Answers – Week 1

1-1 No, this is not a case of harmonic vibration. The only force acting on the ball is its weight $\left(\vec{W}_g = -Mg\hat{y}\right)$ apart from the force during the elastic collision with Earth (when ball reverses its velocity).

1-3 $P_G = -\dfrac{GM_EM}{R_E+h}$, with $h \ll R_E$

$$P_G = -\frac{GM_EM}{R_E+h} = -\frac{GM_EM}{R_E\left(1+\frac{h}{R_E}\right)} = -\frac{GM_EM}{R_E}\left(1+\frac{h}{R_E}\right)^{-1}$$

$$= -\frac{GM_EM}{R_E}\left(1-\frac{h}{R_E}\right) = -\frac{GM_EM}{R_E} + \frac{GM_EM}{R_E^{\,2}}h$$

But $\dfrac{GM_E}{R_E^{\,2}} = g$

So apart form constant $P_g(h) = Mgh$

The large negative constant makes sure that you stay on Earth.

1-5 $k = k_1 + k_2 = 150$ N/m

1-7 f = 1.25 Hz

1-9 To double ω reduce m by factor of 4.
To double T_o increase m by factor of 4.

1-11 k = 420 N/m

1-13 $\omega = 6.28$ rad/s, so T = 1 sec.

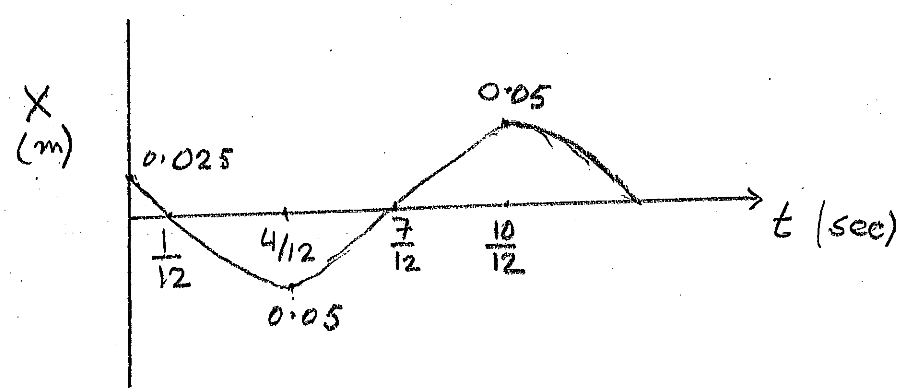
$x = A \operatorname{Cos}\left(6.28t + \frac{\pi}{3}\right)$

FIRST ZERO

at $\dfrac{T}{12} = \dfrac{1}{12}$ sec.

FIRST MAXIMUM

at $\dfrac{4T}{12} = \dfrac{1}{3}$ sec.



$$x = A\ \text{Cos}\left(6.28t - \frac{\pi}{3}\right)$$

<u>FIRST MAXIMUM</u>

$$\frac{T}{6} = \frac{1}{6}\text{sec.}$$

<u>FIRST ZERO</u>

$$\frac{5T}{12} = \frac{5}{12}\text{sec.}$$