Ch. 14- Homework: 9, 15, 18, 22, 27, 31, 39, 43

9) a) 20 cm

b) $f = 1/T$

$f = (1/8)\cdot(2)$

$\boxed{f = .25\ Hz}$

15) $E = \frac{1}{2}mv^2 + \frac{1}{2}kx^2$

a) $E = U_{max} = \frac{1}{2}k\left(\frac{1}{2}A\right)^2$

$U_{max} = \frac{1}{2}k\frac{1}{4}A^2$

$E = K_{max} = \frac{1}{2}mv_{max}^2$

$\boxed{\begin{array}{l}(1/4)\ \text{potential} \\ (3/4)\ \text{kinetic}\end{array}}$

b) $U = \frac{1}{2}E$

$\frac{1}{2}kx^2 = \frac{1}{2}E = \frac{1}{2}\left(\frac{1}{2}kA^2\right)$

$\boxed{x = \frac{A}{\sqrt{2}}}$

18) $T = 12\ s / 10\ oscillations$

$= 1.2\ s$

$T = 2\pi\sqrt{\frac{m}{k}}$

$k = \left(\frac{2\pi}{T}\right)^2 m = \left(\frac{2\pi}{1.2\ sec}\right)^2 (.200\ kg)$

$\boxed{= 5.5\ N/m}$

22) $E_1 = E_2$

$\frac{1}{2}mv_1^2 + \frac{1}{2}kx_1^2 = \frac{1}{2}mv_2^2 + \frac{1}{2}kx_2^2$

$\frac{1}{2}(.30\ kg)(.954\ m/s)^2 + \frac{1}{2}k(.030\ m)^2 = \frac{1}{2}(.30\ kg)(.714\ m/s)^2 + \frac{1}{2}k(.060)^2$

$\frac{1}{2}(.30)(.910) + k(4.5\times10^{-4}) = \frac{1}{2}(.30)(.510) + k(.0018)$

$.137 + k(4.5\times10^{-4}) = .076 + k(.0018)$

$.061 = k(.00135)$

$.00135 \quad .00135$

$\boxed{k \Rightarrow 45.19 \approx 45\ N/m}$

27) $T_{earth} = 2\pi\sqrt{\frac{L_{earth}}{g_{earth}}}$, $T_{moon} = 2\pi\sqrt{\frac{L_{moon}}{g_{moon}}}$

$T_{earth} = T_{moon}$

$2\pi\sqrt{\frac{L_e}{g_e}} = 2\pi\sqrt{\frac{L_{moon}}{g_{moon}}}$

$L_{moon} = \left(\frac{g_{moon}}{g_e}\right)L_e = \frac{1.62\ m/s^2}{9.8\ m/s}(2.00\ m) \boxed{= .33\ m}$

31) a) $\theta t = (0.175\ rad)\sin(\pi t)$

$\theta(.250) = (.175)\sin(\pi(.250))$

$\boxed{\theta = .124\ rad}$

b) $\theta t = A\cos(2\pi f t)$

$\theta(t) = (.175)\sin(\pi t) = \theta t = A\cos(2\pi f t)$

$\pi = 2\pi f$

$1 = 2f \Rightarrow f = 1/2\ Hz$

$T = \frac{1}{f} = 2.00\ s$

c) $f = \frac{1}{2\pi}\sqrt{\frac{mgd}{I}} = \frac{1}{2\pi}\sqrt{\frac{mg(L/2)}{\frac{1}{3}mL^2}} = \frac{1}{2\pi}\sqrt{\frac{3}{2}\frac{g}{L}}$

$T = 1/f \quad \therefore \quad T = 2\pi\sqrt{\frac{2}{3}\frac{L}{g}} \quad \therefore \left(\sqrt{\frac{2}{3}\frac{L}{g}}\right)^2 = \left(\frac{T}{2\pi}\right)^2$

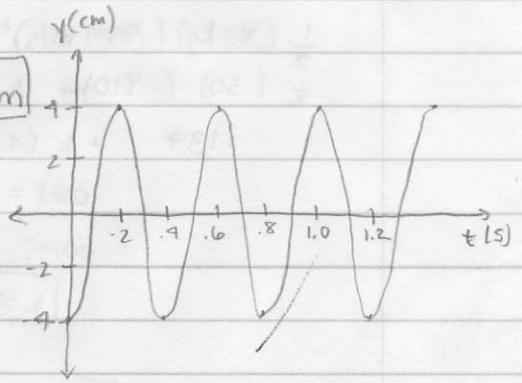
$L = \frac{3}{2}g\left(\frac{T}{2\pi}\right)^2 = \frac{3}{2}(9.8\ m/s^2)\left(\frac{2.00\ s}{2\pi}\right)^2$

$\boxed{= 1.49\ m}$

39) $(F_{sp})_y = -k\Delta y$

a) $k = \frac{mg}{\Delta L} = \frac{(.080\ kg)(9.8\ m/s^2)}{.040\ m} = \boxed{20\ N/m}$

b) $T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{.080\ kg}{20\ N/m}} = \boxed{.40\ s}$ c)



43) $2\pi f = \sqrt{k/m}$

$mg = k\Delta L \Rightarrow k = \frac{mg}{\Delta L}$

$\Delta L = 2.0\ cm$

$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}} = \frac{1}{2\pi}\sqrt{\frac{mg/\Delta L}{m}}$

$= \frac{1}{2\pi}\sqrt{\frac{g}{\Delta L}} = \frac{1}{2\pi}\sqrt{\frac{9.8}{.020\ m}}$

$\boxed{f = 3.5\ Hz}$