Question Number	Scheme	Marks
4 (a)	$2\times4^{x}-2^{x+3}=17\times2^{x-1}-4$	
	Uses an index law and states or implies any of $4^{x}=p^{2},\quad 2^{x+3}=8p \quad \text{or} \quad 2^{x-1}=\frac{p}{2}$	B1
	Writes the given equation in terms of p $2\times4^{x}-2^{x+3}=17\times2^{x-1}-4\Rightarrow 2p^{2}-2^{3}\times p=\frac{17p}{2^{1}}-4$	M1
	Proceeds to $4p^{2}-33p+8=0$ via $2p^{2}-8p=\frac{17p}{2}-4$ * CSO	A1*
		(3)
(b)	$4p^{2}-33p+8=0\Rightarrow(4p-1)(p-8)=0\Rightarrow p=...,...$	M1
	Sets $2^{x}=\frac{1}{4},8\Rightarrow x=...$	M1
	$x=-2,3$	A1
		(3)
		(6 marks)

Question Number	Scheme	Marks
5(a)	$x^{n}\rightarrow x^{n-1}$	M1
	$\left(\frac{dy}{dx}=\right)12x^{2}-\frac{2}{x^{2}}$	A1
		(2)
(b)	$12x^{2}-\frac{2}{x^{2}}=-5\Rightarrow ...\Rightarrow 12x^{4}+5x^{2}-2=0$ *	M1A1*
		(2)
(c)	$12x^{4}+5x^{2}-2=0\Rightarrow(4x^{2}-1)(3x^{2}+2)=0\Rightarrow x^{2}=\frac{1}{4}\rightarrow x=\frac{1}{2}\quad(x>0)$	M1
	$y=4\left(\frac{1}{2}\right)^{3}+\frac{2}{\left(\frac{1}{2}\right)}+9=...\left(=\frac{27}{2}\right)$	M1
	$k="\frac{27}{2}"+5\times"\frac{1}{2}"=...$	dM1
	$k=16$	A1
		(4)
		(8 marks)

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

Question	Scheme	Marks
7(a)(i)	$f(x)=2x^3-kx^2+14x+24 \Rightarrow (f'(x)=)6x^2-2kx+14$	M1A1
	$(f''(x)=)12x-2k$	A1ft
(ii)		**(3)**
(b)	$6x^2-2kx+14=12x-2k \Rightarrow 6(5)^2-2k(5)+14=12(5)-2k \Rightarrow k=...$	M1
	$k=13$	A1
		(2)
(c)	$k=13 \Rightarrow 6x^2-38x+40=0 \Rightarrow x=...$	M1
	$x="\frac{4}{3}" \Rightarrow y=12\left("\frac{4}{3}"\right)-2\times13$ or $y=6\left("\frac{4}{3}"\right)^2-2\times13\times\left("\frac{4}{3}"\right)+14$	M1
	$x=\frac{4}{3},\ y=-10$	A1
		(3)
		Total 8

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

	$-a+6a+8+a^2=32 \Rightarrow a^2+5a-24=0$	M1
	$(a+8)(a-3)=0$	dM1
	$a=3$ or $a=-8$ and chooses $a=3$ with reason *	A1* cso
		(3)
(ii)	$3x^3+26x^2-9x=0 \Rightarrow x(3x^2+26x-9)=0$	M1
	$x(3x-1)(x+9)$	
	$(x=)\ 0, \frac{1}{3}, -9$	A1
		(2)
(b)(i)	$(y=)\ 0$	B1
	$y^{\frac{1}{3}}="\frac{1}{3}"$ or $y^{\frac{1}{3}}="-9" \Rightarrow y=...$ (or $(-9)^3=...$ or $\left(\frac{1}{3}\right)^3=...$)	M1
	$(y=)\ \frac{1}{27},\ -729$	A1
		(3)
(b)(ii)	$9^z="\frac{1}{3}" \rightarrow z=...$	M1
	$(z=)\ -\frac{1}{2}$ only	A1
		(2)
		(10 marks)

Question Number	Scheme	Marks
7.(a)	Attempts $\frac{dy}{dx}=4x$ at $x=2$	M1
	At $x=2$ gradient of tangent $=8$	A1
		(2)
(b)	$(y_Q=)\ 2(2+h)^2+5$	B1
	Gradient $PQ=\frac{\text{their } y_Q-13}{2+h-2}$	M1
	$\left(=\frac{8h+2h^2}{h}\right)=8+2h$	A1
		(3)
(c)	States as $h \rightarrow 0$ Gradient $PQ \rightarrow 8$ = Gradient of tangent	B1
		(1)
		(6 marks)

