Question	Scheme	Marks	AOs
8 (a)	25	B1	3.4
		(1)	
(b)	Attempts to differentiate using the product rule $\frac{\mathrm{d}v}{\mathrm{d}t} = \ln(t+1)\times -0.4 + \frac{(10-0.4t)}{t+1}$	M1 A1	3.1b 1.1b
	Sets their $\frac{\mathrm{d}v}{\mathrm{d}t} = 0 \Rightarrow \frac{(10-0.4\boldsymbol{t})}{(\boldsymbol{t}+1)} = 0.4\ln(t+1)$ **and** then makes progress towards making "$\boldsymbol{t}$" the subject (See notes for this)	dM1	1.1b
	$t = \frac{25-\ln(t+1)}{1+\ln(t+1)}$ $t = \frac{26}{1+\ln(t+1)} - 1$ *	A1*	2.1
		(4)	
(c)	(i) Attempts $t_2 = \frac{26}{1+\ln 8} - 1$	M1	1.1b
	awrt 7.298	A1	1.1b
	(ii) awrt 7.33 seconds	A1	3.2a
		(3)	
			(8 marks)
Notes:			

(a)

B1: 25 but condone 25 seconds. If another value is given (apart from 0) it is B0

(b)

M1: Attempts to use the product rule in an attempt to differentiate $v = (10-0.4t)\ln(t+1)$

Look for $(10-0.4t)\times\frac{1}{(t+1)} \pm k\ln(t+1)$, where k is a constant, condoning slips.

If you see direct evidence of an incorrect rule used e.g. $vu' - uv'$ it is M0

You will see attempts from $v = 10\ln(t+1) - 0.4t\ln(t+1)$ which can be similarly marked.

In this case look for $\frac{a}{t+1} \pm \frac{bt}{t+1} \pm c\ln(t+1)$

A1: Correct differentiation. Condone a missing left hand or it seen as v', $\frac{\mathrm{d}y}{\mathrm{d}x}$ or even = 0

$\left(\frac{\mathrm{d}v}{\mathrm{d}t}\right) = \ln(t+1)\times -0.4 + \frac{(10-0.4t)}{t+1}$ or equivalent such as $\left(\frac{\mathrm{d}v}{\mathrm{d}t}\right) = \frac{10}{t+1} - \frac{0.4t}{(t+1)} - 0.4\ln(t+1)$

dM1: Score for setting their dV/dt = 0 (which must be in an appropriate form) and proceeding to an equation where the variable t occurs only once – ignoring $\ln(t + 1)$.

See two examples of how this can be achieved below. It is dependent upon the previous M.

Look for the following steps

- An allowable derivative set (or implied) = 0 E.g. $\ln(t+1)\times 0.4 = \dfrac{(10-0.4t)}{t+1}$
- Cross multiplication (or division) and rearrangement to form an equation where the variable t only occurs once.

E.g.1.

$$\ln(t+1)\times 0.4 = \frac{(10-0.4t)}{t+1}$$
$$\Rightarrow \ln(t+1) = \frac{25-t}{t+1}$$
$$\Rightarrow \ln(t+1) = -1+\frac{26}{t+1}$$

E.g 2

$$\ln(t+1)\times 0.4 = \frac{(10-0.4t)}{t+1}$$
$$\Rightarrow 0.4t\ln(t+1) + 0.4\ln(t+1) = 10-0.4t$$
$$\Rightarrow 0.4t\left(1+\ln(t+1)\right) = 10-0.4\ln(t+1)$$

A1*: Correctly proceeds to the given answer of $t = \dfrac{26}{1+\ln(t+1)} - 1$ showing all key steps.

The key steps must include

- use of $\dfrac{\mathrm{d}v}{\mathrm{d}t}$ or v' which must be correct
- a correct line preceding the given answer, usually $t = \dfrac{25-\ln(t+1)}{1+\ln(t+1)}$ or $\dfrac{26}{t+1} - 1 = \ln(t+1)$

(c) (i)

M1: Attempts to use the iteration formula at least once.

Usually to find $t_2 = \dfrac{26}{1+\ln 8} - 1$ which may be implied by awrt 7.44

A1: awrt 7.298. This alone will score both marks as iteration is implied. ISW after sight of this value. As t_3 is the only value that rounds to 7.298 just score the rhs, it does not need to be labelled t_3

(c)(ii)

A1: Uses repeated iteration until value established as awrt 7.33 **seconds**. Allow awrt 7.33 **s**

Requires units. It also requires some evidence of iteration which will be usually be awarded from the award of the M