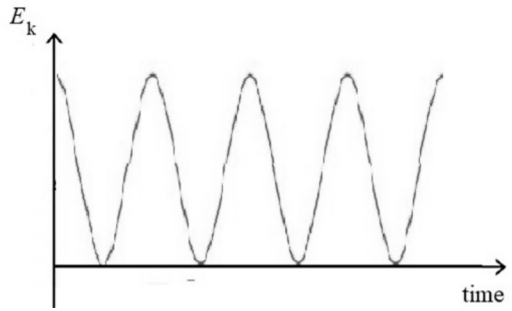
Question Number	Answer	Mark
20(a)	(For simple harmonic motion the) acceleration is: • (directly) proportional to <u>displacement</u> from equilibrium position (1) • acceleration is in the opposite direction to displacement **Or** (always) acting towards the equilibrium position (1) **OR** (For simple harmonic motion the resultant) force is: • (directly) proportional to <u>displacement</u> from equilibrium position (1) • force is in the opposite direction to displacement **Or** (always) acting towards the equilibrium position (1) (An equation with symbols defined correctly is a valid response for both marks For equilibrium position accept: undisplaced point/position **or** fixed point/position **or** central point/position)	**2**
20(b)	Use of $F = k\Delta x$ (1) Use of $T = 2\pi\sqrt{\frac{m}{k}}$ (1) Use of $v_{max} = \omega A$ with $\omega = \frac{2\pi}{T}$ (1) Use of $E_k = \frac{1}{2}mv^2$ (1) $E_k = 9.1 \times 10^{-3}$ J (1) **OR** Use of $F = k\Delta x$ (1) Statement that E_k max = ΔE_{el} (1) Because energy is conserved (1) Use of $\Delta E_{el} = \frac{1}{2}F\Delta x$ with $F = k\Delta x$ (1) $E_k = 9.1 \times 10^{-3}$ J (1) <u>Example of calculation</u> $k = \frac{F}{\Delta x} = \frac{0.25\text{ kg} \times 9.81\text{ N kg}^{-1}}{0.165\text{ m}} = 14.9\text{ N m}^{-1}$ $T = 2\pi\sqrt{\frac{0.25\text{ kg}}{14.9\text{ N m}^{-1}}} = 0.814\text{ s}$ $E_k = \frac{1}{2} \times 0.25\text{ kg} \times \left(\frac{2\pi \times 3.5 \times 10^{-2}\text{ m}}{0.814\text{ s}}\right)^2 = 9.13 \times 10^{-3}\text{J}$	**5**

Question Number	Answer		Mark
20(c)	Sinusoidal curve with twice the frequency of displacement graph	(1)	
	Always positive and maximum E_k at t = 0	(1)	**2**
	Example of graph 		
20(d)	There would be viscous/drag forces on the mass as it moved through the water	(1)	
	This would remove energy (from the oscillation) **Or** this causes damping	(1)	
	The amplitude would decrease over time (dependent on MP2)	(1)	**3**
	Total for question 20		**12**