

Q	Marking instructions	AO	Marks	Typical solution
17(a)	Separates variables to obtain an equation of the form $\int \frac{P}{h^2} dh = \int \frac{1}{Q} \left(2 + \sin \frac{t}{4} \right) dt$ where $PQ = -400$ Must have integral signs and consistent dh and dt	3.1a	B1	$\frac{dh}{dt} = -\frac{h^2}{400} \left(2 + \sin \frac{t}{4} \right)$ $\int \frac{400}{h^2} dh = \int -\left(2 + \sin \frac{t}{4} \right) dt$ $-\frac{400}{h} = -2t + 4 \cos \frac{t}{4} + c$ $t = 0, h = 10 \Rightarrow -40 = 4 + c$ $c = -44$ $h = \frac{400}{2t + 44 - 4 \cos \frac{t}{4}} = \frac{200}{t + 22 - 2 \cos \frac{t}{4}}$
	Integrates the $\frac{P}{h^2}$ term to obtain $-\frac{P}{h}$	1.1a	M1	
	Integrates $\sin \frac{t}{4}$ to obtain $R \cos \frac{t}{4}$	1.1a	M1	
	Completes integration to obtain $-\frac{400}{h} = -2t + 4 \cos \frac{t}{4} + c$ OE Condone missing constant of integration	1.1b	A1	
	Uses $t = 0$ and $h = 10$ to determine constant of integration for their equation of the form $\frac{D}{h} = Et + F \cos \frac{t}{4} + c$ OE	3.4	M1	
	Obtains $-\frac{400}{h} = -2t + 4 \cos \frac{t}{4} - 44$ OE	1.1b	A1	
	Completes reasoned argument to obtain $h = \frac{200}{t + 22 - 2 \cos \frac{t}{4}}$ This mark can be scored without scoring B1 for missing dh etc at the start	2.1	R1	
	Subtotal		7	

Q	Marking instructions	AO	Marks	Typical solution
17(b)	Substitutes $t = 4$ into their model from part (a) of the form $h = \frac{A}{Bt + C - 2\cos\frac{t}{4}}$ to obtain a value for h PI by AWRT 8.03	3.4	M1	$\frac{200}{4 + 22 - 2\cos\frac{4}{4}} = 8.03$ 8.03 is approximately 8 so the model is valid
	Compares AWRT 8.03 to 8 or compares AWRT 1.97 to 2 AND comments that the model is valid.	3.5a	A1	
	Subtotal		2	

	Question 17 Total		9	
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