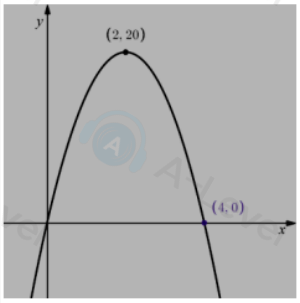
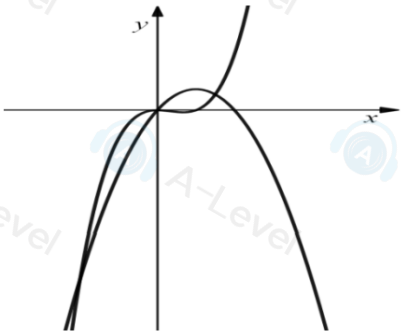
Question Number	Scheme	Marks
9 (a)		
	Correct shape and position passing through (0, 0)	B1
	Intersection at (4, 0)	B1
		(2)
(b)	Attempts form of equation. E.g. $y = Ax(x-4)$ or $y = 20 \pm C(x-2)^2$	M1
	Full attempt to find equation. E.g. $20 = A \times 2(2-4) \Rightarrow A = ...$	dM1
	Or $0 = 20 + C(4-2)^2 \Rightarrow C = ...$	
	$y = -5x(x-4)$, $y = 20 - 5(x-2)^2$ o.e.	A1
		(3)
(c)	Sets $x\left(x^2-4\right) = "-5x(x-4)"$	M1
	$x^3 + 5x^2 - 24x = 0 \Rightarrow x\left(x^2 + 5x - 24\right) = 0$	dM1
	$(x+8)(x-3) = 0 \Rightarrow x$ coordinate of P is -8	ddM1, A1
	$P = \left(-8, -480\right)$	A1
		(5)
		(10 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)	$12x^4 + 5x^2 - 2 = 0 \Rightarrow (4x^2 - 1)(3x^2 + 2) = 0 \Rightarrow x^2 = \frac{1}{4} \rightarrow x = \frac{1}{2}$ $(x > 0)$	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 Number	Scheme	Marks
4 (a)	States or implies that $\left[f(x)=\right]kx(x-4)$	M1
	Attempts to find k. E.g. $-4.8=k\times2\times(2-4)\Rightarrow k=...$	dM1
	$\left[f(x)=\right]1.2x(x-4)$	A1
		(3)
(b)	States or implies that $\left[g(x)=\right]\lambda x(x-4)^2$	M1
	Attempts to find λ . E.g. $7.2=\lambda\times6\times(6-4)^2\Rightarrow\lambda=...$	dM1
	$\left[g(x)=\right]0.3x(x-4)^2$	A1
		(3)
(c)	Sets their $1.2x(x-4)=0.3x(x-4)^2$	B1ft
	Valid attempt to solve $1.2\cancel{x}\cancel{(x-4)}=0.3\cancel{x}(x-4)^{\cancel{2}}\Rightarrow x=4+\frac{1.2}{0.3}$	M1
	$x=8$	A1
	$(8, 38.4)$	A1
		(4)
		(10 marks)

Question Number	Scheme	Marks
3(a)	$(f(x)=)-3\cos x$ or $(f(x)=)3\sin(x-90°)$	M1 A1
		(2)
(b)(i)	8	B1
(ii)	5	B1
		(2)
		(4 marks)

Question Number	Scheme	Marks
5.(a)	$\frac{dy}{dx}=\frac{1}{2}x^2+2x^{-\frac{1}{2}}$	M1A1 A1
		(3)
(b)	$\left.\frac{dy}{dx}\right\|_{x=4}=\frac{1}{2}\times4^2+2\times\frac{1}{\sqrt{4}}=(9)$	M1
	Gradient of normal is $-\frac{1}{9}$	dM1
	$y-\frac{11}{3}=-\frac{1}{9}(x-4)\Rightarrow x+9y-37=0$	M1 A1
		(4)
		(7 marks)

Question Number	Scheme	Marks
7 (a)	States or implies that $f(x)=\lambda x^2(x-4)$	M1
	Attempts to find λ. E.g. $120=\lambda 10^2(10-4)\Rightarrow\lambda=...$	dM1
	$\{f(x)=\}0.2x^2(x-4)$	A1
		(3)
(b)		
	"Upside down" parabola	M1
	Passing through O and +ve x axis > 4	A1
		(2)
(c)	Sets $1.2x(8-x)=$ their $0.2x^2(x-4)$	B1ft
	$1.2x(8-x)=0.2x^2(x-4)\Rightarrow x\left(x^2+2x-48\right)=0$ or $\Rightarrow x^3+2x^2-48x=0$	M1
	$\Rightarrow x=...,...(,0)$	dM1
	For $x=-8,0,6$ OR one of $(-8,-153.6),(6,14.4)$	A1
	All of $(-8,-153.6),(6,14.4),(0,0)$ $\left\{\left(-8,-\frac{768}{5}\right),\left(6,\frac{72}{5}\right),(0,0)\right\}$	A1
		(5)
		(10 marks)

