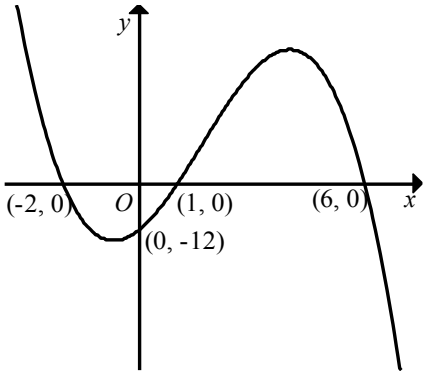
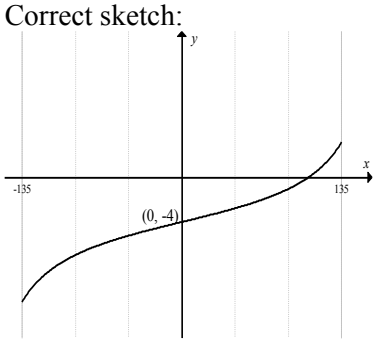
Question	Answer	Marks	Partial Marks
1	Coordinates of mid-point $(-2, 1)$	**B1**	
	$m_{AB} = \frac{9--7}{-8-4}\left[=-\frac{16}{12}\right]$	**B1**	
	$m_{\perp} = \frac{-1}{-16/12}$	**M1**	
	$y-1=\frac{3}{4}(x+2)$ oe	**A1**	
2	Uses b^2-4ac $(-4k)^2-4(4)(2k+3)$ soi	**M1**	
	Correctly simplifies $16k^2-32k-48$	**A1**	**FT** provided of equivalent difficulty
	$16(k+1)(k-3)$ oe	**M1**	
	CV -1, 3	**A1**	
	$-1 < k < 3$	**A1**	**FT** *their* lower CV $< k <$ *their* upper CV
3(a)	Correct sketch  	**B2**	**B1** for correct shape **B1** for correct coordinates (–2, 0), (1, 0), (6, 0) and (0, –12)
3(b)	$-2 \leqslant x \leqslant 1$ and $x \geqslant 6$	**B2**	**B1** for $-2 \leqslant x \leqslant 1$ or $x \geqslant 6$ with no contradictions
4(a)(i)	6720	**B2**	**B1** for $8\times7\times6\times5\times4$ or ${}^8P_5$
4(a)(ii)	2520	**B2**	**B1**for $3\times7\times6\times5\times4$ or ${}^3P_1\times{}^7P_4$
4(b)	${}^4C_1\times{}^5C_2+{}^5C_3$	**M1**	
	50	**A1**	

Question	Answer	Marks	Partial Marks
5(a)	$\frac{\sqrt{128}}{\sqrt{72}}=\frac{\sqrt{64\times2}}{\sqrt{36\times2}}$ or simplifies $\sqrt{\frac{128}{72}}$ to $\sqrt{\frac{16}{9}}$	**M1**	
	correct completion to $\frac{4}{3}$	**A1**	
5(b)	$\frac{3+2\sqrt{3}-\sqrt{3}\left(1+\sqrt{3}\right)}{\left(1+\sqrt{3}\right)\left(3+2\sqrt{3}\right)}$	**M1**	
	$\frac{\sqrt{3}}{3+2\sqrt{3}+3\sqrt{3}+6}$	**M1**	
	$\frac{\sqrt{3}}{9+5\sqrt{3}}\times\frac{9-5\sqrt{3}}{9-5\sqrt{3}}$	**M1**	
	$\frac{9\sqrt{3}-15}{6}$ or equivalent	**A1**	
			Alternative method **M1** for $\frac{1-\sqrt{3}}{(1+\sqrt{3})(1-\sqrt{3})}-\frac{\sqrt{3}(3-2\sqrt{3})}{(3+2\sqrt{3})(3-2\sqrt{3})}$
			M1 for $\frac{1-\sqrt{3}}{1-3}-\frac{3\sqrt{3}-6}{9-12}$
			M1 for writing with a common denominator
			A1 for $\frac{9\sqrt{3}-15}{6}$ or equivalent
6(a)	$a=20$ $b=2$ $c=-3$	**B3**	**B1** for each
6(b)	Correct sketch: 	**B2**	**B1** for correct tan shape with one continuous section only **B1** for correct y-intercept (0, –4)

