19) 1, 3, 6

15) $\text{max } a = \omega^2 A = \frac{\mu \cancel{m} g}{\cancel{m}}$

$$\Rightarrow A = \frac{\mu g}{\omega^2} = \frac{(.63)(9.8)}{[2\pi(2.35)]^2} = \boxed{2.83\,\text{cm}}$$

opps... this wasn't assigned. A bonus (?)

7) $\omega = \sqrt{\frac{k}{m}} \Rightarrow k = \omega^2 m = (2\pi f)^2 m = (2\pi\, 2.95)^2 \frac{1460}{4}$

b) $f = \frac{\omega}{2\pi} = \frac{1}{2\pi}\sqrt{\frac{4(125000)}{1460 + 5(73.2)}} = \boxed{2.63\,\text{Hz}}$ $\qquad = \boxed{1.25 \times 10^5\ \text{N/m}}$

19)

$x(t) = A\cos(\omega t + \phi)$

$A = L/2$

$T = 3/2\,\text{s} \Rightarrow \omega = 2\pi f = \frac{2\pi}{T} = \frac{2\pi\, 2}{3} = \boxed{\frac{4\pi}{3}}$

$x(t) = \frac{L}{2}\cos\left(\frac{4\pi}{3}t + \phi\right)$

$x_{LAG} = \frac{L}{2}\cos\left(\frac{4\pi}{3}t\right) = L/2$ (end of path) at $t = 0$

$x_{LEAD} = \frac{L}{2}\cos\left(\frac{4\pi}{3}t + \pi/6\right)$

meets initial conditions at $t = 0$

$$\left|x_{LEAD} - x_{LAG}\right|_{t=1/2} = \left|\frac{L}{2}\cos\left(\frac{4}{3}\frac{\pi}{2} + \pi/6\right) - \frac{L}{2}\cos\left(\frac{4\pi}{3}\frac{1}{2}\right)\right|$$

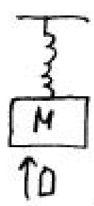
$$= \frac{L}{2}\left\{\cos\frac{5\pi}{6} - \cos\frac{4\pi}{6}\right\} = \boxed{.183\,L}$$

$v_{LAG} = -\omega A \sin(\omega t + \phi) \rightarrow \left(-\frac{4\pi}{3}\right)\left(\frac{L}{2}\right)\sin\left(\frac{4\pi}{3}t\right) \overset{t=1/2}{=} -\frac{4\pi L}{6}\sin\frac{4\pi}{6}$

$v_{LEAD} = \left(-\frac{4\pi}{3}\right)\left(\frac{L}{2}\right)\sin\left(\frac{4\pi}{3}t + \phi\right) \overset{t=1/2}{=} -\frac{4\pi L}{6}\sin\frac{5\pi}{6}$

same sign, hence same direction

36)



from conservation of $\vec{p} \Rightarrow (M+m)v_f = mv$

$v_f = \frac{m_b v_b}{M + m_b}$

v of block right after being struck by bullet

$A\omega = v_f$

$\Rightarrow A = \frac{v_f}{\omega} = v_f\sqrt{\frac{m}{k}}$ where $m = M + m_b$

$$\Rightarrow A = \frac{m_b v_b}{(M + m_b)}\sqrt{\frac{M + m_b}{k}}$$

$$= \frac{m_b v_b}{\sqrt{(M + m_b)k}} = \frac{(.05)(150)}{\sqrt{(4.00 + .05)(500)}} = 16.7\,\text{cm}$$

36) b.

original $KE = \frac{1}{2} m_B v_B^2$

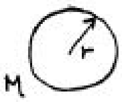
ME in oscillator $= \frac{1}{2}(M+m_B) v_f^2$

ratio: $\dfrac{(M+m_B)\left(\dfrac{v_B m_B}{M+m_B}\right)^2}{m_B v_B^2} = \dfrac{v_B^2 m_B^2}{(M+m_B) m_B v_B^2} = \dfrac{m_B}{M+m_B}$

$= \dfrac{.05}{4.05} = .0123 \Rightarrow \boxed{1.23\%}$

46) $I = \frac{2}{5} m r^2$

$\tau = I\ddot{\theta} = -k\theta$



M

$\Rightarrow \ddot{\theta} + \dfrac{k}{I} = 0$ where $k = \tau/\theta$

So $\omega = \sqrt{\dfrac{\tau}{\theta I}} \Rightarrow T = \dfrac{2\pi}{\omega} = 2\pi\sqrt{\dfrac{I\theta}{\tau}}$

$= 2\pi\sqrt{\dfrac{2mr^2}{5}\dfrac{.850}{(.192}} = 2\pi\sqrt{\dfrac{2(95.2)(.148)^2(.850)}{5\,(.192)}} = \boxed{12.1\text{ s}}$

1) $v = \dfrac{\lambda}{T} \Rightarrow T = \dfrac{\lambda}{v} = \dfrac{3.27\times10^{-2}\text{ m}}{243\text{ m/s}} = \boxed{135\ \mu s}$

$f = \dfrac{1}{T} = \boxed{7.43\text{ kHz}}$

3) This time is 1/4 of a period. So $T = 4 * 178\text{ ms} = \boxed{.712\text{ s} = T}$

$f = \dfrac{1}{T} = \boxed{1.40\text{ Hz}}$ $\quad v = \dfrac{\lambda}{T} \Rightarrow \dfrac{1.38}{.712} = \boxed{1.94\text{ m/s}}$

6) $v = \dfrac{\lambda}{T} \Rightarrow \lambda = vT = \dfrac{v}{f} = \dfrac{353}{493} = \boxed{.716\text{ m}}$

a) $\Delta x = \dfrac{55.0}{360.0}\lambda = \boxed{.109\text{ m}}$

$\dfrac{\Delta\theta}{360} = \dfrac{1.12\text{ ms}}{1/493} \Rightarrow \Delta\theta = (1.12\times10^{-3})(360)(493) = \boxed{199^\circ}$