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Question Number	Scheme	Marks
1. (a)	$5x^2$	B1 (1)
(b)	$(25x^4)^{-\frac{3}{2}} = \dfrac{1}{(25x^4)^{\frac{3}{2}}}$ or $(25x^4)^{\frac{3}{2}} = 125x^6$ or better	M1
	$\dfrac{1}{125x^6}$	A1 (2) **(3 marks)**
2.	$(3-x)^6 = 3^6 + 3^5 \times 6 \times (-x) + 3^4 \times \binom{6}{2} \times (-x)^2$	M1
	$= 729, \quad -1458x, \quad +1215x^2$	B1, A1, A1 **(4 marks)**
3. (i)	$(5-\sqrt{8})(1+\sqrt{2})$	
	$= 5 + 5\sqrt{2} - \sqrt{8} - 4$ — Multiplies out brackets correctly.	M1
	$= 5 + 5\sqrt{2} - 2\sqrt{2} - 4$ — $\sqrt{8} = 2\sqrt{2}$, seen or implied at any point.	B1
	$= 1 + 3\sqrt{2}$ — $1 + 3\sqrt{2}$ or $a = 1$ and $b = 3$	A1 (3)
(ii)	Method 1 / Method 2 / Method 3	
	Method 1: **Either** $\sqrt{80} + \dfrac{30}{\sqrt{5}}\left(\dfrac{\sqrt{5}}{\sqrt{5}}\right)$; Method 2: **Or** $\left(\dfrac{\sqrt{400}+30}{\sqrt{5}}\right)\dfrac{\sqrt{5}}{\sqrt{5}}$; Method 3: $\sqrt{80} + \dfrac{\sqrt{900}}{\sqrt{5}} = \sqrt{80} + \sqrt{180}$	M1
	Method 1: $= 4\sqrt{5} + \ldots$; Method 2: $= \left(\dfrac{20+..}{..}\right)\dfrac{..}{..}$; Method 3: $= 4\sqrt{5} + \ldots$	B1
	Method 1: $= 4\sqrt{5} + 6\sqrt{5}$; Method 2: $= \left(\dfrac{50\sqrt{5}}{5}\right)$; Method 3: $= 4\sqrt{5} + 6\sqrt{5}$	
	$= 10\sqrt{5}$	A1 (3) **(6 marks)**
	As this is a "show that" question – all working should be shown.	

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Question Number	Scheme		Marks
4. (a)	$\frac{\mathrm{d}y}{\mathrm{d}x}=10x^4-3x^{-4}$ or $10x^4-\frac{3}{x^4}$		M1 A1 A1
			(3)
(b)	$\left(\int =\right)\ \frac{2x^6}{6}+7x+\frac{x^{-2}}{-2}=\frac{x^6}{3}+7x-\frac{x^{-2}}{2}$		M1 A1 A1
	$+C$		B1
			(4)
			(7 marks)
5.	$\frac{1}{2}\times 0.25\ ;\times\underline{\left\{0.5+0.2+2\left(0.379+0.299+0.242\right)\right\}}$	Outside brackets $\frac{1}{2}\times 0.25$ or $\frac{1}{8}$	B1 aef
		<u>For structure of</u> <u>$\{\ldots\ldots\ldots\ldots\}$;</u>	M1
		Correct expression <u>inside brackets</u> which all must be multiplied by their "outside constant".	<u>A1</u> $\sqrt{}$
	$\left\{=\frac{1}{8}(2.540)\right\}=0.3175$ or 0.318	awrt 0.32	A1
			4 marks
6. (a)	$\mathrm{f}(x)=x^4+x^3+2x^2+ax+b$		
	Attempting $\mathrm{f}(1)$ or $\mathrm{f}(-1)$.		M1
	$\mathrm{f}(1)=1+1+2+a+b=7$ or $4+a+b=7\Rightarrow\ a+b=3$ (as required) **AG**		A1 * cso
			(2)
(b)	Attempting $\mathrm{f}(-2)$ or $\mathrm{f}(2)$.		M1
	$\mathrm{f}(-2)=\underline{16-8+8-2a+b=-8}$ $\{\Rightarrow -2a+b=-24\}$		A1
	Solving both equations simultaneously to get as far as $a=\ldots$ or $b=\ldots$		dM1
	Any one of $a=9$ or $b=-6$		A1
	Both $a=9$ and $b=-6$		A1 cso
			(5)
			(7 marks)

