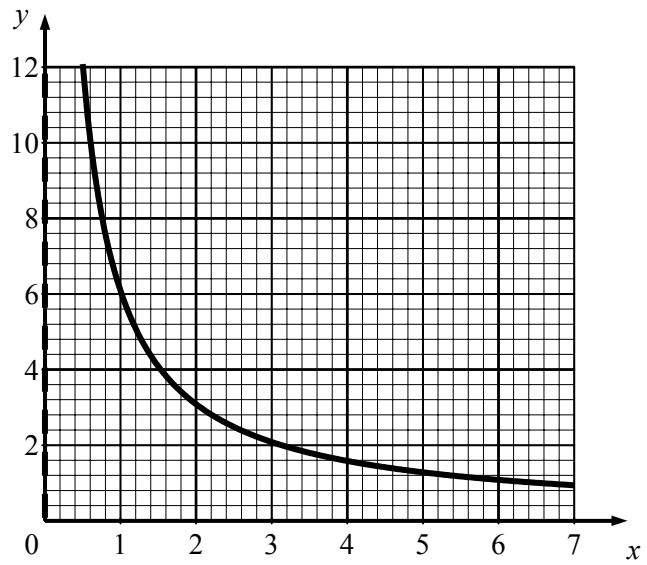
Question		Working	Answer	Mark	Notes
341	(a)		30	1	B1 for 30 minutes
	(b)		20	1	B1 cao
	(c)		graph completed	2	B1 for horizontal line from (5, 20) to (5.30, 20) B1 for a single straight line with the correct gradient from '(5.30, 20)' to the time axis
342	(a)	$3x + 12 + 10x - 2$	$13x + 10$	2	M1 for correct method to expand one bracket eg $3 \times x + 3 \times 4$ **or** $3x + 12$ or $2 \times 5x - 2 \times 1$ **or** $10x - 2$ A1 for $13x + 10$
	(b)	$2x^2 - 8x + x - 4$	$2x^2 - 7x - 4$	2	M1 for all 4 terms (and no additional terms) correct ignoring signs **or** 3 out of no more than four terms correct A1 for $2x^2 - 7x - 4$
	(c)		$3y(2y - 3x)$	2	B2 for $3y(2y - 3x)$ (B1 for $3(2y^2 - 3xy)$ **or** $y(6y - 9x)$ **or** $3y(2y + 3x)$ **or** $3y(2y - ax)$ where a is any positive integer except 3 **or** $3y(by - 3x)$ where b is any positive integer except 2)

Question		Working	Answer	Mark	Notes
343	(a		−2, −1, 0, 1,	2	B2 for all 4 correct values; ignore repeats, any order (B1 for 3 correct (and no incorrect values) eg. −2, −1, 0 **or** one additional value eg. −3, −2, −1, 0, 1)
	(b)		$p>6$	2	M1 for clear intention to add 7 to both sides **or** $3p > 11 + 7$ **or** clear intention to divide all 3 terms by 3 as a first step **or** $3p > 18$ **or** $3p = 18$ **or** $3p < 18$ **or** $\frac{18}{3}$ A1 for $p > 6$ as final answer NB: (p =) 6 on the answer line scores M1 A0
344	(a)	$100 = 4 \times 2 \times c$	12.5	2	M1 for correct substitution into formula A1 for 12.5 oe
	(b)	$m^2 = \frac{k+1}{4}$ $4m^2 = k + 1$ $k = 4m^2 - 1$ or $2m = \sqrt{(k+1)}$ $4m^2 = k + 1$ $k = 4m^2 - 1$	$k = 4m^2 - 1$	3	M1 for correct method to clear fraction **or** remove square root sign M1 (dep) for a fully correct method to both clear fraction **and** remove square root sign A1 for $k = 4m^2 - 1$ **or** $k = (2m + 1)(2m - 1)$

Question		Working	Answer	Mark	Notes
345	(a)		$-1, 0, 1, 2, 3$	2	B2 for all 5 correct values; ignore repeats, any order (B1 for 4 correct (and no incorrect values) eg. 0, 1, 2, 3 **or** one additional value, eg –1, 0, 1, 2, 3, 4)
	(b)		$-4 < x \leq 3$	2	B2 for $-4 < x \leq 3$ **or** > -4 **and** ≤ 3 (B1 for $-4 < x$ **or** $x > -4$ **or** $x \leq 3$ **or** $3 \geq x$ **or** > -4 **or** ≤ 3 **or** $-4 \leq x < 3$) NB : Accept the use of any letter
	(c)	$3y - 2 > 5$ $3y > 7$	$y > \frac{7}{3}$	2	M1 for clear intention to add 2 to both sides (of inequality or equation) or clear intention to divide all three terms by 3 **or** $3y > 7$ **or** $3y < 7$ **or** $3y = 7$ A1 $y > \frac{7}{3}$ **or** $y > 2\frac{1}{3}$ **or** $y > 2.\dot{3}$ NB. final answer **must** be an inequality (SC B1 for $\frac{7}{3}$ oe seen if M0 scored)
346	(a)		$x(x+7)$	1	B1 cao
	(b)		$(y-8)(y-2)$	2	M1 $(y \pm 8)(y \pm 2)$ **or** $y(y-2) - 8(y-2)$ **or** $y(y-8) - 2(y-8)$ A1 cao
	(c)(i)	$2t^2 + 5t + 2 = (2t+1)(t+2)$	$(2t+1)(t+2)$	3	M1 $(2t+2)(t+1)$ oe **or** $2t(t+2) + 1(t+2)$ **or** $t(2t+1) + 2(2t+1)$ A1 $(2t+1)(t+2)$
	(ii)	This is always a product of two whole numbers each of which is greater than 1	Correct explanation		B1 ft from (i) for a convincing explanation referring to factors found in (i)

