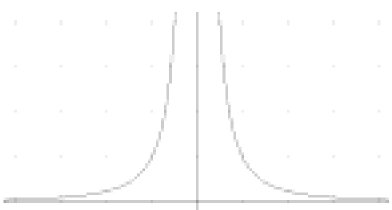
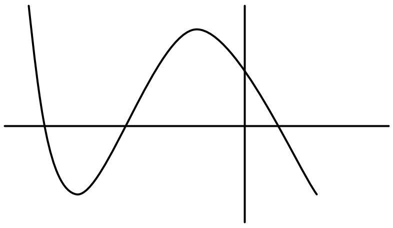
4721 Core Mathematics 1

1	$3\sqrt{5}+\frac{20\sqrt{5}}{5}$ $=7\sqrt{5}$	B1 M1 A1 3 **3**	$3\sqrt{5}$ soi Attempt to rationalise $\frac{20}{\sqrt{5}}$ cao
2 (i) **(ii)**	x^2 $\frac{3y^4\times 1000y^3}{2y^5}$ $=1500y^2$	B1 1 B1 B1 B1 3 **4**	cao $1000y^3$ soi 1500 y^2
3	*Let* $y=x^{\frac{1}{3}}$ $3y^2+y-2=0$ $(3y-2)(y+1)=0$ $y=\frac{2}{3}, y=-1$ $x=\left(\frac{2}{3}\right)^3, x=(-1)^3$ $x=\frac{8}{27}, x=-1$	*M1 DM1 A1 DM1 A1 ft 5 **5**	Attempt a substitution to obtain a quadratic or factorise with $\sqrt[3]{x}$ in each bracket Correct method to find roots Both values correct Attempt cube of at least one value Both answers correctly followed through **SR** If M1* not awarded, **B1** x = -1 from T & I
4 (i) **(ii)** **(iii)**	 $y=\frac{1}{(x+3)^2}$ *(1, 4)*	B1 B1 2 M1 A1 2 B1 B1 2 **6**	Excellent curve in one quadrant or roughly correct curves in correct 2 quadrants Completely correct $\frac{1}{(x\pm 3)^2}$ $y=\frac{1}{(x+3)^2}$ Correct x coordinate Correct y coordinate

5 (i)	$\frac{dy}{dx} = -50x^{-6}$	M1 A1 2	kx^{-6} Fully correct answer
(ii)	$y = x^{\frac{1}{4}}$ $\frac{dy}{dx} = \frac{1}{4}x^{-\frac{3}{4}}$	B1 B1 B1 3	$\sqrt[4]{x} = x^{\frac{1}{4}}$ soi $\frac{1}{4}x^{c}$ $kx^{-\frac{3}{4}}$
(iii)	$y = (x^2 + 3x)(1-5x)$ $= 3x - 14x^2 - 5x^3$ $\frac{\mathrm{d}y}{\mathrm{d}x} = 3 - 28x - 15x^2$	M1 A1 M1 A1 4 **9**	Attempt to multiply out fully Correct expression (may have 4 terms) Two terms correctly differentiated from their expanded expression Completely correct (3 terms)
6(i)	$5(x^2 + 4x) - 8$ $= 5\left[(x+2)^2 - 4\right] - 8$ $= 5(x+2)^2 - 20 - 8$ $= 5(x+2)^2 - 28$	B1 B1 M1 A1 4	$p = 5$ $(x+2)^2$ seen or $q = 2$ $-8 - 5q^2$ or $-\frac{8}{5} - q^2$ $r = -28$
(ii)	$x = -2$	B1 ft 1	
(iii)	$20^2 - 4 \times 5 \times -8$ $= 560$	M1 A1 2	Uses $b^2 - 4ac$ 560
(iv)	2 real roots	B1 1 **8**	2 real roots
7(i)	$30 + 4k - 10 = 0$ $\therefore k = -5$	M1 A1 2	Attempt to substitute x = 10 into equation of line
(ii)	$\sqrt{(10-2)^2 + (-5-1)^2}$ $= \sqrt{64+36}$ $= 10$	M1 A1 2	Correct method to find line length using Pythagoras' theorem cao, dependent on correct value of k in (i)
(iii)	Centre (6, -2) Radius 5	B1 B1 2	
(iv)	Midpoint of AB = (6, -2) Length of AB = 2 x radius Both A and B lie on circumference Centre lies on line 3x + 4y – 10 = 0	B1 B1 2 **8**	One correct statement of verification Complete verification

8 (i)	$x = \dfrac{8 \pm \sqrt{(-8)^2 - (4\times -1\times 5)}}{-2}$	M1	Correct method to solve quadratic
	$= \dfrac{8 \pm \sqrt{84}}{-2}$	A1	$x = \dfrac{8 \pm \sqrt{84}}{-2}$
	$= -4 - \sqrt{21}$ or $= -4 + \sqrt{21}$	A1 3	Both roots correct and simplified
(ii)	$x \le -4 - \sqrt{21}$, $x \ge -4 + \sqrt{21}$	M1	Identifying $x \le$ their lower root, $x \ge$ their higher root
		A1 2	$x \le -4 - \sqrt{21}$, $x \ge -4 + \sqrt{21}$ (not wrapped, no 'and')
(iii)		B1	Roughly correct negative cubic with max and min
		B1	(-4, 0)
		B1	(0, 20)
		B1	Cubic with 3 distinct real roots
		B1 5	Completely correct graph
		10	
9	$\dfrac{dy}{dx} = 3x^2 + 2px$	M1 A1	Attempt to differentiate Correct expression cao
	When $x = 4$, $\dfrac{dy}{dx} = 0$	M1	Setting their $\dfrac{dy}{dx} = 0$
	$\therefore 3\times 4^2 + 8p = 0$	M1	Substitution of $x = 4$ into their $\frac{dy}{dx} = 0$ to evaluate p
	$8p = -48$		
	$p = -6$	A1	
	$\dfrac{d^2y}{dx^2} = 6x - 12$	M1	Looks at sign of $\dfrac{d^2y}{dx^2}$, derived correctly from their $\dfrac{dy}{dx}$, or other correct method
	When $x = 4$, $6x - 12 > 0$		
	Minimum point	A1 7	Minimum point CWO
		7	

10(i)	$\frac{dy}{dx} = 2x + 1$ $= 5$	M1 A1 2	Attempt to differentiate *y* cao
(ii)	Gradient of normal = $-\frac{1}{5}$ When *x* = 2, *y* = 6 $y - 6 = -\frac{1}{5}(x - 2)$ $x + 5y - 32 = 0$	B1 ft B1 M1 A1 4	ft from a non-zero numerical value in (i) May be embedded in equation of line Equation of line, any non-zero gradient, their *y* coordinate Correct equation in correct form
(iii)	$x^2 + x = kx - 4$ $x^2 + (1-k)x + 4 = 0$ One solution => $b^2 - 4ac = 0$ $(1-k)^2 - 4\times1\times4 = 0$ $(1-k)^2 = 16$ $1 - k = \pm4$ *k* = -3 or 5	*M1 DM1 DM1 A1 DM1 A1 6 **12**	Equating $y_1 = y_2$ Statement that discriminant = 0 Attempt (involving *k*) to use a, b, c from their equation Correct equation (may be unsimplified) Correct method to find *k*, dep on 1st 3Ms Both values correct