CQ 7.9

The planet exert a gravitional force on its moon. This force has to be equal to the centripetal acceleration of the moon that the moon stays in a stationary orbit.

$$\Rightarrow \quad m_{MOON}\,\omega^2 r = G\,\frac{M_{PLANET}\,m_{MOON}}{r^2}$$

$$\Rightarrow \quad M_{PLANET} = \frac{m_{MOON}\,\omega^2 r^3}{G\,m_{MOON}} = \frac{\omega^2 r^3}{G}$$

By observing ω and r we know M_{PLANET}.

CQ 7.11

Through the rotation, we have a centripedal force $F = m\omega^2 r$, Now we make $\omega^2 r = g$, so that the force is equal to the gravitional force on earth. ~~usr equal~~

By I. B. B.
On 10/23/2003

CQ 8.9

You want transfer the potential energy mgh in translation energy $\frac{1}{2}mv^2$ and not in rotational energy of the wheels.
So the ~~the~~ moment of inertia has to be as small as possible. Therefor make the mass of the wheel as small as possible and discwise wheels have a smaller motion of inertia as hooplike wheels.

CQ 8.11:

The angular momentum is conserved. So when the cloud shrinks it gets a smaller motion of inertia. Since $L = I\omega$ is constant, when I decreases ω has to increase.

By	I. B. B.
On	10/24/2003

P. 7.12

Coin, radius: 1.20 cm

$\omega_0 = 18.0 \ \frac{rad}{s}$

$1.90 \ \frac{rad}{s^2}$

$\omega_0 - \alpha \cdot t = 0$

$t = \frac{\omega_0}{\alpha} = 9.47 s$

$x = \omega_0 \cdot t \cdot r - \frac{1}{2} \alpha \cdot t^2 \cdot r$

$= 1.023 m$

P. 7.23

$a = \omega^2 r$

$a = \left(3.00 \ \frac{rad}{s}\right)^2 \times 2.00 m = 18 \ \frac{m}{s^2}$

$F = m \omega^2 r$

$= 50 kg \cdot 9 \left(\frac{rad}{s}\right)^2 \times 2.00 m = 900 N$

$900 N \leq 50 kg \times 9.80 \frac{m}{s^2} \times \mu_s$

$(F \leq m g \mu_s)$

$\Rightarrow \mu_s \geq \frac{900 N}{50 kg \times 9.8 \frac{m}{s^2}} = 1.837$

Not reasonable
Normal $\mu_s < 1$.

By I. Z. Z.
On 10/24/2003

P. 7.25

a) $ma = mg - T$ = Force on mass hanging down the whole in the table.

Since this mass is in equilibrium $\Rightarrow a = 0$

$\Rightarrow T = mg = 1.0\,kg \times 9.80\,\frac{m}{s^2} = 9.8\,N$

b) $F = m_2 \omega^2 r = T = gm = 9.8\,N$

c) $m_2 \omega^2 r = m g$

$$\boxed{\begin{aligned} m &= 1.0\,Kg \\ m_2 &= 0.25\,Kg \\ r &= 1.0\,m \end{aligned}}$$

$\omega = \frac{v}{r}$

$\Rightarrow m_2 v^2 \frac{1}{r} = mg$

$\Rightarrow v^2 = \frac{m}{m_2} g r$

$\Rightarrow v = \sqrt{\frac{m}{m_2} g r} = 6.26\,\frac{m}{s}$

By I.B.B.
On 10/24/2003

P. 8.36

$M = 5.00\,Kg$ reel , $r = 0.600\,m$
$m = 3.00\,Kg$ bucket
$t = 4.0\,s$

a) $ma = mg - T$

$\vec{N} = \vec{r} \times \vec{T} \Rightarrow rT = N = I\dot{\omega} = I\alpha$ $\qquad \alpha = \frac{\omega}{t} = a/r$

