Phys 2110-4 11/11/11

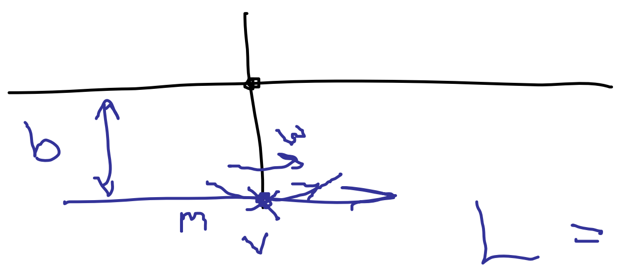
Note Title 11/11/2011

Chap 11 Ang mom:

$$L = I\omega$$

pos or neg

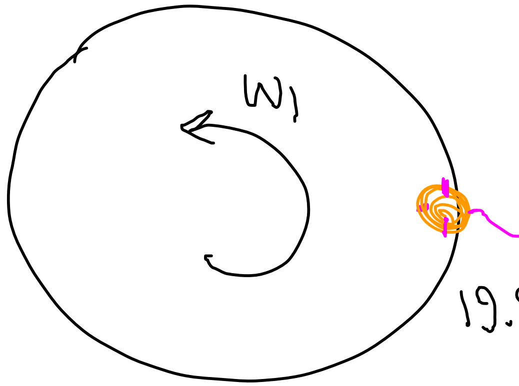
Units $\frac{kg\,m^2}{s} = J\cdot s$



$I\omega$

$$L = mr^2\left(\frac{v}{r}\right) = \frac{mbv}{mrv}$$

11.38



$r = 25$ cm

$I = 0.0154\ \text{kg m}^2$

$\omega_1 = 22.0$ rpm

$= 2.304\ \frac{\text{rad}}{\text{s}}$

No net ext. torque

L_{Tot} is conserved

$L = I\omega$ $\quad I\downarrow \omega\uparrow$

$$L_1 = \overbrace{\left[0.0154\ \text{kg m}^2 + (0.019\ \text{kg})(0.25\ \text{m})^2\right] \cdot \left(2.304\ \frac{\text{rad}}{\text{s}}\right)}^{I_1\omega_1}$$

$$L_2 = \overbrace{\left[0.0154\ \text{kg m}^2\right]\omega_2}^{I_2\omega_2}$$

Get $\omega_2 = 2.48\ \frac{\text{rad}}{\text{s}} = 23.7$ rpm

Energy $E_1 = \frac{1}{2} I_1 \omega_1^2$

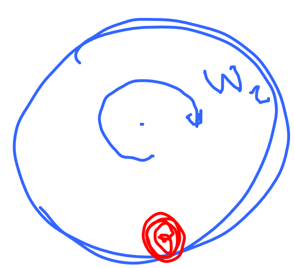
$E_2 = \frac{1}{2} I_2 \omega_2^2$

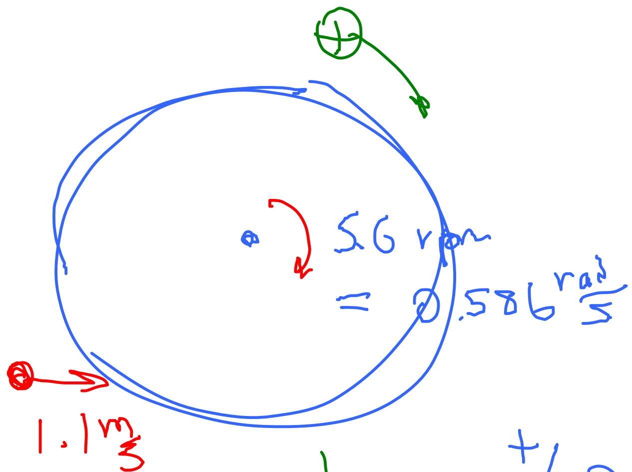
$\Delta E = \Delta K \sim +3.3 \times 10^{-3}\ J$

$\Delta E = E_2 - E_1$

Work by mouse

11.43 A circular bird feeder 19 cm in radius. has rot'l inertia 0.12 kg m^2 Suspended by wire spinning slowly at 5.6 rpm. 140-g bird lands on rim, comes in tangent to rim at 1.1 $\frac{m}{s}$ in dir opp feeder's rotation. What's rotn rate after bird lands?





