Question Number	Scheme	Marks
1.	$\int \left(2x+3x^{\frac{1}{2}}\right) dx = \frac{2x^2}{2}+\frac{3x^{\frac{3}{2}}}{\frac{3}{2}}$	M1 A1 A1
	$\int_1^4 \left(2x+3x^{\frac{1}{2}}\right) dx = \left[x^2+2x^{\frac{3}{2}}\right]_1^4 = (16+2\times 8)-(1+2)$	M1
	$= 29$ (29 + C scores A0)	A1 (5)
		(5 marks)
2. (a)	$(7\times\ldots\times x)$ or $(21\times\ldots\times x^2)$ The 7 or 21 can be in 'unsimplified' form.	M1
	$(2+kx)^7 = 2^7+2^6\times 7\times kx+2^5\times\binom{7}{2}k^2x^2$	
	$= 128;\ +448kx,\ +672k^2x^2$	B1; A1, A1
	(If $672kx^2$ follows $672(kx)^2$, ignore subsequent working and allow A1)	(4)
(b)	$6\times 448k = 672k^2$	M1
	$k = 4$ (Ignore $k = 0$, if seen)	A1 (2)
		(6 marks)
3. (a)	$f(k) = -8$	B1 (1)
(b)	$f(2) = 4 \Rightarrow\ 4 = (6-2)(2-k)-8$	M1
	So $k = -1$	A1 (2)
(c)	$f(x) = 3x^2-(2+3k)x+(2k-8) = 3x^2+x-10$	M1
	$= (3x-5)(x+2)$	M1 A1 (3)
		(6 marks)
4. (a)	$x = 2$ gives 2.236 (allow AWRT) Accept $\sqrt{5}$	B1
	$x = 2.5$ gives 2.580 (allow AWRT) Accept 2.58	B1 (2)
(b)	$\left(\frac{1}{2}\times\frac{1}{2}\right)$, $[(1.414+3)+2(1.554+1.732+1.957+2.236+2.580)]$	B1,[M1A1ft]
	$= 6.133$ (AWRT 6.13, even following minor slips)	A1 (4)
(c)	Overestimate	B1
	'Since the trapezia lie <u>above the curve</u>', or an equivalent explanation, or sketch of (one or more) trapezia above the curve on a diagram (or on the given diagram, in which case there should be reference to this). (Note that there must be some reference to a trapezium or trapezia in the explanation or diagram).	B1 (2)
		(8 marks)

Question Number	Scheme	Marks
5. (a)	$324r^3 = 96$ or $r^3 = \frac{96}{324}$ or $r^3 = \frac{8}{27}$	M1
	$r = \frac{2}{3}$ (*)	A1cso (2)
(b)	$a\left(\frac{2}{3}\right)^2 = 324$ or $a\left(\frac{2}{3}\right)^5 = 96$ $a = ...$, 729	M1, A1 (2)
(c)	$S_{15} = \frac{729\left(1-\left[\frac{2}{3}\right]^{15}\right)}{1-\frac{2}{3}}$, = 2182.00… (awrt 2180)	M1A1ft, (3)
(d)	$S_\infty = \frac{729}{1-\frac{2}{3}}$, = 2187	M1, A1 (2)
		[9]
		(9 marks)
6. (a)	$(x-3)^2 - 9 + (y+2)^2 - 4 = 12$ Centre is (3, –2)	M1 A1, A1
	$(x-3)^2 + (y+2)^2 = 12 + "9" + "4"$ $r = \sqrt{12+"9"+"4"} = 5$ (or $\sqrt{25}$)	M1 A1 (5)
(b)	$PQ = \sqrt{(7--1)^2 + (-5-1)^2}$ or $\sqrt{8^2+6^2}$	M1
	= 10 = 2 $\times$ radius, $\therefore$ diam. (N.B. For A1, need a comment or conclusion)	A1 (2)
(c)	*R* must lie on the circle (angle in a semicircle theorem)… often <u>implied</u> by <u>a diagram with *R* on the circle</u> or by subsequent working)	B1
	$x = 0 \Rightarrow$ $y^2 + 4y - 12 = 0$	M1
	$(y - 2)(y + 6) = 0$ $y = ...$ (M is dependent on previous M)	
