

1 (i)	$11^{-2} = \frac{1}{121}$	B1 1	$\frac{1}{121}$ ($\frac{1}{11^2} = \text{B0}$)
(ii)	$100^{\frac{3}{2}} = 1000$	M1 A1 2	Square rooting or cubing soi 1000
(iii)	$\sqrt{50} + \frac{6}{\sqrt{3}}$ $= 5\sqrt{2} + \frac{6\sqrt{3}}{3}$ $= 5\sqrt{2} + 2\sqrt{3}$	B1 M1 A1 3 <u>6</u>	$5\sqrt{2}$ (allow \pm) Attempt to rationalise $\frac{6}{\sqrt{3}}$ cao
2	$q=2$ $r=3$ $p=28$	B1 B1 M1 A1 $\sqrt{\quad}$ 4 <u>4</u>	(allow embedded values) $qr^2 + 10 = p$ or other correct method
3(i)	$y = 5\sqrt{2x}$	M1 A1 2	$\sqrt{2x}$ or $\sqrt{\frac{x}{2}}$ seen $y = 5\sqrt{2x}$
(ii)	Translation $\begin{pmatrix} 0 \\ -3 \end{pmatrix}$	B1 B1 2 <u>4</u>	Translation $\begin{pmatrix} 0 \\ -3 \end{pmatrix}$ o.e.

4	<p>Either</p> $y = 2x + 1$ <p>or $y = \frac{x^2 + 11}{3}$</p> $x^2 - 6x + 8 = 0$ $(x - 2)(x - 4) = 0$ $x = 2 \quad x = 4$ $y = 5 \quad y = 9$ <p>OR</p> $x = \frac{y - 1}{2}$ $\frac{(y - 1)^2}{4} - 3y + 11 = 0$ $y^2 - 14y + 45 = 0$ $(y - 5)(y - 9) = 0$ $y = 5 \quad y = 9$ $x = 2 \quad x = 4$	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>5</p>	<p>Substitute for x/y or attempt to get an equation in 1 variable only</p> <p>Obtain correct 3 term quadratic</p> <p>Correct method to solve 3 term quadratic</p> <p><u>or</u> one correct pair of values B1</p> <p>second correct pair of values B1 c.a.o</p> <p><u>SR</u> If solution by graphical methods: setting out to draw a parabola <u>and</u> a line M1 both correct A1 reading off of coordinates at intersection point(s) M1 one correct pair A1 second correct pair A1</p> <p>OR No working shown: one correct pair B1 second correct pair B1 full justification that these are the only solutions B3</p>
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5 (i)		B1	Correct curve in +ve quadrant
		B1 2	in -ve quadrant
(ii)	(-1,0) (0,0) (1,0)	M1	Positive cubic with clearly seen max and min points
		A1	(-1,0) (0,0) (1,0) Any one point stated or marked on sketch
(iii)		A1 3	Curve passes through all 3 points and no extras stated or marked on sketch
		B1	Graph <u>only</u> in bottom right hand quadrant
		B1 2	Correct graph, passing through origin
		<u>7</u>	

6 (i)	$49 - 4 \times -2 \times 3 = 73$ 2 real roots	M1	Uses $b^2 - 4ac$
		A1	73
		B1 $\sqrt{3}$	2 real roots (ft from their value)
(ii)	$(p+1)^2 - 64 = 0$ or $2\left[x + \frac{p+1}{4}\right]^2 - \frac{(p+1)^2}{16} + 4 = 0$ $p = -9, 7$	M1	Attempts $b^2 - 4ac = 0$ (involving p) or attempts to complete square (involving p)
		A1	$(p+1)^2 - 64 = 0$ aef
		B1	$p = -9$
		B1 4	$p = 7$
		<u>7</u>	

7 (i)	$\frac{dy}{dx} = 2x^3 - 3$	B1	1 term correct
(ii)	$y = 2x^3 + 2x^2 + 3x + 3$ $\frac{dy}{dx} = 6x^2 + 4x + 3$	B1 2 M1 A1 A1 A1 4	Completely correct (+c is an error, but only penalise once) Attempt to expand brackets $2x^3 + 2x^2 + 3x + 3$ 2 terms correct Completely correct <u>SR</u> Recognisable attempt at product rule M1 one part correct A1 second part correct A1 final simplified answer A1
(iii)	$y = x^{\frac{1}{5}}$ $\frac{dy}{dx} = \frac{1}{5}x^{-\frac{4}{5}}$	B1 B1 B1 3	$x^{\frac{1}{5}}$ soi $\frac{1}{5}x^c$ $kx^{-\frac{4}{5}}$
8(i)	$2[10 + x + x] > 64$	B1 1	$20 + 4x > 64$ o.e.
(ii)	$x(x+10) < 299$ $x^2 + 10x - 299 < 0$ $(x-13)(x+23) < 0$	B1 B1 2	$x(x+10) < 299$ Correctly shows $(x-13)(x+23) < 0$ AG <u>SR</u> <u>Complete</u> proof worked backward B2
(iii)	$x > 11$ $(x-13)(x+23) < 0$ $-23 < x < 13$ $\therefore 11 < x < 13$	B1 $\sqrt{\quad}$ M2 A1 B1 5	$x > 11$ ft from their (i) Correct method to solve $(x-13)(x+23) < 0$ eg graph $-23 < x < 13$ seen in this form or as number line <u>SR</u> if seen with no working B1
		<u>9</u>	
		<u>8</u>	

9(i)	$\frac{dy}{dx} = 4x$	B1		$4x$
	At $x=3$, $\frac{dy}{dx} = 12$	B1	2	12
(ii)	Gradient of tangent = - 8	M1		$\frac{dy}{dx} = -8$
	$4x = -8$	A1		$x = -2$
	$x = -2$			
	$y = 8$	A1	3	$y = 8$
(iii)	Gradient = 6	B1	1	Gradient = or approaches 6
(iv)	$\frac{dy}{dx} = 2kx$	M1		$\frac{dy}{dx} = 2kx$
	$x = 1$	M1		$\frac{dy}{dx} = 2k$
	$\frac{dy}{dx} = 2k$	A1	$\sqrt{3}$	$k = 3$
	$k = 3$			CWO
			<u>9</u>	

