Question	Expected Answers	Marks	Additional guidance
1(a)(i)	displacement is the distance (of the body) from an equilibrium position.	B1	Allow mean/rest/central/mid point Not original, fixed point
	amplitude is the <u>maximum</u> displacement.	B1	This mark can only be gained if the word <u>maximum/greatest/largest is spelled correctly</u>. Allow distance
(a)(ii)	frequency is the number of oscillations/cycles per unit time/second	B1	Do not allow "swings"
	angular frequency is product of 2π x frequency OR 2π/period.	B1	Allow $2\pi f$
(b)(i) 1	amplitude = (18 – 13)/2 = **2.5** m	B1	
(b)(i) 2	frequency = 1/(12.5 x 3600) = (1/45000) $\qquad$ = **2.2(2) x 10^{-5}** Hz	C1 A1	Accept any valid sub^n of time for 1st mark Accept 0.08 h^{-1} OR 1.3x10^{-3} min^{-1} if unit is seen to replace Hz.
(b)(ii)	correct use of $v_{max} = 2\pi f A$ e.g. 2π x 2.22 x 10^{-5} x 2.5 $\qquad\qquad$ = **3.5 x 10^{-4}** m s^{-1} (3.46 or 3.49)	C1 A1	Allow ecf from (b)(i)1 and 2 for full marks: if A=5 is used v_{max} = 6.98 x10^{-4} (6.9 to 7) if A=18 is used v_{max} = 2.5x10^{-3}
(b)(iii)	correct use of A(cos $2\pi f t$): e.g. 2.5 cos [2π x 2.22 x 10^{-5} t] $\qquad\qquad\qquad$ (= 2.5 cos (1.39 x 10^{-4} xt) d = 15.5 + 2.5 cos [2π x 2.22 x 10^{-5} t] OR 15.5 + 2.5 cos (1.39x10^{-4} x t)	C1 A1	Allow 2.5 cos[2πt/45000] Accept A(sin $2\pi f t$) throughout Allow ecf from (b)(i) and (b)(ii)
	Total	**11**	

Question			Expected Answers	Marks	Additional guidance
2	a		The resultant force is zero (WTTE)	B1	For the first mark allow - sum of forces is zer , - upward force = downward force - forces ca cel each other BUT do not allow forces are balanced
			Forces are weight and force from the spring (allow tension)	B1	Allow force of gravity for weight
	b	i	acceleration is (directly) proportional to displacement and is directed in the opposite direction to the displacement. (WTTE)	M1 A1	allow $a = -(2\pi f)^2 x$, provided a and x are identified and –ve sign must be explained. Do not allow "acceleration is prop to negative displacement for second mark. Allow always towards the equilibrium position
		ii	$x = a\cos 2\pi ft \Rightarrow 2\pi f = 7.85$ (expressed in any form) $f = (7.85/2\pi) = 1.25$ (1.249Hz)	**M1** A1	Do not allow use of Fig 4.2 to show T= 0.8s and hence f=1.25 Hz. This scores 0.
		iii	correct subst^n in $V_{max} = (2\pi f)A \Rightarrow V_{max} = 2\pi \times 1.25 \times 0.012$ $V_{max} = \mathbf{0.094}$ ms^{-1}	C1 A1	Many will forget to change 12 mm into 0.012m and have v = 94 ms^{-1} this scores 1 mark.
	c		roughly **sinusoidal** graph of <u>correct period</u> ie **0.8s** <u>90° out of phase</u> with displacement graph (i.e. starts at origin with -ve initial gradient) <u>maximum velocity</u> correctly shown as 0.094 {allow ecf from (iii)}	B1 B1 B1	
			Total	**11**	