Question Number	Scheme	Marks
10. (a)	Sets $30 = 2r^2 + 2r^2\theta + 2r^2\theta$	M1
	Obtains $4r\theta = \frac{30-2r^2}{r}$ oe or $\theta = \frac{30-2r^2}{4r^2}$ oe or $r\theta = \frac{30-2r^2}{4r}$ oe	A1
	Uses $P = 6r + 4r\theta$ with their θ or $...r\theta$ substituted	dM1
	$P = 6r + \frac{30-2r^2}{r} = 4r + \frac{30}{r}$ *	A1*
		(4)
(b)	Differentiates with $r^{-1} \to r^{-2}$	M1
	$\left(\frac{dP}{dr} =\right) 4 - \frac{30}{r^2}$	A1
	Solves $\frac{dP}{dr} = 0 \Rightarrow \left(r = \sqrt{\frac{15}{2}}\right)$ and substitutes to find P	dM1
	$\left(P = 4\sqrt{\frac{15}{2}} + \frac{30\sqrt{2}}{\sqrt{15}} = 2\sqrt{30} + 2\sqrt{30}\right) = 4\sqrt{30}$	A1
		(4)
(c)	e.g. finds $\left(\frac{d^2P}{dr^2} =\right) \frac{60}{r^3} = \frac{60}{"2.7"^3} = ...$	M1
	e.g. states that $\left(\frac{d^2P}{dr^2} =\right)$ awrt $3 > 0$ hence minimum	A1
		(2)
		(10 marks)

Question Number	Scheme	Marks
	$y = x^3 - 4x^{\frac{5}{2}} - kx^{\frac{1}{2}} + 28x - 44$	
7.(a)	$y = x^3 - 4x^{\frac{5}{2}} - kx^{\frac{1}{2}} + 28x - 44 \Rightarrow \left(\frac{dy}{dx}\right) = 3x^2 - 10x^{\frac{3}{2}} - \frac{k}{2}x^{-\frac{1}{2}} + 28$	M1, A1 **(2)**
(b)	Subs $x = 9$ into $\frac{dy}{dx}$ and sets = 0 $\Rightarrow 3\times 81 - 10\times 27 - \frac{k}{6} + 28 = 0$	M1
	$243 - 270 - \frac{k}{6} + 28 = 0 \Rightarrow \frac{k}{6} = 1 \Rightarrow k = 6$ *	A1* **(2)**
(c)	$\int x^3 - 4x^{\frac{5}{2}} - 6x^{\frac{1}{2}} + 28x - 44\,dx = \frac{1}{4}x^4 - \frac{8}{7}x^{\frac{7}{2}} - 4x^{\frac{3}{2}} + 14x^2 - 44x$	M1, A1, A1
	Correct value of $y = -53$ at T	B1
	Shaded area = "53"$\times 9 + \left[\frac{1}{4}x^4 - \frac{8}{7}x^{\frac{7}{2}} - 4x^{\frac{3}{2}} + 14x^2 - 44x\right]_0^9$	dM1
	$= 248$	A1 **(6)** **(10 marks)**

Question Number	Scheme	Marks
3. (i)	$(x-4)^2 \geqslant 2x-9 \Rightarrow x^2 - 10x + 25 \ldots 0$	M1
	$\Rightarrow (x-5)^2 \ldots 0$	A1
	Explains that "square numbers are greater than or equal to zero" hence (as $x \in \mathbb{R}$), $\Rightarrow (x-4)^2 \geqslant 2x-9$ *	A1* **(3)**
(ii)	Shows that it is not true for a value of n Eg. When $n=3$, $2^n + 1 = 8 + 1 = 9$ × Not prime	B1 **(1)** **(4 marks)**

Question Number	Scheme	Marks
4 (a)	$(3+2x)^6$	
	First term 3^6 or 729	B1
	Term in x, x^2 or x^3: Award for one of ${}^6C_5(3)^5(2x)^1$, ${}^6C_4(3)^4(2x)^2$ or ${}^6C_3(3)^3(2x)^3$	M1
	Two of $\ldots+2916x+4860x^2+4320x^3+\ldots$	A1
	$(3+2x)^6=729+2916x+4860x^2+4320x^3+\ldots$	A1
		(4)
(b)	Attempts one correct term $2x^2\times"729"$ **or** $\pm\frac{1}{6x}\times"4320"x^3$	M1
	Attempts to combine the correct two terms $2x^2\times"729"\pm\frac{1}{6x}\times"4320"x^3=\ldots x^2$	dM1
	738 but condone $738x^2$	A1
		(3)
		Total 7