Support Worksheet – Topic 4, Worksheet 1

1 The frequency of oscillations of a particle is 4.5 Hz. Determine the period of the oscillations and the angular frequency ω. [2]

2 State the two conditions that must be satisfied for simple harmonic oscillations to take place. [2]

3 The acceleration of a particle is given in terms of its displacement x from the equilibrium position by the formula $a = 4x$. Suggest why the motion of the particle is not simple harmonic. [1]

4 The acceleration of a particle is given in terms of its displacement x from the equilibrium position by the formula $a = -2x$ (the acceleration is in m s^{-2} and the displacement in m). Determine the period of oscillations. [2]

5 A particle is executing simple harmonic oscillations with amplitude 0.20 m and period 0.12 s. The amplitude is now reduced to half its original value. Determine the new period of oscillations. [1]

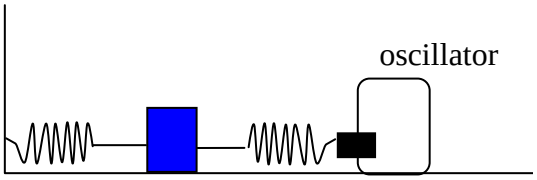
6 A particle is executing simple harmonic oscillations with amplitude 0.20 m and period 0.12 s. At $t = 0$ s the displacement is 0.20 m. Write down the equation giving the displacement as a function of time. [1]

7 A particle is executing simple harmonic oscillations with amplitude 0.20 m and period 0.12 s. Calculate, for the particle, the maximum

a speed. [1]

b acceleration. [1]

8 A mass $m = 0.220$ kg is attached to two identical springs as shown.



The spring on the right is attached to an oscillator of variable frequency. When the oscillator is turned off, the acceleration of the mass is given by the formula

$a = -\frac{2k}{m}x$ where x is the displacement from its equilibrium position and

$k = 280$ N m^{-1}.

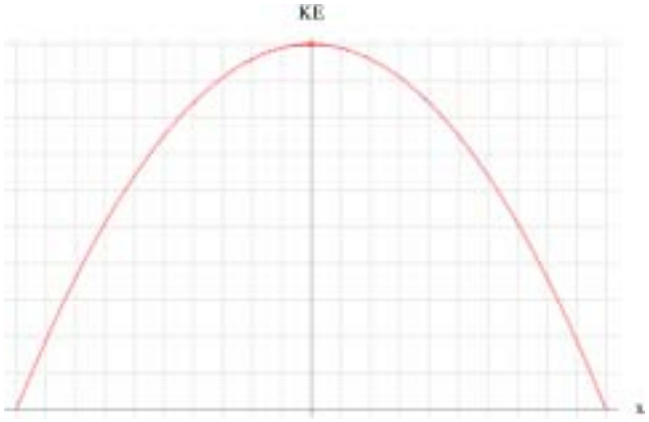
a Show that with the oscillator off, the frequency of oscillations of the mass is $f = 8.0$ Hz. [2]

b The oscillator is now turned on. The amplitude of oscillations is measured for various oscillator frequencies. On the axes below draw a sketch graph to show the variation of the amplitude with oscillator frequency.

[2]

c Suggest how your graph would change if the damping of the system is increased substantially. [2]

9 The graph shows the variation with displacement of the kinetic energy of a body executing simple harmonic motion. On the same axes draw a sketch graph to show the variation with displacement of the potential energy of the body.



[2]

