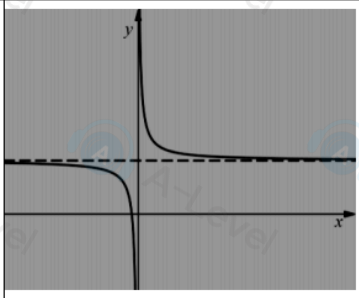
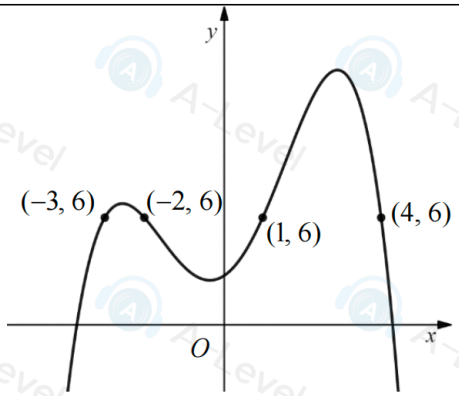
Question Number	Scheme	Marks
6. (a)	 Shape States asymptote as $y=k$ States intercept as $-\frac{4}{k}$	B1 B1 B1 **(3)**
(b)	$10-2x=\frac{4}{x}+k \Rightarrow 10x-2x^2=4+kx$ $\Rightarrow 2x^2+(k-10)x+4=0$ Attempts "b^2-4ac" $=0 \Rightarrow (k-10)^2-4\times2\times4=0$ $k=10\pm4\sqrt{2}$ oe	M1 A1 M1 M1 A1 **(5)** **(8 marks)**

Question Number	Scheme	Marks
1.	$\int\left(\frac{1}{2}x^3+\frac{3}{\sqrt{x}}-4\right)dx=\frac{1}{2}\times\frac{x^4}{4}+3\times\frac{x^{\frac{1}{2}}}{\frac{1}{2}}-4x+c$ $=\frac{1}{8}x^4+6x^{\frac{1}{2}}-4x+c$	M1, A1 A1, A1 **(4 marks)**

Question Number	Scheme	Marks
10(a)	$m=\frac{4}{5}$	B1
	$y+3=\frac{4}{5}(x-4)$ or $-3=\frac{4}{5}\times 4+c\Rightarrow c=...$	M1
	$y=\frac{4}{5}x-\frac{31}{5}$	A1
		(3)
(b)	$f'(4)=\frac{4}{5}\Rightarrow\frac{k\sqrt{4}(4-3)}{5}=\frac{4}{5}\Rightarrow k=...$	M1
	$k=2$	A1
		(2)
(c)	$(f'(x)=)\frac{2\sqrt{x}(x-3)}{5}=\frac{2x^{\frac{3}{2}}}{5}-\frac{6x^{\frac{1}{2}}}{5}$	M1
	$(f(x)=)\frac{4x^{\frac{5}{2}}}{25}-\frac{4x^{\frac{3}{2}}}{5}(+c)$	M1 A1ft
	$x=4, y=-3\Rightarrow -3=\frac{4(4)^{\frac{5}{2}}}{25}-\frac{4(4)^{\frac{3}{2}}}{5}+c\Rightarrow c=\left(-\frac{43}{25}\right)$	ddM1
	$(f(x)=)\frac{4x^{\frac{5}{2}}}{25}-\frac{4x^{\frac{3}{2}}}{5}-\frac{43}{25}$	A1
		(5)
		(10 marks)

Question Number	Scheme	Marks
7(a)	$-1<x<2$	M1A1
	$x<-4,\ x>3$	B1
		(3)
(b)	$(x=)\ 1.5$	B1
		(1)
(c)(i)		B1B1B1
(ii)	$-3\ ,,\ x\ ,,\ -2$	B1
		(4)
		(8 marks)

