4721 Core Mathematics 1

1	(i)	$\frac{dy}{dt} = 5r^4 - 2r^{-3}$	B1	$5x^4$
		dx = 3x = 2x	M1	x^{-2} before differentiation or kx^{-3} in $\frac{dy}{dx}$ soi
			A1 3	$-2x^{-3}$
	(ii)	d^2	M1	Attempt to differentiate their (i) – at least
		$\frac{d^{2}y}{dx^{2}} = 20x^{3} + 6x^{-4}$	A1 2 5	one term correct cao
2		$\frac{(8+\sqrt{7})(2-\sqrt{7})}{(2+\sqrt{7})(2-\sqrt{7})}$	M1	Multiply numerator and denominator by conjugate
		$=\frac{9-6\sqrt{7}}{4-7}$	A1 A1	Numerator correct and simplified Denominator correct and simplified
		$=-3+2\sqrt{7}$	A1 4 4	сао
3	(i)	3 ⁻²	B1 1	
	(ii)	$3^{\frac{1}{3}}$	B1 1	
	(;;;;)	210 230	M1	2^{30} 0^{20}
	(111)	3 ⁻² × 3 ⁻²		5 or 9 soi
		= 3**	4	
4		y = 2x - 4		
		$4x^2 + (2x - 4)^2 = 10$	M1*	Attempt to get an equation in 1 variable only
		$8x^2 - 16x + 16 = 10$		
		$8x^2 - 16x + 6 = 0$	A1	Obtain correct 3 term quadratic (aef)
		$4x^2 - 8x + 3 = 0$		
		(2x-1)(2x-3) = 0	M1dep*	Correct method to solve quadratic of form $ax^2 + bx + c = 0$ ($b \neq 0$) Correct factorisation oe
		$x = \frac{1}{2}$, $x = \frac{3}{2}$	A1	Both x values correct
		y = -3, y = -1	A1 A1 6	Both y values correct
			6	orone correct pair of values wwwB1second correct pair of valuesB1

5	(i)	$(2x^2-5x-3)(x+4)$	M1		Attempt to multiply a quadratic by a linear factor or to expand all 3 brackets with an
		$= 2x^3 + 8x^2 - 5x^2 - 20x - 3x - 12$			appropriate number of terms (including an x^3 term)
		$= 2x^3 + 3x^2 - 23x - 12$	A1		Expansion with no more than one incorrect term
			A1	3	
	(ii)	$2x^4 + 7x^4$	B 1		$2x^4$ or $7x^4$ soi www
		$=9x^{4}$ 9	B1	2	$9x^4$ or 9
				5	
6	(i)				
			B1		One to one graph <u>only</u> in bottom right hand quadrant
			B 1	2	Correct graph, passing through origin
	(ii)	Translation Parallel to y-axis, 5 units	B1 B1	2	
	(iii)	$y = -\sqrt{\frac{x}{2}}$	M1		$\sqrt{2x}$ or $\sqrt{\frac{x}{2}}$ seen
			A1	2 6	cao
7	(i)	$\left(x - \frac{5}{2}\right)^2 - \left(\frac{5}{2}\right)^2 + \frac{1}{4}$	B1		$a = \frac{5}{2}$
		$=\left(x-\frac{5}{2}\right)^2-6$	M1		$\frac{1}{4} - a^2$
			A1	3	cao
	(ii)	$\left(x-\frac{5}{2}\right)^2 - 6 + y^2 = 0$			
		Centre $\left(\frac{5}{2},0\right)$	B1 B1		Correct <i>x</i> coordinate Correct <i>y</i> coordinate
		Radius = $\sqrt{6}$	B1	3 6	

8 (i)	-42 < 6x < -6	M1	2 equations or inequalities both dealing with
		. 1	all 3 terms
	-/ < x < -1		-7 and -1 seen oe 7 < r < 1 (or $r > 7$ and $r < 1$)
		AI J	-7 < x < -1 (or $x > -7$ and $x < -1$)
(ii)	$x^2 > 16$	B1	±4 oe seen
	x > 4	B1	<i>x</i> > 4
	or $x < -4$	B1 <u>3</u>	x < -4 not wrapped, not 'and'
		6	
0 (1)			
9 (1)	$\sqrt{(-1-4)^2+(93)^2}$	M1	Correct method to find line length using
			Pythagoras' theorem
	=13	AI 2	cao
(ii)	$\left(\frac{4+1}{2},\frac{-3+9}{2}\right)$	M1	Correct method to find midpoint
	(3)		
	$\left\lfloor \left(\frac{1}{2}, 3 \right) \right\rfloor$	A1 2	
(;;;)	12	R1	
(III)	Gradient of $AB = -\frac{1}{5}$	DI	
	$y-3 = -\frac{1}{5}(x-1)$	M1	Correct equation for line, any gradient, through $\begin{pmatrix} 1 & 2 \end{pmatrix}$
	12x + 5y - 27 = 0	A1	Correct equation in any form with gradient
	12x + 5y = 27 = 0		simplified
		A1 4	12x + 5y - 27 = 0
		8	
10 (i)	(3r+7)(3r-1) = 0	M1	Correct method to find roots
	(3x + 7)(3x - 1) = 0	A1	Correct factorisation oe
	$x = -\frac{7}{2}, x = \frac{1}{2}$	A1 3	Correct roots
	3 3		
(;;)	dy	M1	Attempt to differentiate y
(11)	$\frac{dy}{dx} = 18x + 18$	M1 M1	dy
	18x + 18 = 0		Uses $\frac{dy}{dx} = 0$
	x = -1	A1	u.
	y = -16	A1 ft 4	
	<i>y</i> = 10		
(iii)	·	B1	Positive quadratic curve
		B1	y intercept (0, -7)
		B1 3	Good graph, with correct roots indicated and
	- t t		minimum point in correct quadrant
	3 1/3		
	-74		
(iv)	r > 1	B1 1	
		11	

11	(i)	Gradient of normal = $-\frac{2}{3}$	B1	
		$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{1}{2}kx^{-\frac{1}{2}}$	M1* A1	Attempt to differentiate equation of curve $\frac{1}{2}kx^{-\frac{1}{2}}$
		When $x = 4$, $\frac{dy}{dx} = \frac{k}{4}$	M1dep*	Attempt to substitute $x = 4$ into their $\frac{dy}{dx}$ soi
		$\therefore \frac{k}{4} = \frac{3}{2}$	M1dep*	Equate their gradient expression to negative reciprocal of their gradient of normal
		<i>k</i> = 6	A1 6	cao
	(ii)	<i>P</i> is point (4, 12)	B1 ft	
		<i>Q</i> is point (22, 0)	M1 A1	Correct method to find coordinates of Q Correct x coordinate
		Area of triangle = $\frac{1}{2} \times 12 \times 22$	M1	Must use <i>y</i> coordinate of P and <i>x</i> coordinate of Q
		= 132 sq. units	A1 5 11	