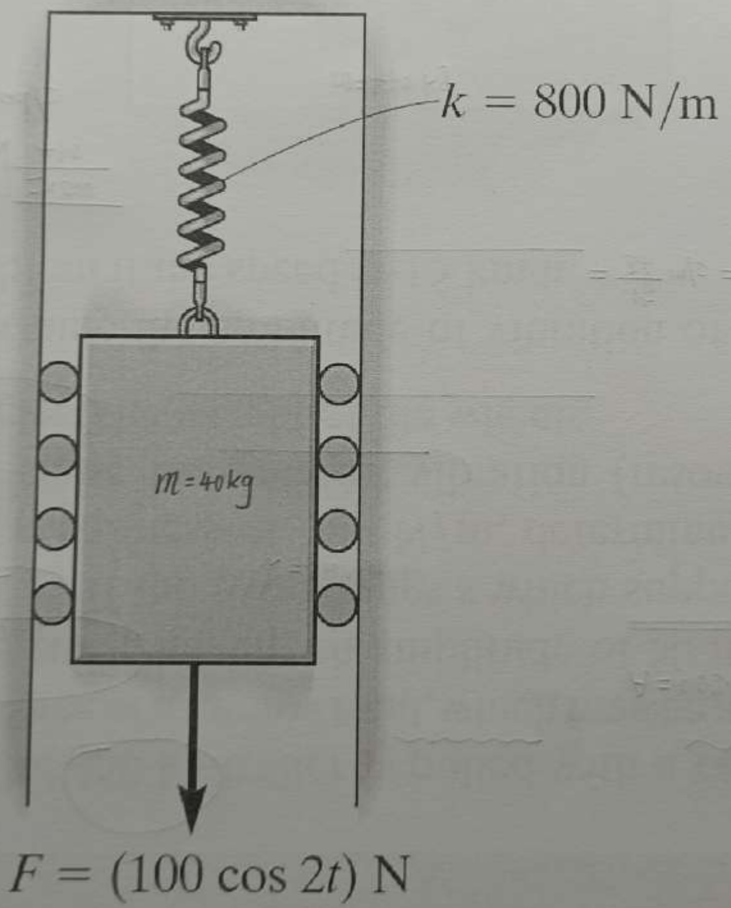
Homework

The 40-kg block is attached to a spring having a stiffness of 800 N/m. A force $F = (\underbrace{100}_{F_0} \cos 2t)$ N, where t is in seconds is applied to the block. Determine the maximum speed of the block for the steady-state vibration.



解: steady-state vibration,
forced vibration

$$x_p(t) = \frac{F_0/k}{1-(\frac{w}{w_n})^2}\sin(wt+\psi)$$

$$F(t) = 100\cos 2t$$

$$\Rightarrow F_0 = 100,\ w = 2$$

$$\therefore \text{amplitude } X = \frac{100/k}{1-(\frac{2}{w_n})^2}\cos 2t$$

$$= \frac{\frac{100}{800}}{1-\frac{4}{\frac{800}{40}}}\cos 2t$$

$$= \frac{5}{32}\cos 2t$$

$$\dot{X} = -\frac{5}{32}\times 2\sin 2t$$

$$= -\frac{5}{16}\sin 2t$$

$$\therefore V_{max} = \frac{5}{16} = 0.3125\ m/s \quad \boxed{ANS}$$

Homework

The 450-kg trailer is pulled with a constant speed over the surface of a bumpy road, which may be approximated by a cosine curve having an amplitude of 50 mm ($A = 0.05m$) and wave length ($\lambda = 4m$) of 4 m. If the two springs s ($k = 800 N/m$) which support the trailer each have a stiffness of 800 N/m, determine the speed v which will cause the greatest vibration (resonance) of the trailer. Neglect the weight of the wheels.

Then determine the amplitude of vibration of the trailer in above problem if the speed v=15 km/h. $= \frac{15}{3.6} m/s = \frac{25}{6} m/s$

解:

resonce occurs : $w = w_n = \sqrt{\frac{2k}{m}} = \sqrt{\frac{2\times 800}{450}}$

$= \frac{4}{3}\sqrt{2}$ rad/s

$T = \frac{2\pi}{w_n} = 3.3322$ s

$v = \frac{\lambda}{T} = 1.2004$ m/s $\boxed{ANS}$

At $V_2 = 15 km/h = \frac{25}{6} m/s$

$w_2 = \frac{2\pi}{T_2} = \frac{2\pi}{\frac{\lambda}{V_2}} = 6.5450$ rad/s

amplitude $X_2 = \frac{X_0}{1-(\frac{w}{w_n})^2} = \frac{0.05}{1-(\frac{6.545}{\frac{4\sqrt{2}}{3}})^2}$

$= -4.5257\times 10^{-3}$ m

∴ amplitude = 4.5257 mm $\boxed{ANS}$