Question	Scheme	Marks
6(a)	$2xy-3x^2=50;\ y-x^3+6x=0$	
	$\Rightarrow 2x\left(x^3-6x\right)-3x^2=50$	**M1**
	$\Rightarrow 2x^4-12x^2-3x^2-50=0\Rightarrow 2x^4-15x^2-50=0$* CSO	**A1***
		(2)
(b)	$\Rightarrow\left(2x^2+5\right)\left(x^2-10\right)=0\Rightarrow x^2=...$	**M1**
	So $x^2=10$	**A1**
	$\Rightarrow y=\left(\sqrt{10}\right)^3-6\sqrt{10}=...$	**M1**
	one solution pair is $x=\sqrt{10}, y=4\sqrt{10}$	**A1**
	Solutions are $x=\sqrt{10}, y=4\sqrt{10}$ and $x=-\sqrt{10}, y=-4\sqrt{10}$ CSO	**A1**
		(5)
		(7 marks)

Question Number	Scheme	Marks
8(a)	$3x^2+6x+9=3(x\pm\ldots)^2\pm\ldots \qquad a=3$	B1
	$3x^2+6x+9=3(x+1)^2\pm\ldots \qquad a=3 \ \&\ b=1$	M1
	$3x^2+6x+9=3(x+1)^2+6$	A1
		(3)
(b)	$(-1,\ 6)$	B1ft
		(1)
(c)	$y=\alpha(x+4)(x+2)(x-3)$	B1
	$6=\alpha(-1+4)(-1+2)(-1-3)$	M1
	$\alpha=-\frac{1}{2}$	A1
	$y="-\frac{1}{2}"(x+4)(x+2)(x-3)\Rightarrow y=\ldots x^3+\ldots x^2+\ldots x+\ldots$	M1
	$A=-\frac{1}{2},\ B=-\frac{3}{2},\ C=5,\ D=12$	A1
		(5)
Alt (c)	$-64A+16B-4C+D=0$ $-8A+4B-2C+D=0$ $27A+9B+3C+D=0$	B1
	$-A+B-C+D=6$	M1
	One of $A=-\frac{1}{2},\ B=-\frac{3}{2},\ C=5,\ D=12$	A1
	Fully solves their simultaneous equations	M1
	$A=-\frac{1}{2},\ B=-\frac{3}{2},\ C=5,\ D=12$	A1
		(9 marks)

Question Number	Scheme	Marks
3.(a)	$\left(\frac{dy}{dx}\right) = 3x^2 + \frac{48}{\sqrt{x}}$	M1, A1, A1 **(3)**
(b)	$\left(\frac{d^2y}{dx^2}\right) = 6x - \frac{24}{x^{\frac{3}{2}}}$	M1
	$\Rightarrow x^{\frac{5}{2}} = \ldots \qquad x = 2^{\frac{4}{5}}$	dM1 A1 **(3)** **(6 marks)**

Question Number	Scheme	Marks
1.	$\int \frac{2}{3}x^3 - \frac{1}{2x^3} + 5\,dx = \frac{2}{3}\times\frac{x^4}{4} - \frac{1}{2}\times\frac{x^{-2}}{-2} + 5x + c$	M1 A1
	$= \frac{1}{6}x^4 + \frac{1}{4}x^{-2} + 5x + c$	A1 A1 **(4 marks)**

Question Number	Scheme	Marks
8(a)	$m = \frac{18-0}{2--3}$	M1
	$y - 18 = \frac{18}{5}(x-2)$ or e.g. $y = \frac{18}{5}(x+3)$ or $18 = \frac{18}{5}(2) + c \Rightarrow c = \ldots$ or e.g. $0 = \frac{18}{5}(-3) + c \Rightarrow c = \ldots$	dM1
	$y = \frac{18}{5}x + \frac{54}{5}$	A1
		(3)
(b)	Examples: $y = ax^2 + bx - 6$; $y = (x+3)(px+q)$; $y = ax^2 + bx + c, (0,-6), (2,18), (-3,0) \Rightarrow a = \ldots$ or $b = \ldots$ or $c = \ldots$; NB $a = \frac{14}{5}$, $b = \frac{32}{5}$, $c = -6$	M1
	Full method to find all constants. E.g. Solves $9a - 3b - 6 = 0$ and $4a + 2b - 6 = 18 \Rightarrow a = \ldots, b = \ldots$	dM1
	Either $a = \frac{14}{5}$ or $b = \frac{32}{5}$	A1
	$y = \frac{14}{5}x^2 + \frac{32}{5}x - 6$	A1
		(4)
(c)	$\frac{14}{5}x^2 + \frac{32}{5}x - 6 < y < \frac{18}{5}x + \frac{54}{5}, \quad x < 0$	M1 A1ft
		(2)
		(9 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
	$y = 2x^{\frac{5}{2}} - 4x + 3$	
2. (a)	$\left\{\frac{dy}{dx} =\right\} 5x^{\frac{3}{2}} - 4$	M1, A1 **(2)**
(b)	$5x^{\frac{3}{2}} - 4 = 16 \Rightarrow x^{\frac{3}{2}} = 4$	M1, A1
	$\Rightarrow x = 4^{\frac{2}{3}} = 2^{\frac{4}{3}} \qquad \Rightarrow k = \frac{4}{3}$	A1 **(3)** **(5 marks)**