1	(a)		(−4.5) 3 4.5 (3) 1.5 (3) 10.5	2	B2 (B1	for all correct for any two correct) No points in table but correctly plotted on grid, award mark
	(b)	(−3, −4.5) (−2,3) (−1,4.5) (0,3) (1,1.5) (2,3) (3,10.5)	Smooth curve	2	B2 (B1	for a correct smooth curve. Points or curve passing through correct values within half a small square. for at least 5 points plotted correctly; ft from table for plotting only provided B1 awarded in part (a))
	(c)			2	M1	for drawing $y = -x - 1$ with two correct points plotted and intersection with curve. **or** for stating $y = -x - 1$ **or** for $\frac{1}{2}x^3 - 2x + 3 = -x - 1$ seen
			−2.3 to −2.4		A1	ft their curve dep on M1 **and** line $y = -x - 1$ drawn
						Total 6 marks

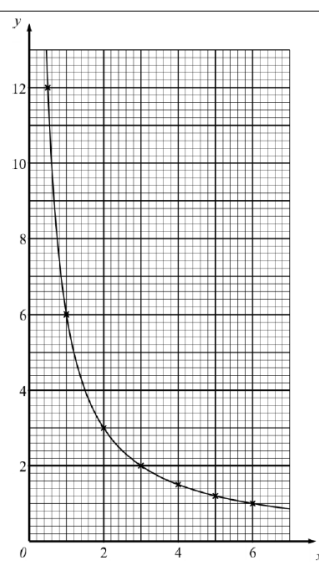| 2 | ai | | | | B1 | tangent drawn at P ($x = 2$) |
					M1	(dep on B1) for a method to find gradient e.g. $\dfrac{\text{difference in } y\text{-values}}{\text{difference in } x\text{-values}}$
			−0.6	3	A1	(dep on B1) accept answers in range −0.4 to −0.7 **and** from correct figures for their line
	aii	e.g. $y = −0.6x + c$ **or** $y = mx + 3.6$ **or** $2.4 = −0.6 \times 2 + c$			M1	for start of method to find the tangent equation e.g. $y = mx + c$ where m is their gradient **or** $y = mx + c$ where c is the y-intercept for their tangent **or** for substituting a point from their tangent e.g. (2, 2.4) into $y = mx + c$ where m is their gradient
			$y = −0.6x + 3.6$	2	A1	ft their gradient from (i) and intercept of their tangent, so long as intercept / value of c is > 3
	b		3		B1	
			−1	2	B1	
						Total 7 marks

| 3 | | | C, B, E | 3 | B3 (B2 (B1 | for all 3 correct for 2 correct) for 1 correct) |
| | | | | | | **Total 3 marks** |

4	(a)		8.5, 5, 4, 5	2	B2	all 4 correct (allow eg 5.0 for 5) (B1 for 2 or 3 correct)
	(b)				M1	ft their table dep on B1 scored in (a) for 5 or 6 points plotted correctly (tolerance 1 small square)
			fully correct graph	2	A1	A fully correct graph – correct points plotted correctly (within tolerance of 1 small square) and intention to join with a smooth curve (be generous if intention is clearly a smooth curve through all points)
						NB: If a student has nothing in the table for part (a) but draws a fully correct graph in part (b) award the marks in part (a)
						Total 4 marks

5		$\left[\dfrac{dy}{dx}=\right]2\times kx-16x^{-2}$ **or** $2kx-\dfrac{16}{x^2}$ oe		5	M2	for both terms differentiated correctly
					(M1)	for one term differentiated correctly
		$"2kx-16x^{-2}"=0$ oe			M1	ft dep on M1
		eg $\dfrac{8}{27}k=8$ or $\dfrac{4}{3}k=36$ or $k=27$ oe			M1	(not ft) for substituting $x=\dfrac{2}{3}$ into their correct equation for k and getting as far as one step from the value of k or the correct value of k
		Working must be seen	36		A1	dep on M4
						Total 5 marks

