

Answer on Question #59257-Physics-Mechanics-Relativity

A block is placed on piston which is moving vertically with a simple harmonic motion period 1second. At what amplitude of the motion will the block and piston just get separated? If the piston has amplitude of 5cm up to what frequency will the block remain continuously in contact with piston?

Solution

The maximal acceleration is needed to be equal and opposite the acceleration due to the gravity:

$$a_{max} = \omega^2 A = g.$$

$$T = \frac{2\pi}{\omega} \rightarrow \omega = \frac{2\pi}{T}$$

$$A = \frac{g}{\omega^2} = \frac{g}{\left(\frac{2\pi}{T}\right)^2} = \frac{9.81 \text{ m/s}^2}{\left(\frac{2\pi}{1 \text{ s}}\right)^2} = 0.248 \text{ m}.$$

The frequency will be:

$$f = \frac{\omega}{2\pi} = \frac{1}{2\pi} \sqrt{\frac{g}{A}} = \frac{1}{2\pi} \sqrt{\frac{9.81 \text{ m/s}^2}{0.05 \text{ m}}} = 2.23 \text{ Hz}.$$