PHYS - 2414 HW # 10 SOLUTIONS

1. Giancoli6 8.P.055. [354342] **0/2 points** Show Details

A figure skater during her finale can increase her rotation rate from an initial rate of 1.0 rev every $\boxed{1.8}$ s to a final rate of 3.0 rev/s. If her initial moment of inertia was $\boxed{5.7}$ kg·m^2, what is her final moment of inertia?

✗ $\boxed{1.06}$ kg·m^2

How does she physically accomplish this change?

- **(o)** by pulling her arms closer to her body
- (_) by pushing her arms away from her body
- (_) by lifting her arms over her head

✗

Sol: Since there is no net torque, change in angular momentum of figure skater is zero.

$$\Delta L = 0 \quad \Rightarrow \quad \underbrace{L_i}_{\text{initial}} = \underbrace{L_f}_{\text{final}}$$

angular momentum $L = I\omega$ — I: Moment of Inertia, ω: angular momentum

$$I_i \omega_i = I_f \omega_f$$

Given Initial frequency $f_i = \dfrac{1.0}{\boxed{1.8}} \dfrac{\text{rev}}{\text{sec}}$

Final frequency $f_f = 3.0 \dfrac{\text{rev}}{\text{sec}}$

Initial moment of Inertia $I_i = \boxed{5.7}$ kg m^2.

$$\omega_i = 2\pi f_i = 2\pi \frac{1.0}{\boxed{1.8}} \frac{\text{rad}}{\text{sec}} = \boxed{3.491} \text{ rad/sec}$$

$$\omega_f = 2\pi f_f = 2\pi \, 3.0 \frac{\text{rad}}{\text{sec}} = 18.85 \text{ rad/sec}.$$

$$I_i \omega_i = I_f \omega_i$$

$$\left(\boxed{5.7} \text{ kg m}^2\right)\left(\boxed{3.491} \text{ rad/sec}\right) = I_f \left(18.85 \text{ rad/sec}\right)$$

$$I_f = \boxed{1.056} \text{ kg m}^2 = \boxed{1.06} \text{ kg m}^2$$

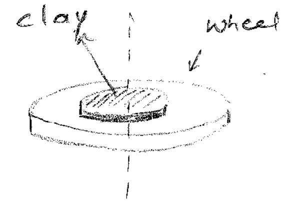
Increase in angular velocity has to be compensated by decrease in moment of inertia such that angular momentum is constant. Since $I = \sum_i m_i r_i^2$, by pulling her arms closer to her body (axis of rotation) she can reduce r_i's thereby decreasing her final moment of inertia.

2. Giancoli6 8.P.056. [354319] **0/1 points** Show Details

A potter's wheel is rotating around a vertical axis through its center at a frequency of $\boxed{1.4}$ rev/s. The wheel can be considered a uniform disk of mass $\boxed{5.8}$ kg and diameter 0.40 m. The potter then throws a 3.1 kg chunk of clay, approximately shaped as a flat disk of radius 8.0 cm, onto the center of the rotating wheel. What is the frequency of the wheel after the clay sticks to it?

✗ $\boxed{1.29}$ rev/s

Sol: Since, chunk of clay sticks to the wheel, this is perfectly inelastic collision. Therefore, only angular momentum 'L' is conserved. After collision both clay and wheel rotate with same angular velocity ω_f.



$$I_i \omega_i = I_f \omega_f$$

$$I_W \omega_i = (I_W + I_c)\,\omega_f \quad — (1)$$

I_W = moment of inertia of wheel

I_c = moment of inertia of clay.

Given: Mass of wheel $m_W = \boxed{5.8}$ kg.

Diameter of wheel $d_W = 0.40$ m.

Initial frequency $f_i = \boxed{1.4}$ rev/sec. $\Rightarrow \omega_i = 2\pi f_i = \boxed{8.796}\ \frac{rad}{sec}$.

Mass of clay $m_c = 3.1$ kg

Radius of clay (disk) $R_c = 8.0$ cm. $= 0.08$ m

Moment of Inertia of wheel $I_W = \frac{1}{2} m_W R_W^2$

$$I_W = \frac{1}{2}(\boxed{5.8}\,kg)^2 \left(\frac{0.40}{2}\,m\right)^2 = \boxed{0.116}\ kg\,m^2$$

Moment of inertia of clay $I_c = \frac{1}{2} m_c R_c^2$

$$I_c = \frac{1}{2}(3.1\,kg)(0.08\,m)^2 = 0.00992\ kg\,m^2$$

Substituting in eq (1)

$$(\boxed{0.116}\ kg\,m^2)\left(\boxed{8.796}\ \frac{rad}{sec}\right) = (\boxed{0.116}\ kg\,m^2 + 0.00992\ kg\,m^2)\,\omega_f$$

$$\Rightarrow \omega_f = \boxed{8.103}\ \frac{rad}{sec} \qquad \Rightarrow f_f = \frac{\omega_f}{2\pi} = \boxed{1.29}\ \frac{rev}{sec}$$

final frequency of wheel.

