Answer on Question #77240, Physics / Other

a) A particle undergoes simple harmonic motion with an angular velocity of 5 rad s^{-1} and an amplitude of 50 cm. If it starts with maximum forward amplitude at t = 0, find:

i) the displacement at t= 10 s;

ii) the acceleration at t = 6 s.

iii) the velocity at t= 2 s.

Solution:

In one-dimensional simple harmonic motion, the position of the particle can be found by

$$x(t) = A\cos(\omega t)$$

Here

$A = 50\ cm = 0.5\ m,$

$\omega = 5\ rad/s,$

i) The displacement at t= 10 s is

$$x(10) = 0.5 \times \cos(5 \times 10) = 0.482\ m$$

ii) The acceleration is the 2nd derivative of *x(t)*, or

$$a(t) = -A\omega^2\cos(\omega t)$$

$$a(6) = -0.5 \times 5^2 \times \cos(5 \times 6) = -10.8\ m/s^2$$

iii) The velocity is the 1st derivative, or

$$v(t) = -A\omega\sin(\omega t)$$

$$v(2) = -0.5 \times 5 \times \cos(5 \times 2) = -2.46\ m/s$$

Answer: $0.482\ m; -10.8\ m/s^2;\ -2.46\ m/s.$

b) i) A 5 kg mass undergoes simple harmonic motion on a spring with a force constant of 70 Nm^{-1}. If the amplitude is 3 m, calculate the maximum velocity.

Solution:

The angular velocity is

$$\omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{70}{5}} = 3.74\frac{rad}{s}$$

The maximum values of velocity is

$$v_{max} = \omega A = 3.74 \times 3 = 11.2\ m/s$$

Answer: $11.2\ m/s.$