$\Rightarrow T = I\frac{\alpha}{r} = I\frac{a}{r^2}$

$I = \frac{1}{2}Mr^2$

$$\Rightarrow ma = mg - \left(\frac{1}{2}Mr^2\right)\frac{a}{r^2}$$

$$ma + \frac{1}{2}Mr^2\frac{1}{r^2}a = mg$$

$$\Leftrightarrow a\left(m + \frac{1}{2}M\right) = mg$$

$$\Leftrightarrow a = \frac{mg}{m + \frac{1}{2}M}$$

$$a = \cancel{\frac{5.00\,Kg}{5.00\,Kg +}} \; \frac{3.00\,Kg}{3.00\,Kg + 2.50\,Kg} \times 9.80\,\frac{m}{s^2}$$

$$= \underline{\underline{5.35\,\frac{m}{s^2}}}$$

to P. 8.36

b) $x = \frac{1}{2} a t^2 + v_0 t$

$v_0 = 0, \; t = 4s, \; a = 5.35 \frac{m}{s^2}$

$x = \frac{1}{2} a t^2$

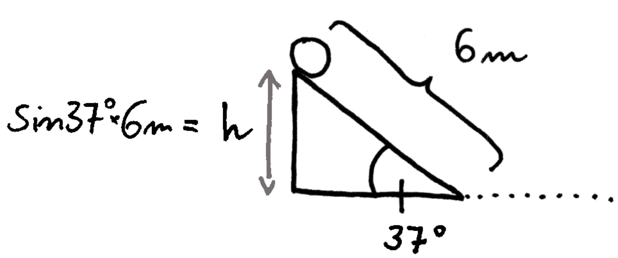
$= \frac{1}{2}\, 5.35 \frac{m}{s^2} \cdot (4s)^2$

$= \underline{\underline{42.8\, m}}$

c) $\dot{\omega} = \alpha = \frac{a}{R}$

$\alpha = \frac{5.35 \frac{m}{s^2}}{0.6\, m} = \underline{\underline{8.92 \frac{1}{s^2}}}$

P. 8.44



I for sphere: $\frac{2}{5} m R^2$ $\quad R = 0.2\, m$

$v_0 = 0 \Rightarrow \omega_0 = 0$

$\omega = ?$

Conservation of Energy: $m \cdot g \cdot h = \frac{1}{2} m v^2 + \frac{1}{2} I \omega^2$

$\Rightarrow m \cdot g \cdot (6m \sin 37°) = \frac{1}{2} m \underbrace{\left(\frac{v}{r}\right)^2 r^2}_{= v^2} + \frac{1}{2} \underbrace{\frac{2}{5} m r^2}_{= I} \omega^2 \quad : m$

$g \times 6m \times \sin 37° = \frac{1}{2} \omega^2 r^2 + \frac{1}{5} r^2 \omega^2 = \left(\frac{1}{2} r^2 + \frac{1}{5} r^2\right) \omega^2$

$\Rightarrow \omega^2 = \frac{g \times 6\, m \times \sin 37°}{\frac{1}{2} r^2 + \frac{1}{5} r^2} \Rightarrow \omega = \sqrt{\quad " \quad} = 35.55 \frac{1}{s}$

P. 8.54

Angular momentum is conserved !
(be careful, when people walk to the center, they do work and change the energy of the system).

$$L = \omega_1 I_1 = \omega_2 I_2 \quad , \quad I = 5.00 \times 10^8 \, Kg \, m^2$$

$$, \quad R = 100 \, m$$

$$I_1 = I + (150 \times R^2 \times 65 Kg)$$

$$I_2 = I + (50 \times R^2 \times 65 Kg)$$

$$\Rightarrow \quad \frac{\omega_1}{\omega_2} = \frac{I_2}{I_1} \qquad \frac{\omega_1}{\omega_2} = 0.89$$

$$\omega_1^2 r = g$$

$$\omega_2^2 r = g \left(\frac{\omega_2}{\omega_1}\right)^2 = g \times 1.26 = 12.35 \, \frac{m}{s^2}$$