3. Giancoli6 8.P.062. [354316] **0/2 points** Show Details

A $\boxed{5.4}$ m diameter merry-go-round is rotating freely with an angular velocity of $\boxed{0.70}$ rad/s. Its total moment of inertia is $\boxed{2300}$ kg·M^2. Four people standing on the ground, each of $\boxed{55}$ kg mass, suddenly step onto the edge of the merry-go-round.

(a) What is the angular velocity of the merry-go-round now?

ω = ✖ $\boxed{0.412}$ rad/s

(b) Assume that the people were on it initially and then jumped off in a radial direction (relative to the merry-go-round). What would be the angular velocity of the merry-go-round?

ω = ✖ $\boxed{0.412}$ rad/s

Sol: This is again a perfectly inelastic collision as people stick to merry-go-round. Since, this process happen suddenly there is no-net torque involved. Therefore angular momentum is conserved.

(a) $I_i \omega_i = I_f \omega_f$

$I_M \omega_i = (I_M + 4 I_p)\, \omega_f$ — ①

I_M = moment of inertia of merry go round

I_p = moment of inertia of one person.

Given Diameter of merry go round $D_M = \boxed{5.4}$ m.

Initial angular velocity $\omega_i = \boxed{0.70}$ rad/sec.

Moment of inertia of merry go round $I_M = \boxed{2300}$ kg m^2.

Mass of one person $m_p = \boxed{55}$ kg.

Each person is rotating about the axis going through center of merry go round. So moment of inertia of one person.

$$I_p = m_p R_M^2 = \left(\boxed{55}\,\text{kg}\right)\left(\frac{\boxed{5.4}}{2}\,\text{m}\right)^2 = \boxed{400.95}\ \text{kg m}^2.$$

Substituting all in eq. ①

$$\left(\boxed{2300}\,\text{kg m}^2\right)\left(\boxed{0.70}\,\frac{\text{rad}}{\text{sec}}\right) = \left(\boxed{2300}\,\text{kg m}^2 + 4\left(\boxed{400.95}\,\text{kg m}^2\right)\right)\omega_f$$

$$\omega_f = \boxed{0.412}\ \text{rad/sec}.$$ ✓✓

Prob (3) contd...

(b) If people were on merry-go-round and jump off in radial direction, the force they apply on merry-go-round will be in radial direction which can cannot apply any torque. Therefore, there is no angular acceleration. This implies that merry-go-round continues to rotate with same angular velocity,

$$\omega = 0.412 \text{ rad/sec}$$

Note :- There is no loss of angular momentum as the people carry off their angular momentum just after they jump off.

4. Giancoli6 8.P.077. [354328] **0/2 points** Show Details

A hollow cylinder (hoop) is rolling on a horizontal surface at speed $v = \boxed{4.1}$ m/s when it reaches a 10° incline.

(a) How far up the incline will it go?

✗ $\boxed{9.88}$ m

(b) How long will it be on the incline before it arrives back at the bottom?

✗ $\boxed{9.64}$ s

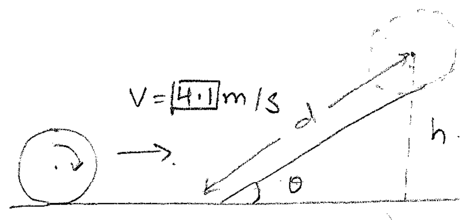
For rolling without skidding.

$\boxed{V = \omega R}$

Sol: Given:

Tangential velocity of hoop $v = \boxed{4.1}$ m/s

Angle of incline $\theta = \boxed{10°}$



(a) Since, the hoop is rolling it's centre of mass is moving. Thus total energy when it is on horizontal surface is

$$E_i = K_i + \cancel{U_i}^{\,0} = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = \frac{1}{2}mv^2 + \frac{1}{2}m\frac{R^2\omega^2}{V^2}$$

where I for hoop is $= mR^2$

When it reaches a maximum height on the incline 'h' it stops its total energy then is.