	$y = -6$ or 2 (Ignore $y = -6$ if seen, and 'coordinates' are not required))	M1 A1 (4)
		(11 marks)
7. (i)	$\tan\theta = -1 \Rightarrow$ $\theta = -45$, 135	B1, B1ft
	$\sin\theta = \frac{2}{5} \Rightarrow$ $\theta = 23.6$, 156.4 (AWRT: 24, 156)	B1, B1ft (4)
(ii)	$4\sin x = \frac{3\sin x}{\cos x}$	M1
	$4\sin x\cos x = 3\sin x$ $\Rightarrow$ $\sin x(4\cos x - 3) = 0$	M1
	Other possibilities (after squaring): $\sin^2 x(16\sin^2 x - 7) = 0$, $(16\cos^2 x - 9)(\cos^2 x - 1) = 0$	
	$x = 0$, 180 <u>seen</u>	B1, B1
	$x = 41.4$, 318.6 (awrt: 41, 319)	B1, B1ft (6)
		(10 marks)

Question Number	Scheme	Marks
8. (a)	$\log_2 y = -3 \quad \Rightarrow \quad y = 2^{-3}$	M1
	$y = \frac{1}{8}$ or 0.125	A1 (2)
(b)	$32 = 2^5$ or $16 = 2^4$ or $512 = 2^9$	M1
	[or $\log_2 32 = 5\log_2 2$ or $\log_2 16 = 4\log_2 2$ or $\log_2 512 = 9\log_2 2$]	
	[or $\log_2 32 = \dfrac{\log_{10} 32}{\log_{10} 2}$ or $\log_2 16 = \dfrac{\log_{10} 16}{\log_{10} 2}$ or $\log_2 512 = \dfrac{\log_{10} 512}{\log_{10} 2}$]	
	$\log_2 32 + \log_2 16 = 9$	A1
	$(\log x)^2 = ...$ or $(\log x)(\log x) = ...$ (May not be seen explicitly, so M1 may be implied by later work, and the base may be 10 rather than 2)	M1
	$\log_2 x = 3 \quad \Rightarrow \quad x = 2^3 = 8$	A1
	$\log_2 x = -3 \quad \Rightarrow \quad x = 2^{-3} = \dfrac{1}{8}$	A1ft (5)
		(7 marks)
9. (a)	(Arc length =) $r\theta = r \times 1 = r$. Can be awarded by implication from later work, e.g. $3rh$ or $(2rh + rh)$ in the S formula. (Requires use of $\theta = 1$).	B1
	(Sector area =) $\dfrac{1}{2}r^2\theta = \dfrac{1}{2}r^2 \times 1 = \dfrac{r^2}{2}$. Can be awarded by implication from later work, e.g. the correct volume formula. (Requires use of $\theta = 1$).	B1
	Surface area = 2 sectors + 2 rectangles + curved face $(= r^2 + 3rh)$ (See notes below for what is allowed here)	M1
	Volume = 300 = $\frac{1}{2}r^2h$	B1
	Sub for h: $S = r^2 + 3\times\dfrac{600}{r} = r^2 + \dfrac{1800}{r}$ (*)	A1cso (5)
(b)	$\dfrac{dS}{dr} = 2r - \dfrac{1800}{r^2}$ or $2r - 1800r^{-2}$ or $2r + -1800r^{-2}$	M1A1
	$\dfrac{dS}{dr} = 0 \Rightarrow r^3 = ...,\quad r = \sqrt[3]{900}$, or AWRT 9.7 (NOT -9.7 or ± 9.7)	M1, A1 (4)
(c)	$\dfrac{d^2S}{dr^2} = ...$ and consider sign, $\dfrac{d^2S}{dr^2} = 2 + \dfrac{3600}{r^3} > 0$ so point is a minimum	M1, A1ft (2)
(d)	$S_{min} = (9.65...)^2 + \dfrac{1800}{9.65...}$	
	(Using their value of r, however found, in the <u>given</u> S formula)	M1
	= 279.65… (AWRT: 280) (Dependent on full marks in part (b))	A1 (2)
		(13 marks)