Question		Answer	Marks	AO	Guidance	
7	**(a)**	**DR** $\frac{8t}{7+4t^2}-\frac{1}{2}=0 \Rightarrow 2(8t)-(7+4t^2)=0$	**M1***	**1.1**	Setting equation for a equal to zero and removing t^2 correctly from the denominator e.g. $8t-\frac{1}{2}(7+4t^2)=0$ to obtain the equivalent of a 3TQ in t **only**	This mark can be implied by a correct 3TQ in t
		$4t^2-16t+7=0 \Rightarrow (2t-1)(2t-7)=0$	**M1dep***	**1.1**	Correct method for solving their 3TQ in t *If factorising*: $at^2+bt+c \Rightarrow (mt+n)(pt+q)$ where $a=mp$ **and** one of $mq+np=b$ **or** $c=nq$ so note that $4t^2-16t+7=(t-0.5)(t-3.5)$ is **M0** but e.g. $(-2t+7)(2t-1)$ is **M1 bod** *If using the formula*: must apply the correct formula for their three-term quadratic in t (no errors) *If completing the square*: The **M** mark is not awarded until correctly getting to the stage $t-2=\pm\sqrt{\frac{9}{4}}$ for their 3TQ in t (must include $\pm$ so implying two roots) with no errors (so consistent with applying the formula correctly)	**Must see the method** – the correct answers **do not** imply this mark therefore $4t^2-16t+7=0$ $\Rightarrow t=0.5$ and 3.5 scores **M1 M0 B1** As a minimum must see (if correct) $\frac{16\pm\sqrt{144}}{8}$
		$t=0.5$ or $t=3.5$	**B1**	**1.1**	This mark is not dependent on the previous **M** mark(s)	So **M1 M0 B1** is common or **M0 M0 B1** if no working seen

Question		Answer	Marks	AO	Guidance	
			[3]			

Question		Answer	Marks	AO	Guidance	
7	**(b)**	$\frac{dv}{dt} = v\left(\frac{8t}{7+4t^2} - \frac{1}{2}\right)$	**B1***	**3.1b**	Stating the correct differential equation	Possibly implied by correct separation of variables
		$\ln v =$ $\ln(7+4t^2) - \frac{1}{2}t(+c)$	**B1dep*** **B1dep***	**1.1** **1.1**	Correct lhs Correct rhs – not multiplied by v or 5 (or any other constant)	Condone lack of $+c$ for both **B** marks
		$t = 0, v = 17.5 \Rightarrow c = \ln 17.5 - \ln 7$	**M1***	**3.1a**	Uses correct initial conditions to find c from an equation of the form $k_1 \ln v = k_2 \ln(7+4t^2) + k_3 t + c$ (note that e.g. + c may appear on the lhs)	With non-zero values of k_i - accept any equivalent form e.g. $v = A(7+4t^2)e^{-0.5t}$ and then use initial conditions to find A (**if** correct then A = 2.5)
		$\ln 5 = \ln(7+4T^2) - \frac{1}{2}T + \ln\left(\frac{5}{2}\right)$	**M1dep***	**2.1**	Uses $t = T,\ v = 5$ to obtain an equation in T only – **dependent on previous M mark**	**Condone use of *t* for *T* throughout the remainder of the question**
		$\frac{1}{2}T = \ln\left[\frac{5(7+4T^2)}{2\times 5}\right] \Rightarrow T = 2\ln\left(\frac{7+4T^2}{2}\right)$	**A1**	**2.2a**	**AG** so at least one step of intermediate working from substitution of t = T and v = 5	Condone $T = 2\ln\left\|\frac{7+4T^2}{2}\right\|$
			[6]			

Question		Answer	Marks	AO	Guidance	
7	**(c)**	$T_{n+1} = 2\ln\left(\frac{7+4T_n^{\ 2}}{2}\right)$ $T_0 = 11.25$ $T_1 = 11.09523175...$ $T_2 = 11.04058716...$ $T_3 = 11.02111643...$ $T_4 = 11.01415608...$ $T_5 = 11.011665...$	**B1**	**1.1**	Uses given result and given starting value to obtain correct T_1 and T_2 (so the first two iterations after the initial value of 11.25) to at least 4 sf (rot) – but all stated values in these two terms must be correct	
		$T = 11.01$	**B1**	**1.1**	Must be stated to **4** sf only – **not dependent on the first B mark** – can be awarded if either of T_2 and/or T_3 incorrect (assume that the iterative process corrected itself or a slip in the candidate writing down an earlier value)	**Must be clear that *T* is 11.01 (and not the final term shown in the iterative process)** – this mark can be awarded from using alternative iterative methods e.g. Newton-Raphson
			[2]			
7	**(d)**	11.01 – 3.5 = 7.51 (s)	**B1**	**2.2a**	awrt 7.51	No follow through from incorrect earlier values
			[1]			