Question	Scheme	Marks
8(a)	$\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)Ax^3+B+\frac{C}{x^3}$	**M1**
	$\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)4\times256x^3-304-2\times27x^{-3}$ oe e.g. $1024x^3-304-\frac{54}{x^3}$	**A1A1**
		(3)
(b)	$\frac{\mathrm{d}y}{\mathrm{d}x}=0$ at SP $\Rightarrow 1024x^3-304-\frac{54}{x^3}=0\Rightarrow 1024x^6-304x^3-54=0$	**M1**
	$\Rightarrow 512\left(x^3\right)^2-152x^3-27=0\Rightarrow\left(8x^3+1\right)\left(64x^3-27\right)=0\Rightarrow x^3=...$	**dM1**
	$x^3=-\frac{1}{8}$ or $x^3=\frac{27}{64}$ or $x=-\frac{1}{2}$ or $x=\frac{3}{4}$	**A1**
	$y=256\left("-\frac{1}{2}"\right)^4-304\left("-\frac{1}{2}"\right)-35+\frac{27}{\left("-1/2"\right)^2}=...$ or with $x=\frac{3}{4}$	**dM1**
	Coordinates are $\left(-\frac{1}{2},241\right)$ and $\left(\frac{3}{4},-134\right)$	**A1**
		(5)
		(8 marks)

Notes:

(a)

M1: Attempts the derivative, with at least two terms of the correct form (ie $x^n\rightarrow..x^{n-1}$ at least twice).

A1: At least two terms correct, need not be simplified.

A1: Fully correct derivative, need not be simplified. Isw after a correct (unsimplified) answer.

Note that there is no need to see the $"\frac{\mathrm{d}y}{\mathrm{d}x}="$ in (a) just look for the differentiation.

Ignore any spurious "= 0"

(b)

M1: Sets their derivative equal to zero and multiplies through by "x^3" to achieve a polynomial equation. If in doubt at least 2 terms must be multiplied.

Allow equivalent work e.g.

$1024x^3-304-\frac{54}{x^3}=0\Rightarrow\frac{1}{x^3}\left(1024x^6-304x^3-54\right)=0\Rightarrow 1024x^6-304x^3-54=0$

To score this mark, the derivative must have a negative power of x so allow for e.g.

$\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)1024x^3-304-54x^{-1}=0\Rightarrow 1024x^4-304x-54=0$

dM1: Solves a 3 term quadratic in x^3 by any valid means (including calculator).

Must come from an attempt at $\frac{\mathrm{d}y}{\mathrm{d}x}=0$ not $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}=0$ or $\int y\,\mathrm{d}x=0$

Condone use of inequalities rather than "=" as long as they solve an equation.

Note that here we accept e.g. $512\left(x^3\right)^2-152x^3-27=0\Rightarrow\left(8y+1\right)\left(64y-27\right)=0\Rightarrow y=...$

Or even $512\left(x^3\right)^2-152x^3-27=0\Rightarrow\left(8x+1\right)\left(64x-27\right)=0\Rightarrow x=...$

A1: Achieves at least one correct value for x or x^3. It must be clear that they are values for x^3 here so $y = \ldots$ is acceptable if $y = x^3$ is seen or implied. If they have $x = \ldots$ then they must have cube rooted. So e.g. $\left(8x+1\right)\left(64x-27\right)=0\Rightarrow x=-\frac{1}{8}$ unless they recover and recognise they have x^3 then this is A0

dM1: Proceeds to find the y coordinate for at least one value of x. Must **cube root** and not e.g. square root the solution from the quadratic first. The x must have come from a 2 or 3 term quadratic in x^3.

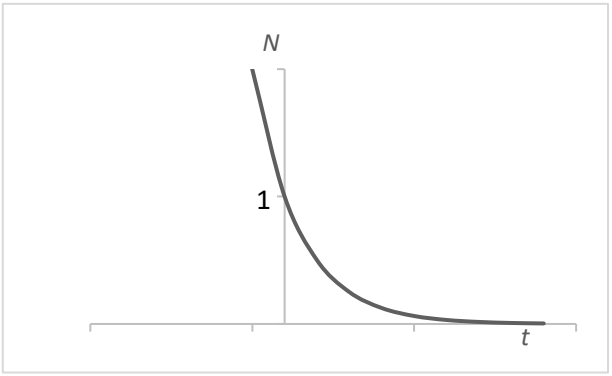
If no method shown, accept any value for y having found an x value but score M0 if there is no evidence of cube rooting or clear evidence that they have substituted into something other than the curve equation but condone if they clearly just mis-copy the equation.

Depends on having scored at least 1 of the previous M marks in (b)

A1: Both correct pairs of coordinates. Accept if given as e.g. $x=-\frac{1}{2}, y=241$ and $x=\frac{3}{4},\ y=-134$

And no other values.

Allow equivalent fractions or values for the $-\frac{1}{2}$ and $\frac{3}{4}$

Question	Scheme	Marks
9(a)		
	Correct shape from or passing through a point on positive vertical axis. May extend to the left of the vertical axis and allow to pass into quadrant 4. There must be no (obvious) turning points. Labels not required on axes and ignore any that are given.	**M1**
	Shape and position correct, accept 1 or k as intercept on the positive vertical axis and allow to extend to the left of the vertical axis as shown. Condone (1, 0) or (k, 0) as long as it is in the correct position. The curve should approach a horizontal asymptote that is half-way between the horizontal axis and the intercept or below. Be tolerant with "wobbles" as it approaches the asymptote. May just "touch" the horizontal axis but not go below it. Labels not required on axes and ignore any that are given.	**A1**
		(2)
(b)	$\frac{1}{2}k = k\lambda^{5700} \Rightarrow \lambda^{5700} = \frac{1}{2}$ (see notes for method via substitution)	**M1**
	$\Rightarrow \lambda = \left(\frac{1}{2}\right)^{\frac{1}{5700}} = 0.999878$ to 6 d.p.*	**A1***
		(2)
(c)	When $t = 3250$, $N = 15 \times 0.999878^{3250} = ...$	**M1**
	$= \text{awrt } 10.1 \text{ (grams)}$	**A1**
		(2)
(d)	$18 = 25 \times 0.999878^t$	**B1**
	$\Rightarrow 0.999878^t = \frac{18}{25} \Rightarrow t = \frac{\log \frac{18}{25}}{\log 0.999878} = ...$	**M1**
	$t = 2692.49...$ so item is 2700 years old	**A1**
		(3)
		(9 marks)

Notes:

(a)
M1: See scheme.
A1: See scheme.