Question Number	Scheme	Marks
4(a)	A and B are where $t^3-4t=0 \Rightarrow t(t^2-4)=0 \Rightarrow t=2$ or -2	M1
	Substitutes $t=2, x=2\times4-6\times2=-4$ Hence $A=(-4,0)$	A1
	When $t=-2, x=2\times4-6\times-2=20, (y=0)$ Hence $B=(20,0)$ *	B1*
		(3)
(b)	$\dfrac{dy}{dx}=\dfrac{dy/dt}{dx/dt}=\dfrac{3t^2-4}{4t-6}$	M1A1
	Sub $t=-2$ into $\dfrac{dy}{dx}=\dfrac{3t^2-4}{4t-6} \Rightarrow$ gradient $=\left(-\dfrac{4}{7}\right)$	M1
	Uses their $\left(-\dfrac{4}{7}\right)$ and $(20,0)$ to produce eqn of tangent $\Rightarrow 7y+4x-80=0$ *	M1 A1*
		(5)
(c)	Substitutes $x=2t^2-6t,\ y=t^3-4t,$ into $7y+4x-80=0$	
	$\Rightarrow 7\left(t^3-4t\right)+4\left(2t^2-6t\right)-80=0$	M1
	$\Rightarrow 7t^3+8t^2-52t-80=0$	A1
	$\Rightarrow (t+2)^2(7t-20)=0$	
	$t="\dfrac{20}{7}" \Rightarrow x=....$	dM1
	$x=-\dfrac{40}{49}$	A1
		(4)
		(12 marks)

(a)

M1: Sets $t^3-4t=0 \Rightarrow t=\ldots$ to reach $t=2$ or -2

A1: Substitutes $t=2 \Rightarrow x=2\times4-6\times2=-4$ and states coordinates of $A=(-4,0)$

Accept $t=2 \Rightarrow A=(-4,0)$ provided the M1 has been awarded

B1*: Show that the coordinates of $B=(20,0)$

Possible ways of this are

1) Solves $t^3-4t=0 \Rightarrow t=-2$ and substitutes into $2t^2-6t \Rightarrow x=20 \Rightarrow B=(20,0)$.

This is a show that and there must be some evidence for the "20", not just sight of $t=-2$

Look for $2\times(-2)^2-6\times(-2) \Rightarrow x=20$ or $8+12 \Rightarrow x=20$

2) Alternatively sets $2t^2-6t=20 \Rightarrow t=-2$ and substitutes into $y=t^3-4t \rightarrow y=0 \Rightarrow B=(20,0)$

This is a show that and there must be some evidence for the "0", not just sight of $t=-2$

(b)

M1: Attempts to differentiate $x(t)$ and $y(t)$ and calculates $\frac{dy}{dx}$ by using $\frac{dy/dt}{dx/dt}$ in part (b)

A1: $\frac{dy}{dx}=\frac{3t^2-4}{4t-6}$

M1: Sub 'their' $t=-2$ into their $\frac{dy}{dx}$ to find the gradient of the tangent at B.

M1: Uses (20,0) and their $\frac{dy}{dx}$ to find an equation of the tangent.

If they use $y=mx+c$ they need to proceed as far as c = ...

A1*: Achieves given answer. cso $\Rightarrow 7y+4x-80=0$ The $=0$ must be seen

ISW after sight of this

(c) The demand here is to use algebra which is satisfied by the setting up of the cubic equation.

M1: Attempts to substitute $x=2t^2-6t$, $y=t^3-4t$ into $7y+4x-80=0$

A1: Correct simplified equation in t: $7t^3+8t^2-52t-80=0$ The $=0$ may be implied by further work

dM1: Uses a correct method to find x

- Using a calculator this can be scored for finding a value of $t \neq -2$ and substituting this in x (t).You may have to check this on a calculator if their equation is incorrect. An accuracy of 2 sf is required for non exact solutions. Note that the equation may be in different forms under this method so $7t^3+8t^2-52t=80 \Rightarrow t=\frac{20}{7}$ is fine

  Note: $7\left(t^3-4t\right)+4\left(2t^2-6t\right)-80=0 \Rightarrow t=\frac{20}{7} \Rightarrow x=-\frac{40}{49}$ would score M1 A0 dM1 A0
- Via factorisation look for factors where the ends work,
  E.g. $"7t^3+8t^2-52t-80"=(Pt+a)(Qt+b)(Rt+c)$ with $PQR="7"$ and $abc="\pm 80"$
  followed by substitution of a value of $t \neq -2$ in x (t)

A1: CSO $x=-\frac{40}{49}$ Do not accept decimals here but remember to isw following a correct answer.

Ignore any references to the y coordinate. Penalise extra solutions, incorrect factorisation etc on this mark.

Question Number	Scheme	Marks
5(a)	$\int \frac{\ln x}{x^2}\,\mathrm{d}x = \int x^{-2}\ln x\,\mathrm{d}x = -x^{-1}\ln x + \int x^{-1}\times\frac{1}{x}\,\mathrm{d}x$	M1
	$= -x^{-1}\ln x - x^{-1}(+c)$	dM1 A1 **(3)**
(b)	$\frac{3+2x+\ln x}{x^2} = 3x^{-2}+2x^{-1}+x^{-2}\ln x$ oe	B1
	Area $= \left[-\frac{3}{x}+2\ln x"-\frac{\ln x}{x}-\frac{1}{x}"\right]_2^4$	M1
	$=\left(-\frac{3}{4}+2\ln 4-\frac{\ln 4}{4}-\frac{1}{4}\right)-\left(-\frac{3}{2}+2\ln 2-\frac{\ln 2}{2}-\frac{1}{2}\right)=1+2\ln 2$	M1 A1 **(4)** **(7 marks)**

(a)

M1: Attempts by parts to reach a form $\int x^{-2}\ln x\,\mathrm{d}x = \pm ax^{-1}\ln x \pm b\int x^{-1}\times\frac{1}{x}\,\mathrm{d}x$ where $a,b\neq 0$

If a formula is stated it must be correct.

dM1: Integrates again to reach a form $\pm ax^{-1}\ln x \pm bx^{-1}$

A1: $-x^{-1}\ln x - x^{-1}(+c)$ o.e such as $-\frac{\ln x}{x}-\frac{1}{x}+c$

Condone the omission of the constant of integration. Condone $-x^{-1}\ln x+\left(-x^{-1}\right)$

(b)

B1: $\frac{3+2x+\ln x}{x^2} = 3x^{-2}+2x^{-1}+x^{-2}\ln x$ or $\frac{3}{x^2}+\frac{2}{x}+\frac{\ln x}{x^2}$.

The $\frac{2}{x}$ may be implied by later work. That is if they state $\int\frac{2x}{x^2}\,\mathrm{d}x = 2\ln x$ or $\ln x^2$

M1: Area $= \left[-\frac{3}{x}+2\ln x"-\frac{\ln x}{x}-\frac{1}{x}"\right]_2^4$ following through on their part (a)

M1: For substituting 2 and 4 **into an expression of the form** $\left[\frac{p}{x}+q\ln x+r\frac{\ln x}{x}+\frac{s}{x}\right]_2^4$ and attempts to simplify by using one log law correctly. (Note that the two terms in $\frac{1}{x}$ may be combined before substitution)

A1: Exact answer: Likely to be $1+2\ln 2$ or $1+\ln 4$

.....

For those who don't read the instruction in (b) to use (a) and do via parts score