Ang mom is conserved

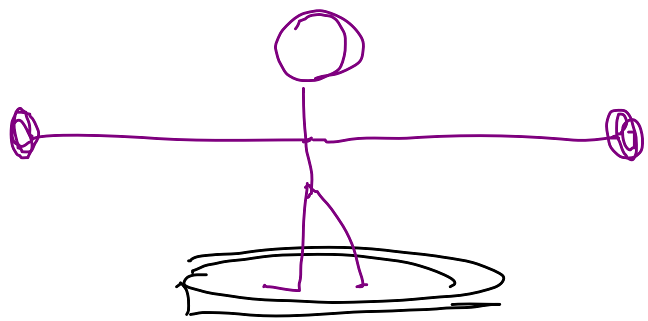
Bird feeder

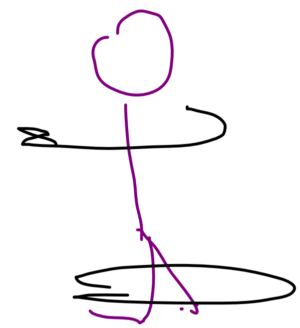
$$L_1 = +\underbrace{(0.12\,kg\,m^2)}_{I}\underbrace{\left(0.586\,\tfrac{rad}{s}\right)}_{\omega} - \underbrace{(0.140\,kg)}_{m}\underbrace{\left(1.1\,\tfrac{m}{s}\right)}_{v}\underbrace{(0.19\,m)}_{b}$$

$$= L_2 = I_{total}\,\omega_2$$

$$= \Big[\underbrace{0.12\,kg\,m^2}_{\text{feeder}} + \underbrace{(0.140\,kg)(0.19\,m)^2}_{\text{bird}}\Big]\,\omega_2$$

$$\boxed{\omega_2 = 0.328\,\tfrac{rad}{s}}$$





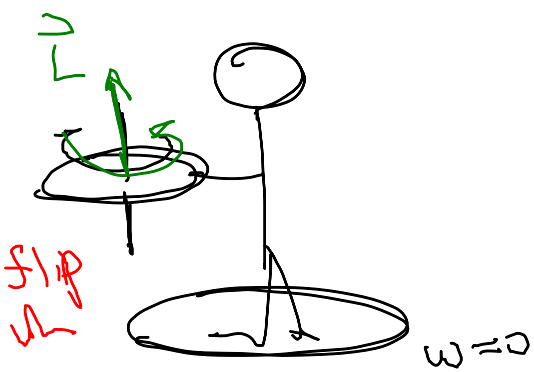
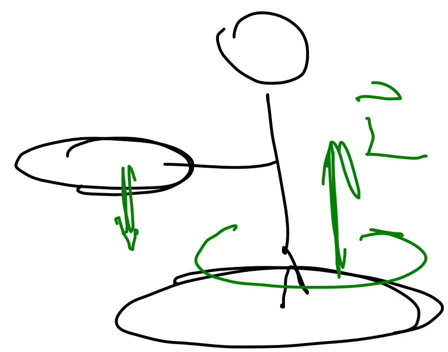
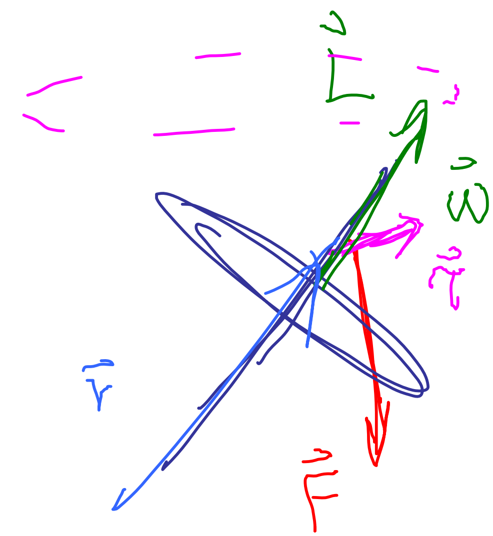


