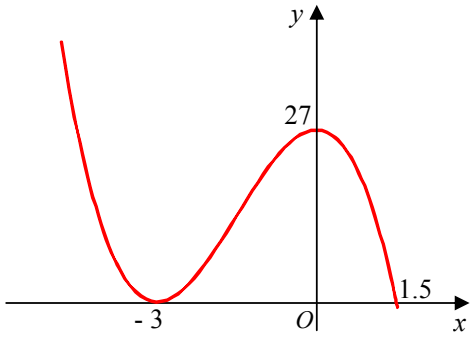
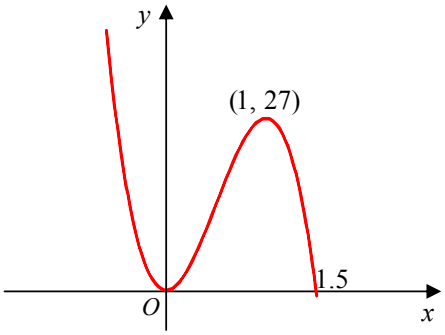
Question Number	Scheme	Marks
1. (a)	$5x^2$	B1 (1)
(b)	$(25x^4)^{-\frac{3}{2}} = \dfrac{1}{(25x^4)^{\frac{3}{2}}}$ or $(25x^4)^{\frac{3}{2}} = 125x^6$ or better	M1
	$\dfrac{1}{125x^6}$	A1 (2) **(3 marks)**
2.	$(3-x)^6 = 3^6 + 3^5\times 6\times(-x) + 3^4\times\binom{6}{2}\times(-x)^2$	M1
	$= 729, \quad -1458x, \quad +1215x^2$	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	
	Either $\sqrt{80} + \dfrac{30}{\sqrt{5}}\left(\dfrac{\sqrt{5}}{\sqrt{5}}\right)$ **Or** $\left(\dfrac{\sqrt{400}+30}{\sqrt{5}}\right)\dfrac{\sqrt{5}}{\sqrt{5}}$ $\sqrt{80} + \dfrac{\sqrt{900}}{\sqrt{5}} = \sqrt{80} + \sqrt{180}$	M1
	$= 4\sqrt{5} + \ldots$ $= \left(\dfrac{20+..}{..}\right)\dfrac{..}{..}$ $= 4\sqrt{5} + \ldots$	B1
	$= 4\sqrt{5} + 6\sqrt{5}$ $= \left(\dfrac{50\sqrt{5}}{5}\right)$ $= 4\sqrt{5} + 6\sqrt{5}$	
	$= 10\sqrt{5}$	A1 (3) **(6 marks)**
	As this is a "show that" question – all working should be shown.	

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

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

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)

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)	$\left\{\int (-x^2 + 2x + 24)\,dx\right\} = -\frac{x^3}{3} + \frac{2x^2}{2} + 24x \{+ c\}$	M1: $x^n \to x^{n+1}$ for any one term. 1st A1 at least two out of three terms correct. 2nd A1 for correct answer.	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
	So area of R is $162 - 40.5 = 121.5$	Area under curve – Area of triangle. 121.5	M1 A1 oe **cao**
			(7) **(11 marks)**

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)**

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)

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
	$\cos x=\frac{1}{2}$, $\{\cos x=-4\}$ $\cos x=\frac{1}{2}$ $\left(\beta=\frac{\pi}{3}\right)$	A1 cso
	$x=\frac{\pi}{3}$ 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)**

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
	$\cos\alpha = \frac{4^2+6^2-9^2}{2\times4\times6}\left(=-\frac{29}{48}=-0.604..\right)$		
	$\alpha = 2.22$ * (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
	$\pi\times4^2 - \frac{1}{2}\times4^2\times2.22 = 32.5$	Correct method for circle - minor sector area.	M1
	$= 32.5$	awrt 32.5	A1 (3)
(c)	Area of triangle = $\frac{1}{2}\times4\times6\times\sin 2.22 \left(=9.56\right)$	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 $= 4\times4.06 \left(=16.24\right)$ Or $8\pi - 4\times2.22$	M1: $4\times$their$\left(2\pi - 2.22\right)$ 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)**

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 $n = 17$ So $l = 5.5$	M1 A1 (2)
(c)	Use $S = \dfrac{a(1-r^n)}{1-r}$ with $a = 1.5$, and $n = 17$ And $r = 1.05$ So $S = 38.76$(km)	M1 A1 A1 (3)
(d)	Total distance running is $S = \frac{n}{2}\{2a + (n-1)d\}$ = 59.5(km) So total in three sports is 123.76(km)	M1 A1 B1 (3)
(e)	Uses $ar^{n-1} > 40$ so $1.5\times(1.05)^{n-1} > 40$ with their r $(1.05)^{n-1} > 26.7$ so $(n-1)\log1.05 > \log 26.7$ $n - 1 > 67.297$ So 69th day of training.	M1 M1 M1 A1 (4) **(13 marks)**