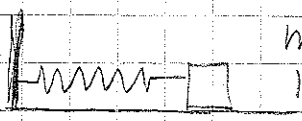
Physics 200 B Assignment 12

1. Ch 15 problem 58



$m = 4.00$ kg, $k = 100$ N/m $A = 2.00$ m → total $E = \frac{1}{2}kA^2$

a) momentum in x direction is conserved when 6.00 kg object dropped on top (perfectly inelastic collision)

as 4 kg mass passes through equilibrium, its speed is given by

$$\frac{1}{2}mv^2 = \frac{1}{2}kA^2 \rightarrow v = \sqrt{\frac{k}{m}}A = \sqrt{\frac{100\ N/m}{4\ kg}}(2m) = 10\ m/s$$

so conservation of momentum gives

$$m_1 v_{ix} = (m_1+m_2)v_{fx} \rightarrow v_{fx} = \frac{m_1}{m_1+m_2}v_{ix} = \frac{4}{10}(10\ m/s) = 4\ m/s$$

and that means the new amplitude A is given by

$$\frac{1}{2}(m_1+m_2)v_f^2 = \frac{1}{2}kA^2$$

$$\rightarrow A = \sqrt{\frac{m_1+m_2}{k}}v_f = \sqrt{\frac{10\ kg}{100\ N/m}}(4\ m/s) = 1.26\ m$$

decreases by 0.74 m

b) period $= 2\pi/\omega = 2\pi\sqrt{\frac{m}{k}}$

initial: $2\pi\sqrt{\frac{4\ kg}{100\ N/m}} = 1.26\ s$

final: $2\pi\sqrt{\frac{10\ kg}{100\ N/m}} = 1.99\ s$ increases by 0.73 s

c) energy $= \frac{1}{2}kA^2$ (mechanical)

initial: $\frac{1}{2}(100\ N/m)(2.00\ m)^2 = 200\ J$

final: $\frac{1}{2}(100\ N/m)(1.26m)^2 = 80\ J$

decreases by 120 J

d) mechanical energy goes to deformation + heat