Question		Working	Answer	Mark	Notes
347	(a)	x: 0.5, 1, 2, 3, 4, 5, 6 y: 12, (6), (3), 2, (1.5), 1.2, (1)	Correct table	2	B2 all 3 correct (B1 1 or 2 correct)
	(b)		Correct graph	2	M1 at least 6 points plotted correctly from their table A1 cao for correct curve drawn from (0.5, 12) to (6, 1)
348		$\frac{3(x+1)}{6}+\frac{2(x+3)}{6}=\frac{3x+3+2x+6}{6}$	$\frac{5x+9}{6}$	3	M1 Use of common denominator of 6 (**or** any other multiple of 6) and at least one numerator correct Eg. $\frac{3(x+1)}{6}$ or $\frac{2(x+3)}{6}$ M1 $\frac{3(x+1)}{6}+\frac{2(x+3)}{6}$ oe A1 cao

347.



Question		Working	Answer	Mark	Notes
349	(a)	$x = \frac{-9 \pm \sqrt{9^2 - 4\times 2\times -7}}{2\times 2} = \frac{-9 \pm \sqrt{137}}{4}$	0.676, − 5.18	3	M1 $\frac{-9 \pm \sqrt{9^2 - 4\times 2\times -7}}{2\times 2}$ allow substitution of ±7 for c M1 $\frac{-9 \pm \sqrt{137}}{4}$ A1 answers in ranges 0.67 - 0.68 **and** − 5.17 to − 5.18 **OR** M1 $(x + \frac{9}{4})^2$ oe M1 for method leading to $\pm\sqrt{\frac{137}{16}} - \frac{9}{4}$ A1 answers in ranges 0.67 - 0.68 **and** − 5.17 to − 5.18
	(b)	Put $y = \frac{1}{x}$ and use part (a) Or $7y^2 - 9y - 2 = 0$ $y = \frac{--9 \pm \sqrt{(-9)^2 - 4\times 7\times (-2)}}{2\times 7}$ $\frac{9 \pm \sqrt{137}}{14}$	1.48, − 0.193	2	M1 $y = \frac{1}{x}$ **or** $x = \frac{1}{y}$ A1 (ft) answers in range 1.47 - 1.48 **and** − 0.19 to − 0.194 **OR** M1 fully correct method which leads to $7y^2 - 9y - 2 = 0$ **or** $-7y^2 + 9y + 2 = 0$ with correct method to solve (condone sign errors in substitution) A1 (ft) answers in range 1.47 - 1.48 **and** − 0.19 to − 0.194

Question		Working	Answer	Mark	Notes
350		<table><tr><td>x</td><td>–1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>y</td><td>–5</td><td>–2</td><td>1</td><td>4</td><td>7</td></tr></table> **OR** Using $y = mx + c$ gradient = 3 y intercept = –2	Straight line from (–1, –5) to (3, 7)	3	**(Table of values)** M1 for at least 2 correct attempts to find points by substituting values of x. M1 ft for plotting at least 2 of their points (any points plotted from their table must be correctly plotted) A1 for correct line between –1 and 3 **(No table of values)** M2 for at least 2 correct points (and no incorrect points) plotted **OR** line segment of $y = 3x–2$ drawn (ignore any additional incorrect segments) (M1 for at least 3 correct points plotted with no more than 2 incorrect points) A1 for correct line between –1 and 3 **(Use of $y = mx+c$)** M2 for line segment of $y = 3x – 2$ drawn (ignore any additional incorrect segments) (M1 for line drawn with gradient of 3 OR line drawn with a y intercept of –2 and a positive gradient) A1 for correct line between –1 and 3
351	(a)		–1, 0, 1, 2, 3	2	B2 for all 5 correct values; ignore repeats, any order. (–1 for each omission or additional value)
	(b)	$7x – 3x < 4 + 9$ $4x < 13$	$x < 3.25$	2	M1 for a clear intention to use a correct operation to collect x terms or non-x terms in an (in)equality A1 for $x < 3.25$ oe (SC: B1 for 3.25 oe seen if M0 scored)

