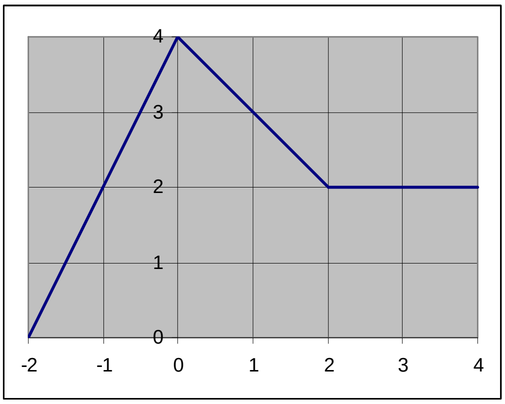
4721 Core Mathematics 1

1		$[(x-6)^2-36]+1$	B1		$(x-6)^2$
		$=(x-6)^2-35$	M1		$q = 1 - (\text{their } p)^2$
			A1	3	$q = -35$
				[3]	
2	(i)		B1		For $x < 0$, straight line joining (–2, 0) and (0, 4)
			B1	2	For $x > 0$, line joining (0,4) to (2, 2) and horizontal line joining (2,2) and (4,2)
	(ii)	Translation	B1		
		1 unit right parallel to x axis	B1	2	Allow: 1 unit right, 1 along the x axis, 1 in x **direction**, allow vector notation e.g. $\begin{pmatrix}1\\0\end{pmatrix}$, 1 unit horizontally
				[4]	
3		$\frac{dy}{dx}=3x^2-8x$	M1		Attempt to differentiate (one of $3x^2$, $-8x$)
			A1		Correct derivative
		When $x = 2$, $\frac{dy}{dx}=-4$	M1		Substitutes $x = 2$ into their $\frac{dy}{dx}$
			A1		
		$\therefore$ Gradient of normal to curve = $\frac{1}{4}$	B1 ft		Must be numerical $= -1 \div$ their m
		$y+1=\frac{1}{4}(x-2)$	M1		Correct equation of straight line through (2, –1), any non-zero numerical gradient
		$x-4y-6=0$	A1	7	Correct equation in required form
				[7]	

4	(i)	$m = 4$	B1	1	May be embedded
	(ii)	$6p^2 = 24$ $p^2 = 4$ $p = 2$ or $p = -2$	M1 A1 A1	 3	$(\pm)6p^2 = 24$ or $36p^4 = 576$
	(iii)	$5^{2n+4} = 25$ $\therefore 2n + 4 = 2$ $n = -1$	M1 M1 A1	 3 7	Addition of indices as powers of 5 Equate powers of 5 or 25
5		$k = \sqrt{x}$ $k^2 - 8k + 13 = 0$	 M1*		 Use a substitution to obtain a quadratic (may be implied by squaring or rooting later) or factorise into 2 brackets each containing $\sqrt{x}$
		$k - 4 = \pm\sqrt{3}$ or $k = \dfrac{8 \pm \sqrt{(-8)^2 - 4\times1\times13}}{2}$	M1 dep A1		Correct method to solve resulting quadratic
		$k = 4 \pm \sqrt{3}$	A1		$k = 4 \pm \sqrt{3}$ or $k = \dfrac{8 \pm \sqrt{12}}{2}$ or $k = 4 \pm \dfrac{\sqrt{12}}{2}$
		$\therefore x = (4 + \sqrt{3})^2$ or $x = (4 - \sqrt{3})^2$	M1 M1		Recognise the need to square to obtain x Correct method for squaring $a + \sqrt{b}$ (3 or 4 term expansion)
		$x = 19 \pm 8\sqrt{3}$ or $19 \pm 4\sqrt{12}$	A1	7 7	
6	(i)	$\dfrac{dy}{dx} = 2x$ When $x = 1$, $\dfrac{dy}{dx} = 2$	B1* B1 dep	 2	
	(ii)	$\dfrac{a^2 + 5 - 6}{a - 1} = 2.3$	M1 A1		uses $\dfrac{y_2 - y_1}{x_2 - x_1}$ correct expression
		$a^2 - 2.3a + 1.3 = 0$ $(a - 1.3)(a - 1) = 0$	M1		correct method to solve a quadratic or correct factorisation and cancelling to get $a + 1 = 2.3$
		$a = 1.3$	A1	4	1.3 only

