Name of the Student:_____

Max. Marks : 20 Marks **Time : 20 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
	An explanation that makes reference to: **Either** • The oscillating frame causes the lead spheres to deform plastically **(1)** • And this removes energy from the oscillating frame **(1)** • So the amplitude of oscillations decrease with time as shown by the graph **(1)** **OR** • Spheres collide/vibrate **(1)** • Hence energy dissipated **(1)** • So the amplitude of oscillations decrease with time as shown by the graph **(1)**		**3**

Q2.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• Use of $T = 2\pi\sqrt{\frac{l}{g}}$ **(1)** • Time to reach maximum height = $T/4$ **(1)** • Time to reach maximum height = 0.56 (s) **(1)**	Example of calculation $T = 2\pi\sqrt{\frac{1.25\ \text{m}}{9.81\ \text{m s}^{-2}}} = 2.24\ \text{s}$ $t = \frac{T}{4} = \frac{2.24\ \text{s}}{4} = 0.56\ \text{s}$	**3**
(ii)	• Use of $T = 2\pi\sqrt{\frac{m}{k}}$ **(1)** • $m = 0.015$ kg (ecf from (b)(i)) **(1)** [show that value gives 0.018 kg]	Example of calculation $2.24\ \text{s} = 2\pi\sqrt{\frac{m}{0.12\ \text{N m}^{-1}}}$ $\therefore m = (\frac{2.24\ \text{s}}{2\pi})^2 \times 0.12\ \text{N m}^{-1} = 0.0153\ \text{kg}$	**2**

Q3.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following points: • The (pushing) frequency must match the natural frequency **(1)** • The time period of oscillation increases, as $T = 2\pi\sqrt{\frac{m}{k}}$ **(1)** • So the frequency of pushing must decrease **(1)** [dependent upon MP2]		**3**

Q4.

Question Number	Answer	Mark
(i)	Identification of weight and force from cone, F_c, as the two forces acting on the sand **(1)** Weight $- F_c = m\omega^2 x$ **(1)** So as x increases, F_c decreases, sand loses contact with cone when $F_c = 0$ **(1)**	3
(ii)	Resultant force equated to weight **Or** acceleration equated to g **(1)** Use of $\omega = 2\pi f$ **(1)** $f = 32$ Hz **(1)** <u>Example of calculation:</u> $mg = m\omega^2 x_0$ $\omega = \sqrt{\frac{g}{x_0}} = \sqrt{\frac{9.81\,\text{m s}^{-2}}{0.25\times10^{-3}\,\text{m}}} = 198\,\text{rad s}^{-1}$ $f = \frac{\omega}{2\pi} = \frac{198}{2\pi} = 31.5\,\text{Hz}$	3