Question		Working	Answer	Mark	Notes
352	(a)	$p^2 - 4p + 9p - 36$	$p^2 + 5p - 36$	2	M1 for all 4 terms correct (condone incorrect signs) or 3 out of 4 terms correct with correct signs A1 cao
	(b)	$5w - 8 = 3(4w + 2)$ $5w - 8 = 12w + 6$ $-8 - 6 = 12w - 5w$ $-14 = 7w$	-2	3	M1 for attempting to multiply both sides by 3 as a first step (this can be implied by equations of the form $5w - 8 = 12w + 6$ or $5w - 8 = 12w + 6$ i.e. the LHS must be correct M1 for isolating terms in w and the number terms correctly from $aw + b = cw + d$ A1 cao **OR** M1 for $\frac{5w}{3} - \frac{8}{3} = 4w + 2$ M1 for isolating terms in w and the number terms correctly A1 cao
	(c)		$(x + 7)(x - 7)$	1	B1 cao
	(d)		$3x^4y^{\frac{3}{2}}$	2	B2 for $3x^4y^{\frac{3}{2}}$ or $3x^4y^{1.5}$ or $3x^4y^{1\frac{1}{2}}$ (B1 for any two terms correct in a product eg. $3x^4y^n$)

Question		Working	Answer	Mark	Notes
353		$\sqrt{\frac{8.5\times10^9 - 4\times10^8}{8.5\times10^9 \times 4\times10^8}}$ $= \sqrt{\frac{8.1\times10^9}{3.4\times10^{18}}}$ $= \sqrt{2.3823529...\times10^{-9}}$ **OR** $\sqrt{\frac{1}{4\times10^8} - \frac{1}{8.5\times10^9}}$ $= \sqrt{2.5\times10^{-9} - 1.17647\times10^{-10}}$ $= \sqrt{2.3823529...\times10^{-9}}$	4.9×10^{-5}	3	B3 for 4.88×10^{-5} to 4.9×10^{-5} (B2 for digits 238(23529) or 24 or 488(09353) or 49) (B1 for digits 81 or 34) **OR** B3 for 4.88×10^{-5} to 4.9×10^{-5} (B2 for digits 238(23529) or 24 or 488(09353) or 49) (B1 for digits 25 or 117(647))
354		$2d - 2t = 4t + 7$ $2d - 7 = 4t + 2t$ $2d - 7 = 6t$ $\frac{2d-7}{6}$	$\frac{2d-7}{6}$	3	B1 for $2d - 2t$ or $2t + \frac{7}{2}$ oe M1 for rearranging 4 terms correctly to isolate terms in t e.g. '$2d$' $- 7 = 4t +$ '$2t$' or $2d - 7 = 6t$ or $-6t = 7 - 2d$ seen A1 for $\frac{2d-7}{6}$ oe
355		$4n^2 + 12n + 3^2 - (4n^2 - 12n + 3^2)$ $= 4n^2 + 12n + 9 - 4n^2 + 12n - 9$ $= 24n$ $=8 \times 3n$	Proof	3	M1 for 3 out of 4 terms correct in expansion of either $(2n + 3)^2$ or $(2n - 3)^2$ **or** $((2n + 3) - (2n - 3))((2n + 3) + (2n - 3))$ A1 for $24n$ from correct expansion of both brackets A1 (dep on A1) for $24n$ is a multiple of 8 or $24n = 8 \times 3n$ or $24n \div 8 = 3n$

Question		Working	Answer	Mark	Notes
356		$a = 3, b = -4, c = -2$ $x = \frac{--4 \pm \sqrt{(-4)^2 - 4 \times 3 \times -2}}{2 \times 3}$ $= \frac{4 \pm \sqrt{16 + 24}}{6} = \frac{4 \pm \sqrt{40}}{6}$ = 1.72075922 or = – 0.3874258867 OR $x^2 - \frac{4}{3}x - \frac{2}{3} = 0$ $\left(x - \frac{2}{3}\right)^2 - \left(\frac{2}{3}\right)^2 - \frac{2}{3} = 0$ $x - \frac{2}{3} = \sqrt{\left(\frac{2}{3}\right)^2 + \frac{2}{3}}$ $x = \frac{2}{3} \pm \sqrt{\frac{10}{9}}$	1.72, –0.387	3	M1 for $\frac{--4 \pm \sqrt{(-4)^2 - 4 \times 3 \times -2}}{2 \times 3}$ (condone incorrect signs for –4 and –2) M1 for $\frac{4 \pm \sqrt{40}}{6}$ or $\frac{2 \pm \sqrt{10}}{3}$ A1 for one answer in the range 1.72 to 1.721 and one answer in the range – 0.387 to – 0.38743 **OR** M1 for $\left(x - \frac{2}{3}\right)^2$ oe M1 for method leading to $\frac{2}{3} \pm \sqrt{\frac{10}{9}}$ oe A1 for one answer in the range 1.72 to 1.721 and one answer in the range – 0.387 to – 0.38743