$$E_f = \cancel{K_f}^{\,0} + U_f = mgh = mg\,d\sin\theta$$

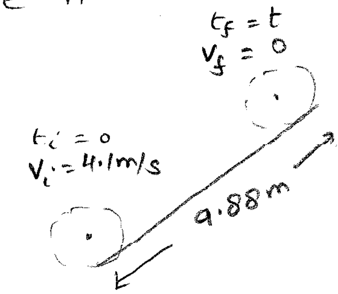
Energy is conserved -

$$E_i = E_f$$

$$\frac{1}{2}mv^2 + \frac{1}{2}m\frac{R^2\omega^2}{V^2} = mg\,d\sin\theta.$$

$$\Rightarrow d = \frac{\cancel{m}v^2}{\cancel{m}g\sin\theta} = \frac{(\boxed{4.1}\ m/s)^2}{(9.8\ m/s^2)(\sin\boxed{10°})} = \boxed{9.88}\ m$$

(b) Time for which hoop is on the incline is time it takes to go up + time it takes to come down.



$$\frac{V_i + V_f}{2} = \frac{x_f - x_i}{t_f - t_i}$$

$$\frac{\boxed{4.1} + 0}{2} = \frac{\boxed{9.88} m}{t}$$

$$t = \boxed{4.82} \text{ sec}$$

time take by hoop is come down is same.

So, total time it is up the incline is

$$t_{tot} = 2t = 2 \times \boxed{4.82} s = \boxed{9.64} s$$

5. Giancoli6 8.P.083. [354346] **0/3 points** Show Details

You are designing a clutch assembly which consists of two cylindrical plates, of mass M_A = $\boxed{6.8}$ kg and M_B = 9.0 kg, with equal radii R = 0.60 m. They are initially separated (Figure 8-57). Plate M_A is accelerated from rest to an angular velocity ω_1 = $\boxed{7.6}$ rad/s in time Δt = 2.0 s.

Given:
Mass $M_A = \boxed{6.8}$ kg.
Mass $M_B = 9.0$ kg.
$R = 0.60$ m
Angular velocity of plate A initially $\omega_1 = \boxed{7.6}$ $\frac{rad}{sec}$.

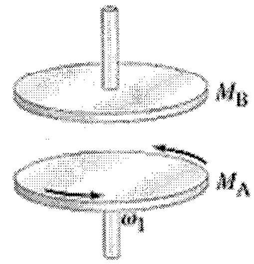


Figure 8-57

(a) Calculate the angular momentum of M_A.
✗ 9.3 kg·m²/s

(b) Calculate the torque required to have accelerated M_A from rest to ω_1.
✗ 4.65 N·m

(c) Plate M_B, initially at rest but free to rotate without friction, is allowed to fall vertically (or pushed by a spring), so it is in firm contact with plate M_A (their contact surfaces are high-friction). Before contact, M_A was rotating at constant ω_1. After contact, at what constant angular velocity ω_2 do the two plates rotate?
✗ 3.27 rad/s

Sol: (a) Angular momentum of plate A, $L_A = I_A \omega_1$

moment of inertia of cylindrical plate about an axis going through its center is $I = \frac{1}{2} m R^2$.

$$L_A = \frac{1}{2} M_A R^2 \omega_1 = \frac{1}{2}(\boxed{6.8}\,kg)(0.60\,m)^2(\boxed{7.6}\,\frac{rad}{sec}) = \boxed{9.30}\ kg\frac{m^2}{s}$$

(b) Torque $\tau = I\alpha$

Angular acceleration $\alpha = \frac{\Delta\omega}{\Delta t} = \frac{\boxed{7.6}\,rad/sec}{2.0\,sec} = \boxed{3.8}\ rad/sec^2$

$$\tau = \underbrace{\left(\frac{1}{2}M_A R^2\right)}_{I}\alpha = \frac{1}{2}(\boxed{6.8}\,kg)(0.60\,m)^2(\boxed{3.8}\ rad/sec^2) = \boxed{4.65}\ \underbrace{\frac{kg\,m^2\,rad}{sec^2}}_{N\,m}$$

Prob 5 contd..

(c) Since two plates stick together this is perfectly inelastic collision. Therefore, only angular momentum is conserved.

$$I_i \omega_i = I_f \omega_f$$

$$I_A \omega_1 = (I_A + I_B)\,\omega_2$$

Moment of inertia of plate A

$$I_A = \frac{1}{2} M_A R^2 = \frac{1}{2}\left(\boxed{6.8}\ kg\right)(0.60\ m)^2 = \boxed{1.224}\ kg\ m^2.$$

Moment of inertial of plate B.

$$I_B = \frac{1}{2} M_B R^2 = \frac{1}{2}(9.0\ kg)(0.60\ m)^2 = 1.62\ kg\ m^2$$

$$\Rightarrow \left(\boxed{1.224}\ \cancel{kg\ m^2}\right)\left(\boxed{7.6}\ rad/sec\right) = \left(\boxed{1.224} + 1.62\right)\cancel{kg\ m^2}\,(\omega_2)$$

$$\omega_2 = \boxed{3.271}\ rad/sec = \boxed{3.27}\ rad/sec.$$

6. Giancoli6 9.P.007. [355822] **0/2 points** Show Details

A uniform steel beam has a mass of $\boxed{900}$ kg. On it is resting half of an identical beam, as shown in Fig. 9-44. What is the vertical support force at each end?