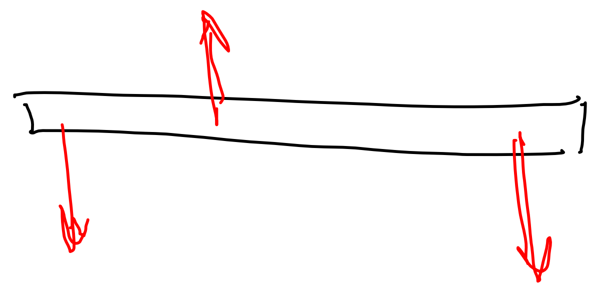
Fig 11.8





Conventional approach

Statics



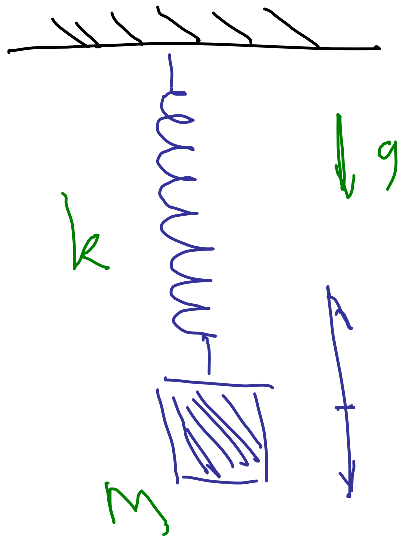
Chap 12

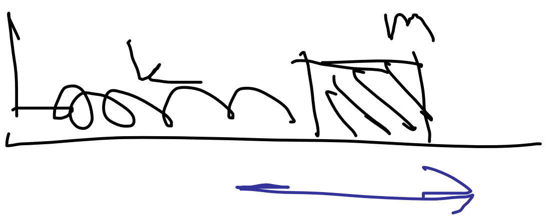
Skip!