Question	Answer	Marks	Partial Marks
7(a)	$\ln y = \ln(Ax^n)$ and so $\ln y = \ln A + \ln x^n$	**M1**	
	$\ln y = \ln A + n \ln x$	**A1**	
7(b)	$\ln A = 0.5$	**M1**	
	$A = e^{0.5}$ or 1.6	**A1**	
	$n = \dfrac{1.7 - 0.5}{3.2 - 0}$	**M1**	
	$n = \dfrac{3}{8}$ oe	**A1**	
7(c)	$y = their\, e^{0.5} (11)^{their \frac{3}{8}}$ oe	**M1**	
	4.05 or 4.05200... rot to four or more figs	**A1**	
8(a)	$\sec^2(x+4) - 3\cos x$	**B2**	**B1** for each
8(b)	$\dfrac{d(\ln(2x+5))}{dx} = \dfrac{2}{2x+5}$	**B1**	
	$\dfrac{d(2e^{3x})}{dx} = 6e^{3x}$	**B1**	
	$\dfrac{dy}{dx} =$ $\dfrac{2e^{3x}\left(their \dfrac{2}{2x+5}\right) - their 6e^{3x} \ln(2x+5)}{4e^{6x}}$	**M1**	**FT** *their* derivatives of $\ln(2x+5)$ and $2e^{3x}$
	$\dfrac{dy}{dx} =$ $\dfrac{2e^{3x}\left(\dfrac{2}{2x+5}\right) - 6e^{3x} \ln(2x+5)}{4e^{6x}}$	**A1**	
	$\delta y = their \left.\dfrac{dy}{dx}\right\|_{x=1} \times h$	**M1**	
	$-0.138h$	**A1**	
9(a)	–540	**B2**	**B1** for $\dfrac{6\times5\times4}{3!}(3x)^3\left(-\dfrac{1}{x}\right)^3$ oe

Question	Answer	Marks	Partial Marks
9(b)	$\frac{n(n-1)(n-2)(n-3)(n-4)(n-5)}{6!}\times\left(\frac{1}{2}\right)^6$	**B1**	
	$\frac{n(n-1)(n-2)(n-3)}{4!}\times\left(\frac{1}{2}\right)^4$	**B1**	
	Forms a correct equation with *their* coefficients in terms of n	**M1**	
	Simplifies their equation to $(n-4)(n-5)=240$ or better	**M1**	
	Factorises or attempts to solve *their* 3-term quadratic	**M1**	
	$n=20$	**A1**	
10(a)	$5(1+\tan^2 A)+14\tan A-8=0$ soi	**B1**	
	Solves or factorises *their* 3-term quadratic in tan$A$ oe	**M1**	
	11.3 and 108.4 or 11.30[99...] and 108.43[49...] rot to four or more decimal places	**A2**	with no extras in range; not from clearly wrong working but allow recovery from minor slips or **A1** for either, ignoring extras
10(b)	$4B-\frac{\pi}{8}=\sin^{-1}\left(-\frac{2}{5}\right)$ soi	**B1**	
	–0.411[516...] rot to three or more figs	**M1**	
	–0.00470[444...] rot to three or more figs	**A1**	
	–0.584[344...] rot to three or more figs	**A1**	
11(a)	$R=\frac{1}{2}(w+180)$	**B1**	
	$V=\frac{1}{3}\pi(\textit{their } R)^2(w+180)$ $-\frac{1}{3}\pi(90)^2(180)$	**M1**	
	Correct completion to given answer: $V=\frac{\pi}{12}(w+180)^3-486000\pi$	**A1**	

Question	Answer	Marks	Partial Marks
11(b)	$\frac{dV}{dw} = 3\frac{\pi}{12}(w+180)^2$ oe	**B1**	
	$\frac{dw}{dt} = \frac{dw}{dV} \times \frac{dV}{dt}$ soi	**M1**	
	$\frac{dw}{dt} = \frac{1}{their\left(\frac{dV}{dw}\right)\Big\vert_{w=10}} \times 10000$	**M1**	
	0.353 [cms^{-1}] or 0.3526[97...] [cms^{-1}] rot to four or more figs	**A1**	
12(a)(i)	$\frac{-(-\sin x)}{\cos^2 x}$ oe	**B2**	**B1** for $\frac{-\sin x}{\cos^2 x}$ oe
	Correct completion to given answer: tan$x$sec$x$	**B1**	dep on all previous marks having been awarded
12(a)(ii)	$\sqrt[4]{e^{3x}} = e^{\frac{3x}{4}}$ oe	**B1**	
	$\frac{3}{\cos x} - \int e^{\frac{3x}{4}} dx = \frac{3}{\cos x} - ke^{\frac{3x}{4}}$ oe	**M1**	
	$\frac{3}{\cos x} - \frac{4}{3}e^{\frac{3x}{4}} + c$ oe	**A1**	
12(b)	$\left[\ln(px+10)\right]_2^5 = \ln 2$	**M1**	
	$\ln(5p+10) - \ln(2p+10) = \ln 2$	**M1**	
	$\ln\left(\frac{5p+10}{2p+10}\right) = \ln 2$	**M1**	
	$5p+10 = 2(2p+10)$	**M1**	
	$p = 10$	**A1**	