		Alternative method: Equation of straight line through (1,6) with m = 2.3 found then $a^2 + 5 = 2.3a +$ "c" seen **M1** with $c = 3.7$ **A1** then as main scheme			
	(iii)	A value between 2 and 2.3	**B1**	1 7	2 < value < 2.3 (strict inequality signs)
7	**(i)**	(a) Fig 3 (b) Fig 1 (c) Fig 4	**B1** **B1** **B1**	3	
	(ii)	$-(x-3)^2$	**M1**		Quadratic expression with correct x^2 term and correct y-intercept and/or roots for **their unmatched diagram** (e.g. negative quadratic with y-intercept of –9 or root of 3 for Fig 2)
		$y = -(x-3)^2$	**A1**	2 5	Completely correct equation for **Fig 2**
8	**(i)**	Centre (–3, 2)	**B1**		
		$(x+3)^2 - 9 + (y-2)^2 - 4 - 4 = 0$ $r^2 = 17$	**M1**		Correct method to find r^2
		$r = \sqrt{17}$	**A1**	3	Correct radius
	(ii)	$x^2 + (3x+4)^2 + 6x - 4(3x+4) - 4 = 0$	**M1***		substitute for x/y or attempt to get an equation in 1 variable only
			A1		correct unsimplified expression
		$10x^2 + 18x - 4 = 0$	**A1**		obtain correct 3 term quadratic
		$(5x-1)(x+2) = 0$	**M1 dep**		correct method to solve their quadratic
		$x = \dfrac{1}{5}$ or $x = -2$	**A1**		
		$y = \dfrac{23}{5}$ or $y = -2$	**A1**	6 9	**SR** If A0 A0, one correct pair of values, spotted or from correct factorisation **www** **B1**
9	**(i)**	$f'(x) = -x^{-2} - \dfrac{1}{2}x^{-\frac{1}{2}}$	**M1**		Attempt to differentiate
			A1		$-x^{-2}$ or $-\dfrac{1}{2}kx^{-\frac{1}{2}}$ **www**
			A1	3	Fully correct expression

	(ii)	$f''(x) = 2x^{-3} + \frac{1}{4}x^{-\frac{3}{2}}$	**M1**		Attempt to differentiate their $f'(x)$
			A1 ft		One correctly differentiated term
			A1		Fully correct expression **www** in either part of the question
		$f''(4) = \frac{2}{4^3} + \frac{1}{4}.\frac{1}{8}$	**M1**		Substitution of $x = 4$ into their $f''(x)$
		$= \frac{1}{16}$	**A1**	**5** **8**	oe single fraction **www** in either part of the question
10		$(-30)^2 - 4 \times k \times 25k = 0$	**M1**		Attempts $b^2 - 4ac$ involving k
		$900 - 100k^2 = 0$	**M1**		States their discriminant = 0
		$k = 3$	**B1**		
		or $k = -3$	**B1**	**4** **4**	
11	**(i)**	$P = 2 + x + 3x + 2 + 5x + 5x$ $= 14x + 4$	**M1**		Adds lengths of all 4 edges with attempt to use Pythagoras to find the missing length
			A1	**2**	May be left unsimplified
	(ii)	Area of rectangle = $3x(2+x) = 6x + 3x^2$ Area of triangle $= \frac{1}{2}(3x)(4x) = 6x^2$	**M1**		Correct method – splitting or formula for area of trapezium
		Total area = $9x^2 + 6x$	**A1**	**2**	Convincing working leading to given expression **AG**
	(iii)	$14x + 4 \geq 39$	**B1 ft**		ft on their expression for P from **(i)** unless restarted in **(iii)**. (Allow $>$)
		$\frac{5}{2}$	**B1**		o.e. (e.g. $\frac{35}{14}$) soi by subsequent working
		$9x^2 + 6x < 99$	**B1**		
		$3x^2 + 2x - 33 < 0$			Allow $\leq$
		$(3x+11)(x-3) < 0$	**M1**		Correct method to find critical values
		$\left(-\frac{11}{3} <\right) x < 3$	**B1**		$x < 3$ identified
			M1		root from linear $< x <$ upper root from quadratic
		$\therefore \frac{5}{2} \leq x < 3$	**A1**	**7** **11**	Fully correct including inequality signs or exact equivalent in words **cwo**
		Total		**72**	