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Question Number	Scheme	Marks
7. (a)	$(a_2 =)\ 6 - c$	B1
		(1)
(b)	$a_3 = 3(\text{their } a_2) - c \quad (= 18 - 4c)$	M1
	$a_1 + a_2 + a_3 = 2 + "(6-c)" + "(18-4c)"$	M1
	"$26 - 5c$" $= 0$	A1ft
	So $c = 5.2$	A1 o.e
		(4)
		(5 marks)
8. (a)	Attempts $b^2 - 4ac$ for $a = (k+3)$, $b = 6$ and their c. $\quad c \neq k$	M1
	$b^2 - 4ac = 6^2 - 4(k+3)(k-5)$	A1
	$-4k^2 + 8k + 96$	B1
	As $b^2 - 4ac > 0$, then $-4k^2 + 8k + 96 > 0$ and so, $k^2 - 2k - 24 < 0$	A1 *
		(4)
(b)	Attempts to solve $k^2 - 2k - 24 = 0$ to give $k =$	M1
	($\Rightarrow$ Critical values, $k = 6, -4$.)	
	$k^2 - 2k - 24 < 0$ gives $-4 < k < 6$	M1 A1
		(3)
		(7 marks)
9. (a)	$\log_3 3x^2 = \log_3 3 + \log_3 x^2$ or $\log y - \log x^2 = \log 3$ or $\log y - \log 3 = \log x^2$	B1
	$\log_3 x^2 = 2\log_3 x$	B1
	Using $\log_3 3 = 1$ and deduces answer.	B1
		(3)
(b)	$3x^2 = 28x - 9$	M1
	Solves $3x^2 - 28x + 9 = 0$ to give $x = \frac{1}{3}$ or $x = 9$	M1 A1
		(3)
		(6 marks)

 PMT

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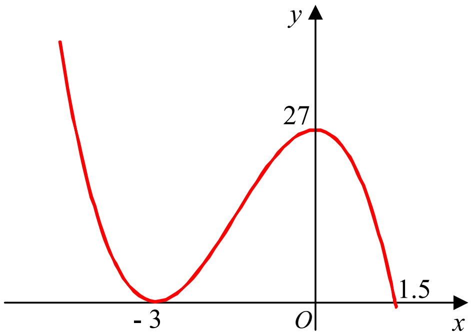
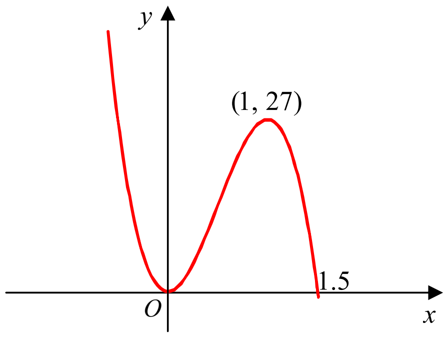
Question Number	Scheme	Marks
10. (a)	{Coordinates of A are} $(4.5, 0)$	B1
(b) i		
	Horizontal translation	M1
	-3 and their ft 1.5 on positive x-axis	A1 ft
	Maximum at 27 marked on the y-axis	B1
		(3)
(b) ii		
	Correct shape, minimum at $(0, 0)$ and a maximum within the first quadrant.	M1
	1.5 on x-axis	A1 ft
	Maximum at $(1, 27)$	B1
		(3)
(c)	$\{k =\}\ -17$	B1
		(1)
		(8 marks)

