Question	Scheme	Marks	AOs
6 (a)(i)	10750 barrels	B1	3.4
(ii)	Gives a valid limitation, for example • The model shows that the daily volume of oil extracted would become negative as t increases, which is impossible • States when $t=10, V=-1500$ which is impossible • States that the model will only work for $0 \leqslant t \leqslant \frac{64}{7}$	B1	3.5b
		(2)	
(b)(i)	Suggests a suitable exponential model, for example $V = A\mathrm{e}^{kt}$	M1	3.3
	Uses $(0,16000)$ and $(4,9000)$ in $\Rightarrow 9000 = 16000\mathrm{e}^{4k}$	dM1	3.1b
	$\Rightarrow k = \frac{1}{4}\ln\left(\frac{9}{16}\right)$ awrt -0.144	M1	1.1b
	$V = 16000\mathrm{e}^{\frac{1}{4}\ln\left(\frac{9}{16}\right)t}$ or $V = 16000\mathrm{e}^{-0.144t}$	A1	1.1b
(ii)	Uses their exponential model with $t=3 \Rightarrow V =$ awrt 10 400 barrels	B1ft	3.4
		(5)	
			(7 marks)

Notes:

(a)(i)

B1: 10750 barrels

(a)(ii)

B1: See scheme

(b)(i)

M1: Suggests a suitable exponential model, for example $V = A\mathrm{e}^{kt}$, $V = Ar^t$ or any other suitable function such as $V = A\mathrm{e}^{kt} + b$ where the candidate chooses a value for b.

dM1: Uses both $(0,16000)$ and $(4,9000)$ in their model.

With $V = A\mathrm{e}^{kt}$ candidates need to proceed to $9000 = 16000\mathrm{e}^{4k}$

With $V = Ar^t$ candidates need to proceed to $9000 = 16000r^4$

With $V = A\mathrm{e}^{kt} + b$ candidates need to proceed to $9000 = (16000 - b)\mathrm{e}^{4k} + b$ where b is given as a positive constant and $A + b = 16000$.

M1: Uses a correct method to find all constants in the model.

A1: Gives a suitable equation for the model passing through (or approximately through in the case of decimal equivalents) both values $(0,16000)$ and $(4,9000)$. Possible equations for the model could be for example

$V = 16000\mathrm{e}^{-0.144t}$ $V = 16000 \times (0.866)^t$ $V = 15800\mathrm{e}^{-0.146t} + 200$

(b)(ii)

B1ft: Follow through on their exponential model