Homework Solutions
10/8/2007

Conceptual

6. The spring and weight will eventually stop oscillating due to air resistance and damping within the spring.

Problems

7. a.

$$k = \frac{F}{x} = \frac{15N}{0.01m} = 1500\frac{N}{m}$$

$$U_s = \frac{1}{2}kx^2 = 2\left(\frac{1}{2}\left(1500\frac{N}{m}\right)(0.20m)^2\right) = 60J$$

b.

$$\frac{1}{2}kx^2 = \frac{1}{2}mv^2$$

$$v = \sqrt{\frac{kx^2}{m}} = \sqrt{\frac{\left(1500\frac{N}{m}\right)(0.20m)^2}{0.05kg}} = 49\frac{m}{s}$$

9.

$$KE_i + U_{g,i} + U_{s,i} = KE_f + U_{f,i} + U_{f,i}$$

$$\frac{1}{2}kx^2 = mgh$$

$$k = \frac{2mgh}{x^2} = \frac{2(0.100kg)\left(9.80\frac{m}{s^2}\right)(0.600m)}{(0.020m)^2} = 2940\frac{N}{m}$$

12. a.

$$W = \left(KE_f + U_{f,i} + U_{f,i}\right) - \left(KE_i + U_{g,i} + U_{s,i}\right)$$

$$Fx_f = \frac{1}{2}mv_f^2 + \frac{1}{2}kx^2$$

$$v_f = \sqrt{\frac{2\left(Fx_f - \frac{1}{2}kx^2\right)}{m}} = \sqrt{\frac{2\left((20.0N)(0.300m) - \frac{1}{2}\left(19.6\frac{N}{m}\right)(0300m\right.}{1.50kg}}$$

$$v_f = 2.61\frac{m}{s}$$

b.

$$v_f = \sqrt{\frac{2\left(Fx_f - \mu_k\eta - \frac{1}{2}kx^2\right)}{m}}$$

$$v_f = \sqrt{\frac{2\left((20.0N)(0.300m) - 0.20(1.50kg)\left(9.80\frac{m}{s^2}\right) - \frac{1}{2}\left(19.6\frac{N}{m}\right)(0300m)^2\right)}{1.50kg}}$$

$$v_f = 2.38\frac{m}{s}$$

21. The angle, theta, of the crank pin (orange thingy) in radians is:

$$\theta = \omega t$$

So the x component of the crank pin is:

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

which is harmonic.

26. a. Remember omega is in radians per second so your calculator needs to be in radians.

$$x = (0.30m)\cos\left(\frac{\pi t}{3}\right)$$

$$x = (0.30m)\cos(0) = 0.30m$$

$$x = (0.30m)\cos\left(\frac{\pi(0.60s)}{3}\right) = (0.30m)\cos(0.20\pi) = 0.24$$

b.

$$x_{max} = A = (0.30m)\cos(0) = 0.30m$$

c. Frequency is number of rotations per second. There are 2 times pi radians in one rotation.

$$f = \frac{\omega}{2\pi} = \frac{1}{6}Hz$$

d. Period is the number of seconds per rotation, which is the inverse of frequency.

$$T = \frac{1}{f} = \frac{1}{\frac{1}{6}Hz} = 6.0s$$