Question Number	Scheme	Marks
	$y=\frac{1}{2}x^4-3+\frac{10}{x^2}$	
5(a)	$\left(\int \frac{1}{2}x^4-3+\frac{10}{x^2}\,dx=\right)\frac{1}{10}x^5-3x-\frac{10}{x}+c$	M1A1A1
		(3)
(b)(i)	$\left(\frac{dy}{dx}=\right)2x^3-\frac{20}{x^3}$	M1A1A1
		(3)
(b)(ii)	$2x^3-\frac{20}{x^3}=3\Rightarrow 2x^6-20=3x^3$	M1
	$2x^6-3x^3-20=0\Rightarrow\left(2x^3+5\right)\left(x^3-4\right)=0\Rightarrow x^3=...\Rightarrow x=...$ or e.g. $x^3=a\Rightarrow(2a+5)(a-4)=0\Rightarrow a=...\Rightarrow x^3=...\Rightarrow x=...$	dM1
	$\Rightarrow x=-\sqrt[3]{\frac{5}{2}},\quad \sqrt[3]{4}$	A1A1
		(4)
		(10 marks)

Question Number	Scheme	Marks
8 (a)	States or implies that gradient of tangent is 24	B1
	Solves $f'(3)=24$ to find k. E.g $4\times3^2+k\times3+3=24\Rightarrow k=...$	M1
	$3k+39=24\Rightarrow k=\frac{24-39}{3}=-5$ *	A1*
		(3)
(b)	$f'(x)=4x^2-5x+3\Rightarrow f(x)=\frac{4}{3}x^3-\frac{5}{2}x^2+3x+c$	M1 A1
	Substitutes $x=3, y=-\frac{3}{24}+5$ into $y=f(x)$ to find "c"	dM1
	$f(x)=\frac{4}{3}x^3-\frac{5}{2}x^2+3x-\frac{141}{8}$	A1
		(4)
		(7 marks)

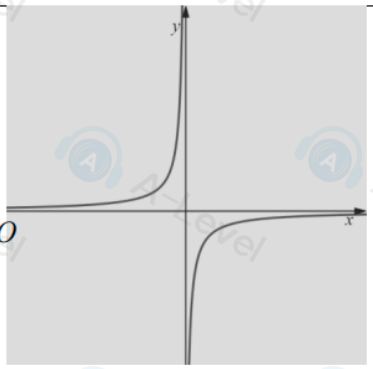
Question Number	Scheme	Marks
9 (a)	$x \ldots -5$	B1 **(1)**
(b)	$f(x) = (x+5)\left(3x^2 - 4x + 20\right) = 3x^3 + 11x^2 + 100$	M1
	$f'(x) = 9x^2 + 22x$	M1 A1cso **(3)**
(c)	Finds $f'(-4) = 9\times\left(-4\right)^2 + 22\times -4 = \left(56\right)$	M1
	Sets $f'(x) = "9x^2 + 22x" = "56"$	dM1
	$9x^2 + 22x - 56 = 0 \Rightarrow x = \frac{14}{9}, \left(-4\right)$	ddM1 A1cso **(4)**
(d)(i)	$\left(-1, 84\right)$	B1
(ii)	$\left(-4, 336\right)$	B1 **(2)** **(10 marks)**

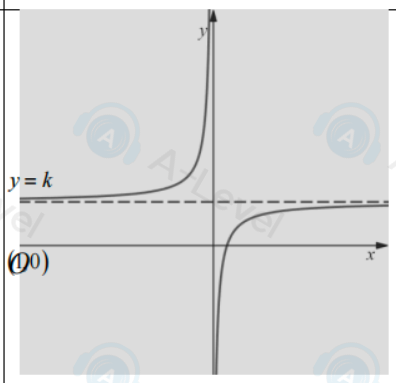
Question Number	Scheme	Marks
1.	$\int 12x^3 + \frac{1}{6\sqrt{x}} - \frac{3}{2x^4}\,dx = 12\times\frac{x^4}{4} + \frac{1}{6}\times 2x^{\frac{1}{2}} - \frac{3}{2}\times\frac{x^{-3}}{-3}$	M1
	$= 3x^4 + \frac{1}{3}x^{\frac{1}{2}} + \frac{1}{2}x^{-3} + c$	A1A1A1A1
		(5)
		(5 marks)