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Question Number	Scheme		Marks
11. (a)	Curve: $y = -x^2 + 2x + 24$, Line: $y = x + 4$		
	$\{\text{Curve} = \text{Line}\} \Rightarrow -x^2 + 2x + 24 = x + 4$	Eliminating y correctly.	B1
	$x^2 - x - 20\ \{= 0\} \Rightarrow (x-5)(x+4)\ \{= 0\} \Rightarrow x = ...$	Attempt to solve a ***resulting*** quadratic to give x = their values.	M1
	So, $x = 5, -4$	Both $x = 5$ and $x = -4$	A1
	So corresponding y-values are $y = 9$ and $y = 0$		B1ft
			(4)
(b)	$\left\{\int(-x^2 + 2x + 24)\,\mathrm{d}x\right\} = \underline{-\frac{x^3}{3} + \frac{2x^2}{2}} + 24x\ \{+c\}$	M1: $x^n \to x^{n+1}$ for any one term. 1st A1 at least two out of three terms correct. 2nd A1 for <u>correct answer</u>.	M1 A1 A1
	$\left[-\frac{x^3}{3} + \frac{2x^2}{2} + 24x\right]_{-4}^{5} = (......) - (......)$	Substitutes 5 and -4 (or their limits from part (a)) into an "integrated function" and subtracts, either way round.	dM1
	$\left\{\left(-\frac{125}{3} + 25 + 120\right) - \left(\frac{64}{3} + 16 - 96\right) = \left(103\frac{1}{3}\right) - \left(-58\frac{2}{3}\right) = 162\right\}$		
	Area of $\Delta = \frac{1}{2}(9)(9) = 40.5$	Uses correct method for finding area of triangle.	M1
		Area under curve – Area of triangle.	M1
	So area of R is $162 - 40.5 = 121.5$	121.5	A1 oe **cao**
			(7)
			(11 marks)

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Question Number	Scheme	Marks
12. (a)	$(10-2)^2+(7-1)^2$ or $\sqrt{(10-2)^2+(7-1)^2}$	M1 A1
	$(x\pm 2)^2+(y\pm 1)^2=k$ (k a positive value)	M1
	$(x-2)^2+(y-1)^2=100$ (Accept 10^2 for 100)	A1
	(Answer only scores full marks)	(4)
(b)	(Gradient of radius =) $\frac{7-1}{10-2}=\frac{6}{8}$ (or equiv.) Must be seen in part (b)	B1
	Gradient of tangent $=\frac{-4}{3}$ (Using perpendicular gradient method)	M1
	$y-7=m(x-10)$	M1
	$y-7=\frac{-4}{3}(x-10)$ or equivalent (ft gradient of radius, dep. on both M marks)	A1ft
		(4)
(c)	$\sqrt{r^2-\left(\frac{r}{2}\right)^2}$ Condone sign slip if there is evidence of correct use of Pythag.	M1
	$=\sqrt{10^2-5^2}$ or numerically exact equivalent.	A1
	$PQ\left(=2\sqrt{75}\right)=10\sqrt{3}$ Simplest surd form $10\sqrt{3}$ required for final mark.	A1
		(3) **(11 marks)**

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Question Number	Scheme	Marks
13. (a)	$kr^2 + cxy = 4$ or $kr^2 + c[(x+y)^2 - x^2 - y^2] = 4$	M1
	$\frac{1}{4}\pi x^2 + 2xy = 4$	A1
	$y = \dfrac{4 - \frac{1}{4}\pi x^2}{2x} = \dfrac{16 - \pi x^2}{8x}$ *	B1 cso
		(3)
(b)	$P = 2x + cy + k\pi r$ where $c = 2$ or 4 and $k = ¼$ or $½$	M1
	$P = \dfrac{\pi x}{2} + 2x + 4\left(\dfrac{4 - \frac{1}{4}\pi x^2}{2x}\right)$ or $P = \dfrac{\pi x}{2} + 2x + 4\left(\dfrac{16 - \pi x^2}{8x}\right)$ o.e.	A1
	$P = \dfrac{\pi x}{2} + 2x + \dfrac{8}{x} - \dfrac{\pi x}{2}$ so $P = \dfrac{8}{x} + 2x$ *	A1
		(3)
(c)	$\left(\dfrac{dP}{dx} =\right) - \dfrac{8}{x^2} + 2$	M1 A1
	$-\dfrac{8}{x^2} + 2 = 0 \Rightarrow x^2 = ..$	M1
	and so $x = 2$ o.e. (ignore extra answer $x = -2$)	A1
	$P = 4 + 4 = 8$ (m)	B1
		(5)
		(11 marks)