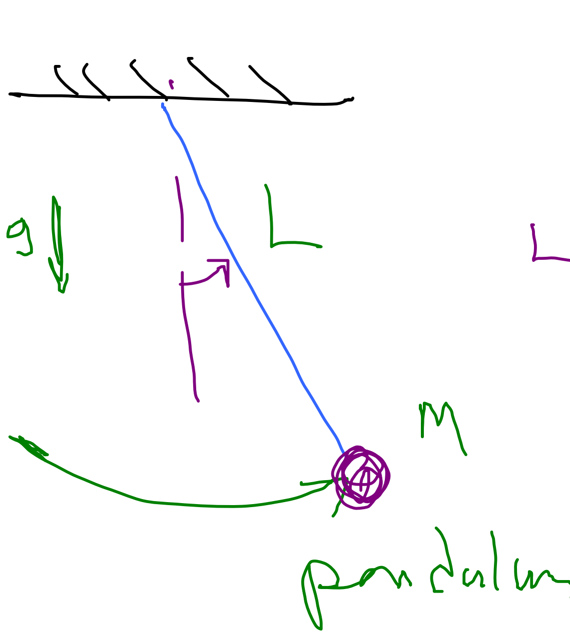
Static

Solve for forces

Chap 13 Oscillations



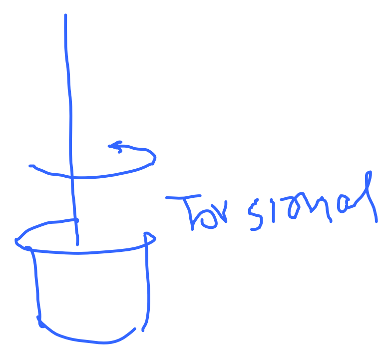


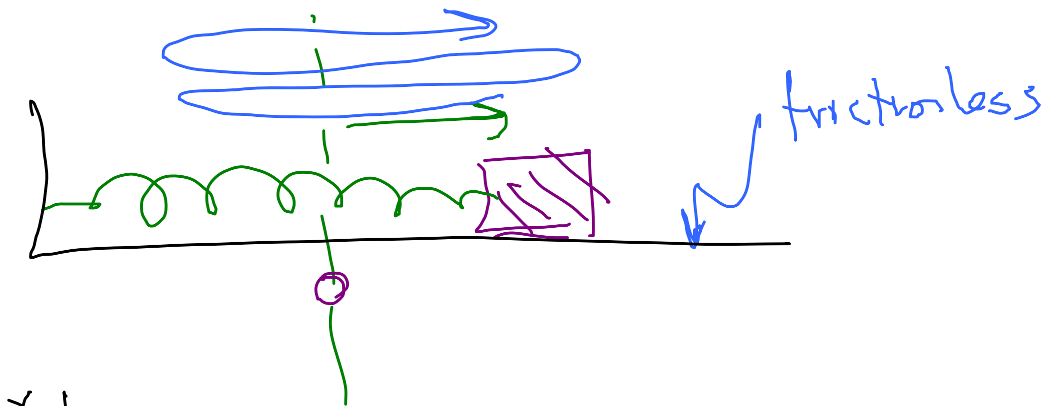


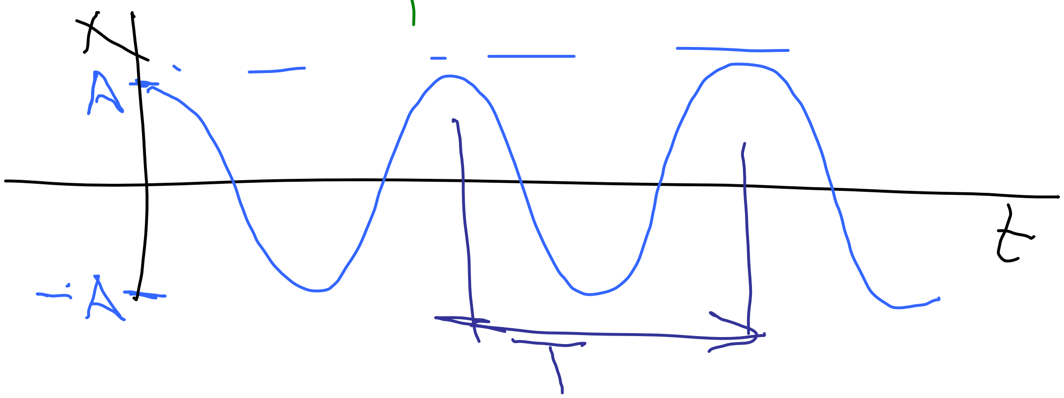
periodic

Restoring force

Linear restoring force







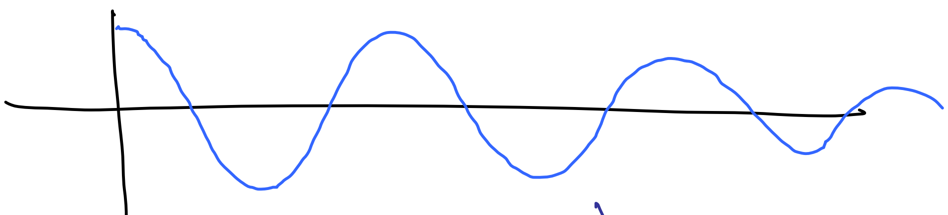
Amplitude

T = period, seconds

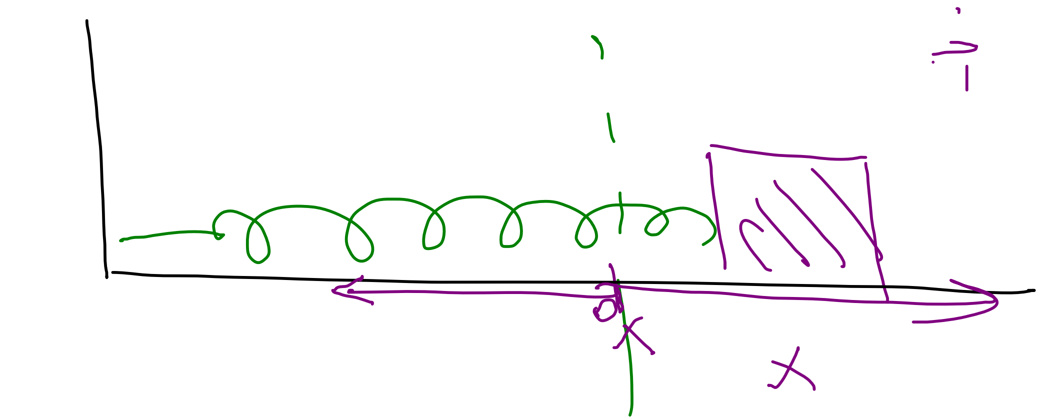
frequency $= f = 1/T$

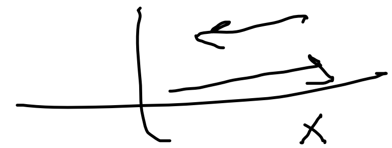
$= \text{osc's}/\text{sec}$

Hertz $=$ Hz



$\omega = 2\pi f = \frac{\text{rad}}{s}$





N's 2nd law

$$F_x = -kx = ma = m\frac{d^2x}{dt^2}$$

algebra

$$\boxed{\frac{d^2x}{dt^2} = -\frac{k}{m}x}$$

Fma $x(t)$

$$\frac{d^2x}{dt^2} = -\frac{k}{m}x \qquad x(t)$$

Find a function. Define $\omega^2 = k/m$ $\quad \omega = \sqrt{k/m}$

$$\frac{d^2x}{dt^2} = -\omega^2 x \qquad \underline{\text{Diff. eqn.}}$$

Soln:

$$\sin(\omega t) \longrightarrow -\omega^2 \sin(\omega t)$$

$$\cos(\omega t) \longrightarrow -\omega^2 \cos(\omega t)$$

Solution:

$$x(t) = C_1 \cos(\omega t) + C_2 \sin(\omega t)$$

C's depend on initial conditions.

Pull back & let go

$$x(t) = C_1 \cos(\omega t)$$
$$= A \cos(\omega t)$$