6	(a)	$\left(\dfrac{dy}{dx}=\right)2x+px^{-2}$ oe		4	M2	Both terms correct (M1 for one term correct)
		$2(-3)+p(-3)^{-2}(=0)$			M1	(dep on M1) substitute -3 into a derivative of the form $ax+bx^{-2}$
			54		A1	
	(b)	$\left(\dfrac{dy}{dx}=\right)2x+16x^{-2}=0$		3	M1	set $\dfrac{dy}{dx}=0$, at least one term correct
		eg $2x^3+16=0$ **or** $2x^3=-16$ or $x^3=-8$ **or** $x=\sqrt[3]{-8}$ **or** $x=-2$			M1	rearrangement of the correct equation to remove the negative power of x
			12		A1	
						Total 7 marks

7			C, F, D, H	3	B3	for all 4 correct
					(B2	for 2 or 3 correct)
					(B1	for 1 correct)
						Total 3 marks

8	(a)

x	0.5	1	2	3	4	5	6
y	12	6	3	2	1.5	1.2	1

			Correct table	2	B2 for all 4 correct values oe (ie $\dfrac{6}{5}$ or $\dfrac{3}{2}$) (B1 for 2 or 3 correct values)

	(b)		Correct graph 7 points joined by a smooth curve.	2	M1ft (dep B1 in (a)) for 6 or 7 points plotted correctly using their values (within the circles on overlay). May be implied by curve passing through correct point.
					A1ft only allow one incorrect value from the table in (a), and for a curve that is decreasing throughout for $x=0.5$ to $x=6$. Ignore graph to the right of (6, 1) and to the left of (0.5, 12)
					Total 4 marks

9	eg $-6 = 8a + 4b - 24 + 6$ **or** $8a + 4b = 12$ oe		6	M1	for substituting $x = 2$ and $y = -6$ into the equation for **C**
	$\left(\dfrac{dy}{dx} =\right) 3ax^2 + 2bx - 12$ oe			M1	at least 2 terms correct
	eg $16 = 12a + 4b - 12$ **or** $12a + 4b = 28$ oe			M1ft	(dep on previous M1) follow through their $\dfrac{dy}{dx}$
	$a = 4$ **and** $b = -5$			M1	for $a = 4$ **and** $b = -5$
	eg "4"× 3³ + "−5"× 3² − 12 × 3 + 6			M1ft	correctly substituting their a, their b and $x = 3$ into the equation for **C**
		33		A1	(dep on M3) allow (3, 33)
					Total 6 marks

10	(a)	x: −2, −1, −0.5, 0, 1, 1.5, 2 / y: 0, , , 2, , , 4		2	B2	(B1 for 1 or 2 correct)
	(b)		correct curve	2	B2	For correct smooth curve. **(there is an overlay for the curve – check the line now for (c))** If not B2, then B1 for at least 5 points plotted correctly ft from table dep on B1 or B2 in (a)
	(c)	$2x^3 - 6x + 4 = -3x$ **or** $x^3 - 3x + 2 = -\dfrac{3}{2}x$ or $y = -\dfrac{3}{2}x$ seen (allow $-\dfrac{3}{2}x$)		3	M1	
		$y = -\dfrac{3}{2}x$ allow a correct line that intercepts with the curve eg of points on line (0, 0), (−1, 1.5), (−1.5, 2.25), (−2, 3)			M1	a correct line that intercepts with the curve (a correct line drawn implies M2)
		Answer dependent on a correct line being drawn	(x=) −1.6		A1ft	accept −1.6 or −1.7 or ft their curve/line intercept **dep on a correct line being drawn** NB: if y value given as well then M2 only
						Total 7 marks

11	(a)		12 and 4.5	1	B1 allow $\dfrac{9}{2}$ oe May be awarded if plotted correctly on the graph
	(b)		Correct graph	2	M1 ft for at least 5 points plotted correctly (± half square)
		Correct answer scores full marks (unless from obvious incorrect working)			A1 for correct curve between $x = 0.5$ and $x = 5$ (clear intention to go through all the points and which must be curved) **Note**: If a fully correct graph is shown, but an incomplete table is shown in (a), then award the marks for (a)
					Total 3 marks

12		**B**	3	B1
		A		B1
		F		B1
				Total 3 marks

13	(a)		D	1	B1 allow d
	(b)		C	1	B1 allow c
	(c)		B	1	B1 allow b
					Total 3 marks

14		C	3	B1	check diagrams
		F		B1	check diagrams
		A		B1	check diagrams
					Total 3 marks