

Q	Marking Instructions	AO	Marks	Typical Solution
11(a)(i)	Uses model to form equation with $V=0$	AO3.4	M1	$\therefore 10 + 100\left(\frac{T}{30}\right)^3 - 50\left(\frac{T}{30}\right)^4 = 0$ $\Rightarrow 50\left(\frac{T}{30}\right)^4 = 10 + 100\left(\frac{T}{30}\right)^3$ $\Rightarrow \frac{T^4}{16200} = 10 + \frac{T^3}{270}$ $\Rightarrow \frac{T^3}{16200} = \frac{10}{T} + \frac{T^2}{270}$ $\Rightarrow T = \sqrt[3]{\frac{162000}{T} + 60T^2}$
	Rearranges to isolate T^4 term	AO1.1a	M1	
	<p>Completes rigorous and convincing argument to clearly show the required result. Need to see evidence of division by T to isolate T^3 term</p> <p>Must be an equation throughout</p> <p>AG</p>	AO2.1	R1	
11(a)(ii)	Calculates T_1 (44.96345.....)	AO1.1a	M1	$T_1 = 44.963$
	Calculates T_2 and T_3 (49.98742....)	AO1.1b	A1	$T_2 = 49.987$
	Condone greater than 3dp (53.50407....)			$T_3 = 53.504$
11(a)(iii)	Explains 38 in context	AO3.2a	B1	38 represents current year 2018
11(b)	Translates 2029 into $t=49$	AO3.3	B1	$10 + 100\left(\frac{t}{30}\right)^3 - 50\left(\frac{t}{30}\right)^4 = 4.5 \times 1.063^t$ $\Rightarrow t = 49.009$ <p>$1980 + 49 = 2029$</p> <p>Therefore use of oil and production of oil will be equal in the year 2029</p>
	Uses models to set up equation or evaluate both models at one value of t	AO3.4	M1	
	Obtains correct values for both models for two appropriate values of t . $t \in [49, 50]$ eg $t=49$ and $t=50$ $t=49$ gives: 89.89 and 89.81 $t=50$ gives: 87.16 and 95.47 Or Solves equation using any method to obtain AFWW 49.009 to 49.01	AO1.1b	A1	
	Explains that the use of oil and the production of oil are equal when $t = 49.009$ Or Uses a change of sign argument OE to explain that the value of each model for two appropriate values of t shows that the production of oil and the use of oil are the same for $t \in (49, 50)$	AO2.4	E1	
Total			10	