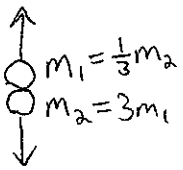
HW #6

Ch.8 #64



$m_1 + m_2 = 2400$

$m_1 + 3m_1 = 2400$

$4m_1 = 2400$

$m_1 = 600\ kg \quad m_2 = 1800\ kg$

$p_1 + p_2 = 0$

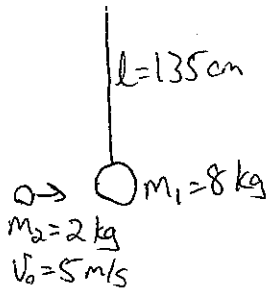
$m_1 v_1 + m_2 v_2 = 0$

$600 v_1 + 1800 v_2 = 0$

$v_2 = -\frac{1}{3} v_1 \Rightarrow \Delta x = vt$ so $\Delta x = -\frac{1}{3}\Delta x_{m_1} = -\frac{1}{3}(274) = -91.3\ m.$

or **91.3 m South**

Ch.8 #81



$p_0 = m_2 v_0 = 10\ kg\,m/s$

$v_{fs} = \frac{2m_2}{m_2 + m_1} v_0 = \frac{2(2)}{2+8} 5$

$= 2\ m/s$

$F_c = \frac{mv^2}{r} = \frac{8(2)^2}{1.35}$

$T = F_c + F_g = 23.7\ N + mg = 23.7 + 78.4 = \boxed{102\ N}$

Ch. 9 #43

a) $\omega = \frac{1\text{ rev}}{27.3\text{ days}} = \frac{2\pi\text{ rad}}{27.3\text{ days}} \cdot \frac{1\text{ day}}{24\text{ hr}} \cdot \frac{1\text{ hr}}{60\text{ min}} \cdot \frac{1\text{ min}}{60\text{ sec}} = 2.7\times10^{-6}\ \frac{\text{rad}}{\text{s}}$

$I = \frac{2}{5}mr^2$

$= \frac{2}{5}(7.35\times10^{22})(1.74\times10^{6})^2$

$= 8.9\times10^{34}\ \text{kg}\cdot\text{m}^2$

$E = \frac{1}{2}I\omega^2 = \frac{1}{2}(8.9\times10^{34})(2.7\times10^{-6})^2 = \boxed{3.24\times10^{23}\ \text{J}}$

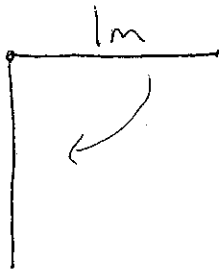
b) $E_0 = 4\times10^{20}\ \text{J}$

$E_f = 5\cdot E_0 = 2\times10^{21}\ \text{J}$

$\#\text{years} = E/E_f = \frac{3.24\times10^{23}}{2\times10^{21}} = 162\text{ years}.$

No.

Ch. 9 #83



$m = 0.16\text{ kg}$

a) center of mass dropped 0.5 m.

$\Delta PE = mgh = 0.16(9.8)(0.5) = \boxed{0.784\text{ J}}$

b) $0.784 = \frac{1}{2}I\omega^2$

$I = \frac{ml^2}{3} = 0.053$

$0.784 = \frac{1}{2}(0.053)\omega^2$

$\omega^2 = 29.6$

$\omega = \boxed{5.44\ \text{rad/s}}$

c) $v = \omega r = \boxed{5.44\ \text{m/s}}$

d) $v^2 = 2a\Delta x$

$v^2 = 2(9.8)(1)$

$v^2 = 19.6$

$v = \boxed{4.43\ \text{m/s}}$

End of meter stick is faster.

Ch.9 #98

a) $P = 5\times10^{31}\ W$

$\omega = \frac{1\ rev}{0.0331s} = \frac{2\pi\ rad}{0.0331s.} = 189.8\ rad/s$

period $= T = 0.0331s.$

$\frac{dT}{dt} = 4.22\times10^{-13}\ s.$

$\omega = \frac{2\pi}{T} \Rightarrow \frac{d\omega}{dt} = -\frac{2\pi}{T^2}\frac{dT}{dt} = -\frac{2\pi}{0.0331^2}(4.22\times10^{-13}) = -2.42\times10^{-9}\ \frac{rad}{s^2} = \alpha$

$KE = \frac{1}{2}I\omega^2$

$\frac{d(KE)}{dt} = P = I\omega\frac{d\omega}{dt} = I\omega\alpha$

$5\times10^{31} = I(189.8)(+2.42\times10^{-9})$

$I = \boxed{1.09\times10^{38}\ kg\cdot m^2}$

b) $I = \frac{2}{5}mr^2 = 1.09\times10^{38}$

$\frac{2}{5}(1.4)(1.99\times10^{30})r^2 = 1.09\times10^{38}$

$r^2 = 9.8\times10^{7}$

$r = 9.9\times10^{3}\ m = \boxed{9.9\ km.}$

c) $v = \omega r = 189.8 \cdot 9.9\times10^{3}$

$= \boxed{1.88\times10^{6}\ m/s} \approx 0.63\%$ speed of light.

d) $\rho = \frac{M}{V} = \frac{M}{\frac{4}{3}\pi r^3} = \frac{1.4(1.99\times10^{30})}{\frac{4}{3}\pi(9.9\times10^{3})^3} = \boxed{7.05\times10^{17}\ kg/m^3}$

VERY DENSE!