1 (i)	$11^{-2} = \frac{1}{121}$	B1 1	$\frac{1}{121}$ ($\frac{1}{11^2} =$ 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 6	$5\sqrt{2}$ (allow $\pm$) Attempt to rationalise $\frac{6}{\sqrt{3}}$ cao
2	q=2 r=3 p=28	B1 B1 M1 A1$\sqrt{}$ 4 4	(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 4	Translation $\begin{pmatrix} 0 \\ -3 \end{pmatrix}$ o.e.

4	Either $y = 2x + 1$ or $y = \frac{x^2 + 11}{3}$	M1	Substitute for x/y or attempt to get an equation in 1 variable only
	$x^2 - 6x + 8 = 0$	A1	Obtain correct 3 term quadratic
	$(x-2)(x-4) = 0$	M1	Correct method to solve 3 term quadratic
	$x = 2 \quad x = 4$	A1	<u>or</u> one correct pair of values B1
	$y = 5 \quad y = 9$	A1	second correct pair of values B1 c.a.o
	OR $x = \frac{y-1}{2}$ $\frac{(y-1)^2}{4} - 3y + 11 = 0$ $y^2 - 14y + 45 = 0$ $(y-5)(y-9) = 0$ $y = 5 \quad y = 9$ $x = 2 \quad x = 4$		
			<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 OR No working shown: one correct pair B1 second correct pair B1 full justification that these are the only solutions B3
		<u>5</u>	

5 (i)		B1	Correct curve in +ve quadrant
		B1 2	in –ve quadrant
(ii)		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
	(-1,0) (0,0) (1,0)	A1 3	Curve passes through all 3 points and no extras stated or marked on sketch
(iii)		B1	Graph only in bottom right hand quadrant
		B1 2	Correct graph, passing through origin
		7	

6 (i)	$49-4\times-2\times3=73$	M1	Uses b^2-4ac
	2 real roots	A1	73
		B1$\sqrt{}$ 3	2 real roots (ft from their value)
(ii)	$(p+1)^2-64=0$ or $2[(x+\frac{p+1}{4})^2-\frac{(p+1)^2}{16}+4]=0$	M1	Attempts b^2-4ac = 0 (involving p) or attempts to complete square (involving p)
		A1	$(p+1)^2-64=0$ aef
	p= -9,7	B1	*p*= -9
		B1 4	p= 7
		7	

7 (i)	$\frac{dy}{dx} = 2x^3 - 3$	B1 B1 2	1 term correct Completely correct (+c is an error, but only penalise once)
(ii)	$y = 2x^3 + 2x^2 + 3x + 3$ $\frac{dy}{dx} = 6x^2 + 4x + 3$	M1 A1 A1 A1 4	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 <u>9</u>	$x^{\frac{1}{5}}$ 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 $\sqrt{}$ M2 A1 B1 5 <u>8</u>	$x > 11$ 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

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

10(i)	Gradient DE = $-\frac{1}{2}$	B1 1	$-\frac{1}{2}$ (any working seen must be correct)
(ii)	$y-3=-\frac{1}{2}(x-2)$	M1	Correct equation for straight line, any gradient, passing through F
		A1	$y-3=-\frac{1}{2}(x-2)$ aef
	$x+2y-8=0$	A1 3	$x+2y-8=0$ (this form but can have fractional coefficients e.g. ½x + y – 4 = 0
(iii)	Gradient EF = $\frac{4}{2}$ =2	B1	Correct supporting working must be seen
	$-\frac{1}{2}\times 2=-1$	B1 2	Attempt to show that product of their gradients = - 1 o.e.
(iv)	DF=$\sqrt{4^2+3^2}=5$	M1	$\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$ used
		A1 2	5
(v)	DF is a diameter as angle DEF is a right angle.	B1	Justification that DF is a diameter
	Mid-point of DF <u>or</u> centre of circle is $(0,1\frac{1}{2})$	B1	Mid-point of DF <u>or</u> centre of circle is $(0,1\frac{1}{2})$
	Radius = 2.5	B1	Radius = 2.5
	$x^2+(y-\left(\frac{3}{2}\right)^2)=\left(\frac{5}{2}\right)^2$ $x^2+y^2-3y+\frac{9}{4}=\frac{25}{4}$	B1$\sqrt{}$	$x^2+(y-\left(\frac{3}{2}\right)^2)=\left(\frac{5}{2}\right)^2$
	$x^2+y^2-3y-4=0$	B1 5	$x^2+y^2-3y-4=0$ obtained correctly with at least one line of intermediate working. <u>SR</u> For working that only shows $x^2+y^2-3y-4=0$ is equation for a circle with centre $(0,1\frac{1}{2})$ B1 radius 2.5 B1
		<u>13</u>	