Question Number	Scheme	Marks
1	$y = 2 + 10x^{\frac{1}{2}} - 2x^{\frac{3}{2}}$	
(a)	$\frac{dy}{dx} = 5x^{-\frac{1}{2}} - 3x^{\frac{1}{2}}$	M1 A1 A1
		(3)
(b)	$x = 2 \Rightarrow \quad \frac{dy}{dx} = \frac{5}{\sqrt{2}} - 3\sqrt{2}$	M1
	$\frac{5}{\sqrt{2}} - 3\sqrt{2} = \frac{5}{2}\sqrt{2} - 3\sqrt{2} = -\frac{1}{2}\sqrt{2}$	A1
		(2)
		(5 marks)

Question Number	Scheme	Marks
8(a)	$y = 3x + "c"$ or $y = "m"x - 12'$	M1
	$y = 3x - 12$	A1
		(2)
(b)	$k = 10$	B1
		(1)
(c)	E.g. $y = A(x-4)(x-10)$ or $y = C(x-7)^2 - 18$	M1
	E.g. $-18 = A(7-4)(7-10) \Rightarrow A = \ldots$ Or $0 = C(4-7)^2 - 18 \Rightarrow C = \ldots$	dM1
	$y = 2(x-4)(x-10)$, $y = 2(x-7)^2 - 18$ o.e.	A1
		(3)
(d)	Two of $y > 3x - 12$, $y < 2(x-4)(x-10)$, $x > 0$, $x < 4$	M1
	E.g. $3x - 12 < y < 2(x-4)(x-10)$, $0 < x < 4$	A1
		(2)
		(8 marks)

Question Number	Scheme	Marks
7. (a)	$2x-3\sqrt{x}-5=9 \Rightarrow 2x-3\sqrt{x}-14=0$ and treats as quadratic equation	M1
	$\Rightarrow \left(2\sqrt{x}-7\right)\left(\sqrt{x}+2\right)=0 \Rightarrow \left(\sqrt{x}=\right)\frac{7}{2},(-2)$	A1
	$\Rightarrow x=\left(\frac{7}{2}\right)^2=\frac{49}{4}$	dM1 A1
		(4)
(b)	$\left(f'(x)=\right)\ 2-\frac{3}{2}x^{-\frac{1}{2}}$	B1

Question Number	Scheme	Marks
	$\left(f''(x)=\right)\ \frac{3}{4}x^{-\frac{3}{2}}$	M1 A1
	Attempts $\frac{3}{4}x^{-\frac{3}{2}}=6 \Rightarrow x^{-\frac{3}{2}}=8 \Rightarrow x=\frac{1}{4}$	dM1 A1
		(5)
		(9 marks)

Question Number	Scheme	Marks
11a	$2(x\pm...)^2$	B1
	$...(x\pm3)^2...$	M1
	$2(x-3)^2-4$	A1
		(3)
b	$(3,-4)$	B1ft
		(1)
c	$m=\frac{28--4}{-1-3}\ (=-8)$	M1
	$y-28=-8(x+1)$	dM1
	$y=-8x+20$	A1
		(3)
d	$y\leqslant$ "$-8x+20$" and $y\geqslant 2x^2-12x+14$ (or $y\geqslant$ "$2(x-3)^2-4$")	B1ftB1ft
	$y\leqslant -8x+20$ $\quad y\geqslant 2x^2-12x+14$ $\quad y\geqslant 0,\ x\geqslant 0$	B1cso
		(3)
		(10 marks)

Question Number	Scheme	Marks
3.(a)	Attempts $\left(\frac{dy}{dx}=\right) 2x+3$ at $x=3$	M1
	At $x=3$ gradient of tangent $=9$	A1
		(2)
(b)	$\left(y_Q=\right)\ (3+h)^2+3(3+h)-2$	B1
	Gradient $PQ=\frac{(3+h)^2+3(3+h)-2-16}{3+h-3}=\frac{9h+h^2}{h}=9+h$	M1 A1
		(3)
(c)	States as $h\to 0$ Gradient $PQ\to 9$ = Gradient of tangent	B1
		(1)
		(6 marks)

Question Number	Scheme	Marks
5 (a)	$9x^3-10x^2+x=x\left(9x^2-10x+1\right)=x(ax\pm 1)(bx\pm 1)$ with $ab=9$	M1
	$=x(9x-1)(x-1)$	A1
		(2)
(b)	States or implies that $x=3^y$ AND sets = to their 1 or $\frac{1}{9}$	M1
	Solves their $3^y=$"1" or $3^y=$"$\frac{1}{9}$"	dM1
	$y=0,-2$	A1
		(3)
		(5 marks)