Question Number	Answer	Mark
19(a)	(When the object is displaced): there is a (resultant) force that is proportional to the displacement from the equilibrium position **(1)** and (always) acting towards the equilibrium position **(1)** [Accept force is in the opposite direction to displacement] (Accept 'acceleration' for 'force') (For equilibrium position accept: undisplaced point/position or fixed point/position or central point/position, do not accept mean position)	**2**
19(b)(i)	Frequency/period calculated from oscillations per minute **(1)** T = 0.22 s [can be seen on graph] **(1)** Use of $\omega = 2\pi f$ **Or** Use of $\omega = \frac{2\pi}{T}$ **(1)** Use of $v = A\omega \sin \omega t$ **(1)** v = 1.1 m s^{-1} [can be seen on graph] **(1)** At least 1 cycle of a sinusoidal graph with calculated values of v and T on axes **(1)** <u>Example of calculation</u> $f = \frac{270 \text{ min}^{-1}}{60 \text{ s min}^{-1}} = 4.5 \text{ Hz}$ $\omega = 2\pi \text{ rad} \times 4.5 \text{ s}^{-1} = 28.3 \text{ rad s}^{-1}$ $v = \left(\frac{8.0 \times 10^{-2} \text{ m}}{2}\right) \times 28.3 \text{ s}^{-1} = 1.13 \text{ m s}^{-1}$	**6**
19(b)(ii)	Use of $a = -\omega^2 x$ **(1)** a = 32 m s^{-2} [ecf from (i)] **(1)** <u>Example of calculation</u> $a = -(28.3 \text{ s}^{-1})^2 \times 4.0 \times 10^{-2} \text{ m} = 32.0 \text{ m s}^{-2}$	**2**

19(b)(iii)	The particles are free to move inside the can **Or** Not all the particles will move with simple harmonic motion **Or** Amplitude/frequency/period of oscillation of particles is different to amplitude of can **Or** The particles may continue to move upwards as the can starts moving downwards **Or** The particles may collide with each other **Or** the force on the paint particles is not equal to the force on the can. **(1)**	**1**
	Total for question 16	**11**