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Question Number	Scheme		Marks
14. (a)	$\sin(x+45^\circ)=\frac{2}{3}$, so $(x+45^\circ)=41.8103...$ $(\alpha=41.8103...)$	$\sin^{-1}\left(\frac{2}{3}\right)$ or awrt 41.8 or awrt 0.73^c	M1
	So, $x+45^\circ=\{138.1897...,\ 401.8103...\}$	$x+45^\circ=$ either "180 − their α" or "360° + their α"	M1
	and $x=\{93.1897...,\ 356.8103...\}$	Either awrt 93.2° or awrt 356.8°	A1
		Both awrt 93.2° and awrt 356.8°	A1
			(4)
(b)	$2(1-\cos^2 x)+2=7\cos x$	Applies $\sin^2 x=1-\cos^2 x$	M1
	$2\cos^2 x+7\cos x-4=0$	Correct 3 term, $2\cos^2 x+7\cos x-4\{=0\}$	A1 oe
	$(2\cos x-1)(\cos x+4)\{=0\}$, $\cos x=...$	Valid attempt at solving and $\cos x=...$	M1
	$\cos x=\frac{1}{2}$, $\{\cos x=-4\}$	$\cos x=\frac{1}{2}$	A1 cso
	$\left(\beta=\frac{\pi}{3}\right)$		
	$x=\frac{\pi}{3}$ or $1.04719...^c$	Either $\frac{\pi}{3}$ or awrt 1.05^c	B1
	$x=\frac{5\pi}{3}$ or $5.23598...^c$	Either $\frac{5\pi}{3}$ or awrt 5.24^c or 2π − their β	B1 ft
			(6)
			(10 marks)

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Question Number	Scheme		Marks
15. (a)	$9^2 = 4^2 + 6^2 - 2\times4\times6\cos\alpha \Rightarrow \cos\alpha = ...$	Correct use of cosine rule leading to a value for cos α	M1
	$\cos\alpha = \dfrac{4^2+6^2-9^2}{2\times4\times6}\left(=-\dfrac{29}{48}=-0.604..\right)$		
	$\alpha = 2.22$ * (NB $\alpha = 2.219516005$)	cso (2.22 must be seen here)	A1 (2)
(b)	$2\pi - 2.22 (= 4.06366......)$	$2\pi - 2.22$ or awrt 4.06	B1
	$\frac{1}{2}\times4^2\times"4.06"$	Correct method for major sector area. Allow $\pi - 2.22$ for the major sector angle.	M1
	32.5	awrt 32.5	A1 (3)
Or (b)	Alternative method: Circle – Minor sector		
	$\pi\times4^2$	Correct expression for circle area.	B1
	$\pi\times4^2 - \dfrac{1}{2}\times4^2\times2.22 = 32.5$	Correct method for circle - minor sector area.	M1
	$= 32.5$	awrt 32.5	A1 (3)
(c)	Area of triangle = $\frac{1}{2}\times4\times6\times\sin2.22 (= 9.56)$	Correct expression for the area of triangle *XYZ*	B1
	So area required = “9.56” + “32.5”	Their Triangle *XYZ* (**Not** triangle *ZXW*) + (part (b) answer or correct attempt at major sector)	M1
	= 42.1 cm^2 or 42.0 cm^2	awrt 42.1 or 42.0 (Or <u>just</u> 42).	A1 (3)
(d)	Arc length $= 4\times4.06 (= 16.24)$ Or $8\pi - 4\times2.22$	M1: $4\times$their$(2\pi - 2.22)$ Or circumference – minor arc A1: Correct ft expression	M1 A1ft
	Perimeter = *ZY* + *WY* + Arc Length	9 + 2 + Any Arc	M1
	Perimeter = 27.2 or 27.3	awrt 27.2 or awrt 27.3	A1 (4) **(12 marks)**

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Question Number	Scheme	Marks
16. (a)	$17\times1.5 = 25.5$(km)	B1
		(1)
(b)	Use $l = a+(n-1)d$ with a = 1.5, d = 0.25 and n = 17	M1
	So l = 5.5	A1
		(2)
(c)	Use $S=\frac{a(1-r^n)}{1-r}$ with a = 1.5, and n = 17	M1
	And r = 1.05	A1
	So S = 38.76(km)	A1
		(3)
(d)	Total distance running is $S=\frac{n}{2}\{2a+(n-1)d\}$	M1
	= 59.5(km)	A1
	So total in three sports is 123.76(km)	B1
		(3)
(e)	Uses $ar^{n-1} > 40$ so $1.5\times(1.05)^{n-1} > 40$ with their r	M1
	$(1.05)^{n-1} > 26.7$ so $(n-1)\log 1.05 > \log 26.7$	M1
	$n - 1 > 67.297$	M1
	So 69th day of training.	A1
		(4)
		(13 marks)