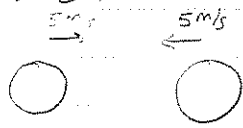


extra credit Ch 7-54



$$D = 25.4 \text{ mm}$$

$$\text{steel - density} \sim \text{iron} = 7.9 \times 10^3 \text{ kg/m}^3$$

a) interaction acts for nonzero  $\Delta t$  (acceleration  $\neq$  infinite)

b) spring constant  $k = F/\Delta x = \frac{16000 \text{ N}}{0.2 \times 10^{-3} \text{ m}} = 8.0 \times 10^7 \text{ N/m}$

c)  $KE = \frac{1}{2} mv^2$       $m = \rho V = (7.9 \times 10^3 \text{ kg/m}^3) \left(\frac{4}{3}\pi\right) \left(\frac{25.4 \times 10^{-3} \text{ m}}{2}\right)^3 = 0.068 \text{ kg}$   
so KE of one =  $\frac{1}{2} (0.068 \text{ kg}) (5 \text{ m/s})^2 = 0.85 \text{ J} = K_i$

d) each ball is like a spring with  $k = 8.0 \times 10^7 \text{ N/m}$ , and compresses from  $x_i = 0$  to  $x_f$ ,  
so to stop, work done by other ball =  $\Delta KE$       $\text{OO} \rightarrow \text{OO}$   
when  $v = 0$

$$\frac{1}{2} k x_i^2 - \frac{1}{2} k x_f^2 = K_f - K_i$$

$$0 - \frac{1}{2} k x_f^2 = 0 - K_i$$

$$\Rightarrow x_f = \sqrt{\frac{2K_i}{k}} = \sqrt{\frac{2(0.85 \text{ J})}{8 \times 10^7 \text{ N/m}}} = 1.5 \times 10^{-4} \text{ m} \\ = 0.15 \text{ mm}$$

e) ball goes from  $5 \text{ m/s}$  to  $0 \text{ m/s}$  in  $\Delta x = 0.15 \text{ mm}$

if  $a = \text{const} \Rightarrow v_f^2 = v_i^2 + 2a\Delta x$

$$0 = (5 \text{ m/s})^2 + 2a(1.5 \times 10^{-4} \text{ m}) \rightarrow a = -2.3 \times 10^4 \text{ m/s}^2$$

$$\text{so } a = \frac{\Delta v}{\Delta t} \rightarrow \Delta t \sim \frac{\Delta v}{a} = \frac{0 - 5 \text{ m/s}}{-2.3 \times 10^4 \text{ m/s}^2} = 6 \times 10^{-5} \text{ s} \\ \sim 10^{-4} \text{ s}$$