Question Number	Scheme	Marks
8. (a)	$-5 < x < \frac{2}{3}$	M1, A1 **(2)**
(b)	$(2x-7)$	B1 **(1)**
(c)	$f'(x) = 2(3x-2)(x+5) = 6x^2 + 26x - 20$	
	$f(x) = 2x^3 + 13x^2 - 20x + c$	M1, A1
	$x = \frac{7}{2}$, $y / f(x) = 0 \Rightarrow c = (-175)$	dM1, A1
	$f(x) = 2x^3 + 13x^2 - 20x - 175 = (2x-7)(x^2 + 10x + 25)$	ddM1
	$= (2x-7)(x+5)^2$	A1 **(6)** **(9 marks)**

Question Number	Scheme	Marks
4. (a)	$\log_3(a+1) - \log_3 a = 4 \Rightarrow \log_3\left(\frac{a+1}{a}\right) = 4$	M1
	$\Rightarrow \left(\frac{a+1}{a}\right) = 3^4$	A1
	$\Rightarrow a + 1 = 81a \Rightarrow a = \frac{1}{80}$	dM1, A1 **(4)**
(b)	Area $\approx \frac{1}{2}\left\{\log_3\left(\frac{2}{1}\right) + \log_3\left(\frac{6}{5}\right) + 2\left(\log_3\left(\frac{3}{2}\right) + \log_3\left(\frac{4}{3}\right) + \log_3\left(\frac{5}{4}\right)\right)\right\}$	M1, A1
	$= \frac{1}{2}\log_3\left(\frac{2}{1} \times \frac{6}{5} \times \frac{3^2}{2^2} \times \frac{4^2}{3^2} \times \frac{5^2}{4^2}\right) = \frac{1}{2}\log_3 15 = \log_3\sqrt{15}$	dM1, A1 **(4)**
(c)	States 'increase the number of strips'	B1 **(1)** **(9 marks)**

Question Number	Scheme	Marks
10 (a)	$\left(\frac{dy}{dx}=\right) x-2187x^{-\frac{5}{2}}$	M1, A1
	Sets $x-2187x^{-\frac{5}{2}}=0\Rightarrow x^{\frac{7}{2}}=2187$ $\left(\text{or e.g. } x=\left(\sqrt[7]{2187}\right)^2\right)\Rightarrow x=9$ *	dM1A1*
		(4)
(b)	e.g. $\int\left\{\frac{1}{2}x^2+1458x^{-\frac{3}{2}}-74\right\}dx=\frac{1}{6}x^3-2916x^{-\frac{1}{2}}-74x$ or $\int\left\{\frac{1}{2}x^2+1458x^{-\frac{3}{2}}-"94.5"\right\}dx=\frac{1}{6}x^3-2916x^{-\frac{1}{2}}-94.5x$	M1A1ft
	y value at P is 20.5	B1
	e.g. Area $R=\left[\frac{1}{6}x^3-2916x^{-\frac{1}{2}}-74x\right]_4^9-(9-4)\times"20.5"$ $=\left(\frac{1}{6}\times9^3-2916\times9^{-\frac{1}{2}}-74\times9\right)-\left(\frac{1}{6}\times4^3-2916\times4^{-\frac{1}{2}}-74\times4\right)-(9-4)\times"20.5"$	dM1
	$\left(-1516\frac{1}{2}+1743\frac{1}{3}-102\frac{1}{2}\right)=124\frac{1}{3}$	A1
		(5)
		Total 9

