

### Exam III - Practice Problems

9- A) The speaker is undergoing SHM, with the motion of the diaphragm completely analogous to that of a spring.

$$m = 50g \quad A = 1.8 \times 10^{-4} m \quad \omega = 2\pi f = 12.5 \times 10^3 / s$$

The maximum Force is  $kx$ , with  $x = 1.8 \times 10^{-4} m$   
To find  $k$  we use elastic Formula

$$\omega = \sqrt{\frac{k}{m}} \quad k = \omega^2 m = \frac{7.8 \times 10^6 kg}{s^2} = k$$

$$F = kx = 7.8 \times 10^6 \times 1.8 \times 10^{-4} m = \boxed{1.4 \times 10^3 N}$$

B) at max displacement (A) all the mechanical Energy is elastic potential Energy

$$U = \frac{1}{2} kx^2 = .13 J$$

10- ~~stress,  $F/A$  is breaks hair~~ Hair breaks when the stress,  $F/A$  is equal to tensile strength

$$\frac{1.2 N}{A} = 2 \times 10^8 N/m^2 \Rightarrow A = .6 \times 10^{-8} m^2 = 6 \times 10^{-9} m^2$$

$$\text{but } A_{\text{circle}} = \left(\frac{d}{2}\right)^2 \pi = \frac{d^2}{4} \pi = 6 \times 10^{-9} m^2 \Rightarrow d = \frac{240}{\pi} \times 10^{-8} m^2$$

$$d = \sqrt{76.4 \times 10^{-4} m} = \boxed{8.7 \times 10^{-4} m}$$

11) Momentum of rifle + bullet system is 0 initially & 0 Finally

$$0 = p_{\text{bullet}} + p_{\text{rifle}} \quad p_{\text{rifle}} = -m_{\text{bullet}} v_{\text{bullet}} = 10g \cdot 820 m/s = 8,200 \frac{mg}{s}$$

$$p_{\text{rifle}} = M_{\text{rifle}} v_{\text{rifle}} = 4.5 \times 10^3 g \cdot v = 8.2 \times 10^3 g \cdot m/s$$

$$v = \frac{8.2}{4.5} m/s = \boxed{1.8 m/s}$$

12  $P_{\text{power}} = \frac{\Delta E}{\Delta t}$   $\Delta t = 40 \text{ sec}$   $\Delta E = mgh = 20kg \cdot 9.8 \frac{m}{s^2} \cdot 4m$

$$\Delta E = 784 J$$

$$P = 19.6 \text{ Watts}$$