Question Number	Scheme	Marks
1(a)	$\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right) \ldots x^{1}+\ldots x^{-\frac{3}{2}}+\ldots x^{-2}$	M1
	$\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right) \ \frac{2}{3}x \ -2x^{-\frac{3}{2}} \ -\frac{8}{3}x^{-2}$	A1A1A1
		(4)
(b)	$\frac{\mathrm{d}y}{\mathrm{d}x}="\frac{2}{3}"\times 4-"2"\times 4^{"-\frac{3}{2}"}-"\frac{8}{3}"\times 4^{"-2"}=\frac{9}{4}$	M1
	$\frac{9}{4}\rightarrow -\frac{4}{9}$	M1
	$y-3="-\frac{4}{9}"(x-4)$	dM1
	$4x+9y-43=0$	A1
		(4)
		(8 marks)

(a)

M1 Reduces the power by 1 on any of the following terms

$\ldots x^{2}\rightarrow \ldots x^{1}, \ldots x^{-\frac{1}{2}}\rightarrow \ldots x^{-\frac{3}{2}}, \ldots x^{-1}\rightarrow \ldots x^{-2}, \ 5\rightarrow 0$

A1 One of $\frac{2}{3}x$, $-2x^{-\frac{3}{2}}$, $-\frac{8}{3}x^{-2}$ or exact simplified equivalent terms eg $\frac{-2}{\left(\sqrt{x}\right)^{3}}$ or $-\frac{8}{3x^{2}}$ or $-2.\dot{6}x^{-2}$

Condone $\frac{2}{3}x^{1}$ and condone double signs such as $+-2x^{-\frac{3}{2}}$ The terms do not need to be on the same line for this mark.

A1 Two of $\frac{2}{3}x$, $-2x^{-\frac{3}{2}}$, $-\frac{8}{3}x^{-2}$ or exact simplified equivalent terms eg $\frac{-2}{\left(\sqrt{x}\right)^{3}}$ or $-\frac{8}{3x^{2}}$.

Condone $\frac{2}{3}x^{1}$ and condone double signs such as $+-2x^{-\frac{3}{2}}$. The terms do not need to be on the same line for this mark.

A1 $\frac{2}{3}x \ -2x^{-\frac{3}{2}} \ -\frac{8}{3}x^{-2}$ or exact simplified equivalent all on one line eg $\frac{2}{3}x-\frac{2}{\left(\sqrt{x}\right)^{3}} \ -\frac{8}{3x^{2}}$.

Do not allow $\frac{2}{3}x^{1} \ -2x^{-\frac{3}{2}} \ -\frac{8}{3}x^{-2}$ or double signs and do not isw in this part (including rounding decimals).

(b)

M1 Substitutes $x = 4$ into their $\frac{dy}{dx}$ to find the numerical gradient of the tangent at *P*.

Condone slips in their working. They must proceed as far as finding a value.
It may be implied by their answer or embedded in further work such as finding the equation of the perpendicular line. Do not be too concerned by the labelling of their $\frac{dy}{dx}$ (It may even be labelled as $y = \ldots$)

M1 For a correct attempt at using $m_N = -\frac{1}{m_T}$ or equivalent to find the gradient of the perpendicular.

dM1 It is for the method of finding a line passing through $(4,3)$ with a changed gradient.

Eg $\frac{9}{4} \rightarrow \frac{4}{9}$ would be acceptable as a changed gradient.

Look for $(y-3) =$ changed $m_T(x-4)$ Both brackets must be correct

Alternatively uses the form $y = mx + c$ AND proceeds as far as $c = \ldots$

It is dependent only on the first method mark.

A1 $4x + 9y - 43 = 0$ or exact equivalent with all terms on one side = 0.

Accept $\pm A(4x + 9y - 43 = 0)$ where $A \in \mathbb{N}$

Question Number	Scheme	Marks
2(a)(i)		

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

(a)(i)

M1 Substitutes in $x=\pm 1, y=32$ and proceeds to a 3TQ in terms of *a* with all terms on one side of the equation. Condone the lack of = 0 and condone slips in their rearrangement.

dM1 Attempts to solve their quadratic equation by either factorising, completing the square or the quadratic formula. They cannot just state the roots. It is dependent on the first method mark. In all cases they must show their working to score this mark so:

- Solving by factorising requires the factorised form of their $a^2+5a-24=0$ to be stated before proceeding to the roots i.e $(a+"8")(a-"3")\ (=0)$
- Solving by using the quadratic formula requires the values for *a*, *b* and *c* to be stated in the formula before proceeding to the roots. They cannot just state the values of *a*, *b* and *c*.