Question Number	Scheme	Marks
11 (a)	Gradient of normal $= \frac{1}{4}$	B1
	Equation of normal $(y+50) = "\frac{1}{4}"(x-4) \Rightarrow y = \frac{1}{4}x - 51$	M1 A1 **(3)**
(b)	$\left(f''(x) = \right) \frac{6}{\sqrt{x^3}} + x = 6x^{-\frac{3}{2}} + x \Rightarrow f'(x) = -12x^{-\frac{1}{2}} + \frac{1}{2}x^2 + k$	M1 A1
	Substitutes $x = 4,\ f'(x) = -4 \Rightarrow k = -6$	dM1 A1
	$\left(f'(x) = \right) -12x^{-\frac{1}{2}} + \frac{1}{2}x^2 - 6 \Rightarrow \left(f(x) = \right) -24x^{\frac{1}{2}} + \frac{1}{6}x^3 - 6x + d$	dM1 A1ft
	Substitutes $x = 4,\ f(x) = -50 \Rightarrow d = \frac{34}{3}$	dddM1
	$\left(f(x) = \right) -24x^{\frac{1}{2}} + \frac{1}{6}x^3 - 6x + \frac{34}{3}$	A1 **(8)** **(11 marks)**

Question Number	Scheme	Marks
6 (a)	$\frac{\sin CAO}{17}=\frac{\sin 0.6}{15}\Rightarrow CAO=0.6944...$	M1
	Angle $COA=\pi-0.6-"0.6944"=1.847$ *	dM1, A1* **(3)**
(b)	Attempts $\frac{1}{2}r^2\theta=\frac{1}{2}\times15^2\times\theta$ where $\theta=\left(2\pi-1.847\right)$ or just 1.847 OR attempts $\frac{1}{2}ab\sin C=\frac{1}{2}\times15\times17\sin\left(1.847\right)$	M1
	Attempts $\frac{1}{2}r^2\theta=\frac{1}{2}\times15^2\times\left(2\pi-1.847\right)\left(\approx499\right)$ AND $\frac{1}{2}ab\sin C=\frac{1}{2}\times15\times17\sin\left(1.847\right)\left(\approx122.7\right)$ AND adds	dM1
	(awrt) 622 m^2	A1 **(3)**
(c)	$r\theta=15\times\theta$ where $\theta=\left(2\pi-1.847\right)$ or just 1.847 OR $\left(AC^2=\right)15^2+17^2-2\times15\times17\cos\left(1.847\right)\left(\approx653\right)$	M1
	Attempts $r\theta=15\times\left(2\pi-1.847\right)\left(=66.54\right)$ AND $\left\{AC=\right\}\sqrt{15^2+17^2-2\times15\times17\cos\left(1.847\right)}$	dM1
	92.1 + 2 = (awrt) 94.1 m	A1 **(3)** **(9 marks)**

Question	Scheme	Marks
8(a)	$y=\left(x-2\right)\left(x^2-8x+16\right)\Rightarrow y=x^3-8x^2+16x-2x^2+16x-32\Rightarrow$ $y=x^3\pm...x^2\pm...x\pm32$	M1
	$=x^3-10x^2+32x-32$	A1
	$\frac{dy}{dx}=3x^2-20x+32$*	M1A1*
		(4)
(b)	$x=6\Rightarrow y=\left(6-2\right)\left(6-4\right)^2=16$	B1
	$\frac{dy}{dx}=3\left(6\right)^2-20\left(6\right)+32=20$	B1
	$y-"16"="20"\left(x-6\right)$	M1
	$y=20x-104$	A1
		(4)
(c)	$3x^2-20x+32="20"\Rightarrow3x^2-20x+12=0$	M1
	$3x^2-20x+12=0\Rightarrow\left(3x-2\right)\left(x-6\right)=0\Rightarrow x=...$	dM1
	$\alpha=\frac{2}{3}$	A1
		(3)
		(11 marks)

Question Number	Scheme	Marks
6.(a)	 Negative reciprocal shape Fully correct	M1 A1 **(2)**

Question Number	Scheme	Marks
(b)	 Graph is part (a) translated ↑ Correct asymptote or intercept Correct asymptote and intercept	B1ft B1 B1 **(3)**
(c)	Sets $3x+4=-\frac{k}{x}+k \Rightarrow 3x^2+(4-k)x+k=0$ Attempts use $b^2-4ac=0$ to find the critical values Uses $b^2-4ac<0$ and selects inside region for critical values $10-2\sqrt{21}<k<10+2\sqrt{21}$	M1, A1 M1 dM1 A1 **(5)** **(10 marks)**