10.5.2.14

EE23BTECH11003 - pranav

Question:A spring having with a spring constant 1200 Nm^{-1} is mounted on a horizontal table as shown in Fig.A mass of 3 kg is attached to the free end of the spring. The mass is then pulled sideways to a distance of 2.0 cm and released.
Determine (i) the frequency of oscillations, (ii) maximum acceleration of the mass, and (iii) the maximum speed of the mass

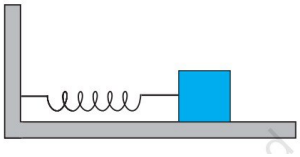

Fig. 1

Solution: at $t = 0$

Variable	Description	Value
k	spring constant	$1200N/m$
ω	angular frequency	$20rad/s$
A	amplitude	$0.02m$
$x(t)$	displasment function of the body	$0.02\cos 20t$
$v(t)$	velocity of the body	$-0.4\sin 20t$
$a(t)$	accelaration of the body	$-8\cos 20t$

TABLE 1: Variables Used

$$A = A\sin\left(w(0) + \phi\right) \tag{1}$$

$$\implies \phi = \frac{\pi}{2} \tag{2}$$

$$\implies x(t) = A\cos wt \tag{3}$$

(i) frequency of the oscillation

$$f = \frac{\omega}{2\pi} \tag{4}$$

$$\implies f = \frac{10}{\pi} \tag{5}$$

(iii)maximum speed of mass

$$x(t) = 0.02\cos 20t \tag{6}$$

$$v(t) = \frac{dx(t)}{dt} = -0.4\sin 20t \tag{7}$$

$$v_{\max} = 0.4m/s \tag{8}$$

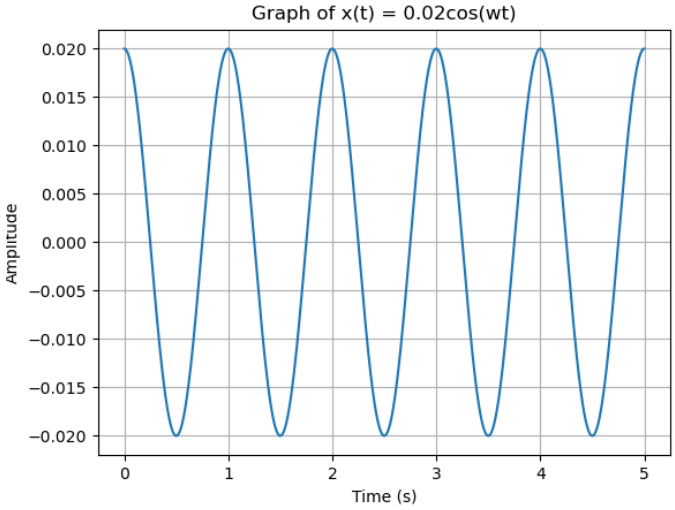

Fig. 2: Enter Caption

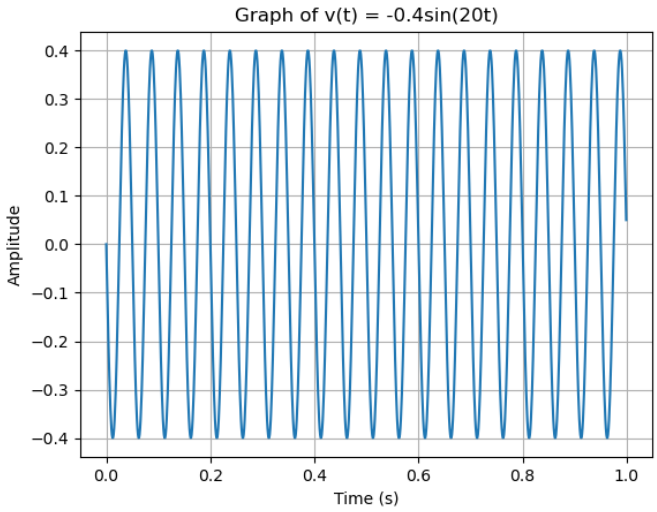

Fig. 3: Enter Caption

(ii)maximum accelaration of mass

$$a(t) = \frac{dv(t)}{dt} = -8\cos 20t \tag{9}$$

$$a_{max} = 8m/s^2 \tag{10}$$

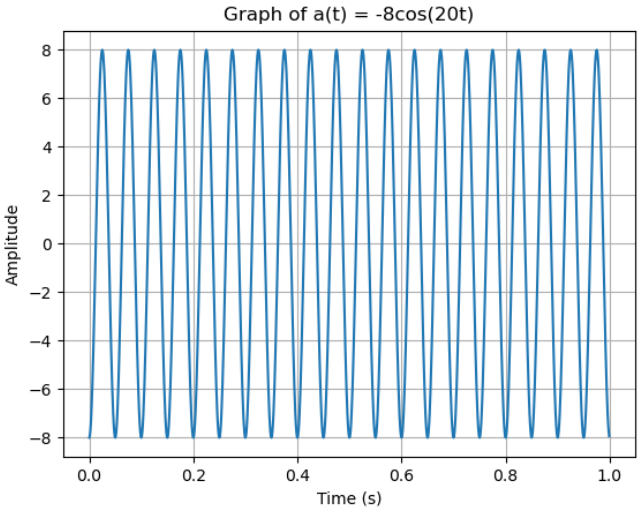

Fig. 4: Enter Caption