Question Number	Scheme	Marks
	$y=\frac{9x^2\left(5-\sqrt{x}\right)}{5}$	
9(a)	$y=9x^2-\frac{9}{5}x^{\frac{5}{2}}\Rightarrow\frac{dy}{dx}=18x-\frac{9}{2}x^{\frac{3}{2}}$	M1, A1
	$18x-\frac{9}{2}x^{\frac{3}{2}}=0\Rightarrow x^{\frac{1}{2}}=(4)$	dM1
	$(16, 460.8)$	A1, A1
		(5)
(b)	$5-\sqrt{x}=0\Rightarrow x=25$	M1, A1
		(2)
(c)	$\int 9x^2-\frac{9}{5}x^{\frac{5}{2}}dx=3x^3-\frac{18}{35}x^{\frac{7}{2}}$	M1A1
	Shaded area $=\underline{(25-16)\times460.8}-\left[3x^3-\frac{18}{35}x^{\frac{7}{2}}\right]_{16}^{25}$	<u>M1</u>, dM1
	$=1312.7$	A1
		(5)
		(12 marks)

Question Number	Scheme	Marks
8 (i)	$\int \frac{8\sqrt{x}-5}{2x^2}\,dx = \int 4x^{-\frac{3}{2}} - \frac{5}{2}x^{-2}\,dx$	B1
	$= -8x^{-\frac{1}{2}} + \frac{5}{2}x^{-1} \quad (+C)$	M1 A1
	$\int_2^4 \left(4x^{-\frac{3}{2}} - \frac{5}{2}x^{-2}\right)dx = \left(-4+\frac{5}{8}\right) - \left(-4\sqrt{2}+\frac{5}{4}\right) = 4\sqrt{2} - \frac{37}{8}$	dM1 A1
		(5)
(ii)	$\int \left(\frac{1}{2}x^2 + k\right)dx = \left[\frac{1}{6}x^3 + kx\right]$	M1 A1
	$\int_{-3}^{6} \left(\frac{1}{2}x^2 + k\right)dx = 55 \Rightarrow \left[\frac{1}{6}x^3 + kx\right]_{-3}^{6} = 55 \Rightarrow (36+6k) - \left(-\frac{9}{2}-3k\right) = 55 \Rightarrow k = \ldots$	dM1
	$k = \frac{29}{18}$	A1
		(4)
		(9 marks)

Question Number	Scheme		Marks
	OPEN TOPPED	**CLOSED CONTAINER**	
3.(a)	$120 = 3x^2y \Rightarrow y = \frac{40}{x^2}$	$120 = 3x^2y \Rightarrow y = \frac{40}{x^2}$	M1, A1
	$A = 3x^2 + 8xy$	$A = 6x^2 + 8xy$	
	$= 3x^2 + 8x \times \frac{40}{x^2} = 3x^2 + \frac{320}{x}$	$= 6x^2 + 8x \times \frac{40}{x^2} = 6x^2 + \frac{320}{x}$	dM1, A1
			(4)
(b)	$\frac{dA}{dx} = 6x - \frac{320}{x^2}$	$\frac{dA}{dx} = 12x - \frac{320}{x^2}$	M1, A1ft
	$\frac{dA}{dx} = 6x - \frac{320}{x^2} = 0$	$\frac{dA}{dx} = 12x - \frac{320}{x^2} = 0$	
	$\Rightarrow x^3 = \frac{160}{3} \Rightarrow x = \text{awrt } 3.76$	$\Rightarrow x^3 = \frac{80}{3} \Rightarrow x = \text{awrt } 2.99$	dM1, A1
			(4)
(c)	Attempts $\left.\frac{d^2A}{dx^2}\right\|_{x=3.76} = 6 + \frac{640}{x^3}$	Attempts $\left.\frac{d^2A}{dx^2}\right\|_{x=2.99} = 12 + \frac{640}{x^3}$	M1
	$= 6 + \frac{640}{3.76^3} = ..$	$= 12 + \frac{640}{2.99^3} = ..$	
	$\left.\frac{d^2A}{dx^2}\right\|_{x=3.76} = \text{awrt } 18 > 0$ MINIMUM*	$\left.\frac{d^2A}{dx^2}\right\|_{x=2.99} = \text{awrt } 36 > 0$ MINIMUM*	A1*
			(2)
			(10 marks)