left end

✗ 7720 N (upward)

right end

✗ 5510 N (upward)

FREE BODY DIAGRAM

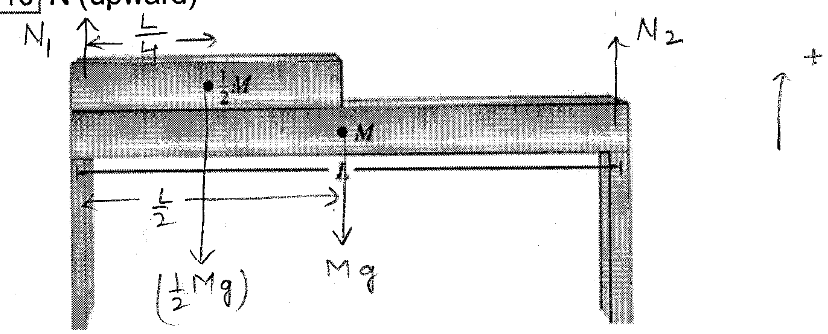


Figure 9-44

Sol. Since beams are resting net force and net torque acting on them is zero.

(See free body diagram above.)

$N_1 \equiv$ contact force / vertical support force on left end)

$N_2 =$ vertical support force on right end.

Note: Vector notation takes care of direction

$$\sum \vec{F} = 0$$

$$\vec{N_1} + \vec{N_2} + M\vec{g} + \frac{1}{2}M\vec{g} = 0$$

This is in terms of magnitude so we explicitly write +, − to show direction.

$$N_1 + N_2 - Mg - \frac{1}{2}Mg = 0$$

$$\Rightarrow N_1 + N_2 = \frac{3}{2}Mg \quad \text{— } (1)$$

$$\sum \vec{\tau} = 0 = \vec{\tau}_{N_1} + \vec{\tau}_{N_2} + \vec{\tau}_{M\vec{g}} + \vec{\tau}_{\frac{1}{2}M\vec{g}}$$

clockwise −

counterclockwise +

$\tau = rF\sin\theta$

Let axis of rotation be left end.

then $\tau_{N_1} = 0$

$\tau_{N_2} = L N_2$

$\tau_{Mg} = -\frac{L}{2}Mg$

$\tau_{\frac{1}{2}Mg} = -\frac{L}{4}\frac{1}{2}Mg$

Prob 6 contd..

$$0 + \cancel{\ell} N_2 - \frac{\cancel{\ell}}{2} Mg - \frac{\cancel{\ell}}{8} Mg = 0$$

$$N_2 = \frac{1}{2} Mg + \frac{1}{8} Mg = \frac{5}{8} Mg \qquad -(2)$$

$$N_2 = \frac{5}{8}(\boxed{900}\ kg)(9.8\ m/s^2) = \boxed{5512.5}\ N$$

$$= \boxed{5510}\ N \quad \text{upward}.$$

Using eq (1)

$$N_1 + N_2 = \frac{3}{2} Mg$$

$$N_1 = \frac{3}{2}(\boxed{900}\ kg)(9.8\ m/s^2) - (\boxed{5512.5}\ N)$$

$$N_1 = \boxed{7717.5}\ N = \boxed{7720}\ N \quad \text{upward}$$

7. Giancoli6 9.P.013. [353118] **0/1 points** Show Details

How close to the edge of the 24.0 kg table shown in Figure 9-47 can a 64.0 kg person sit without tipping it over?

0.275 m

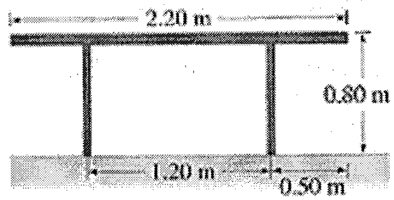


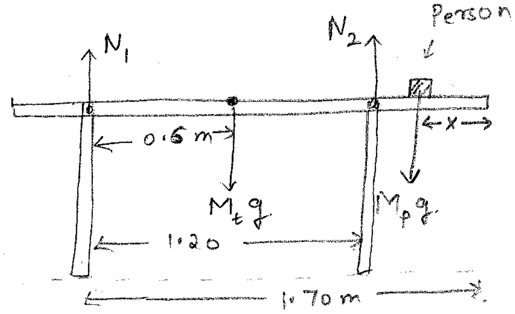
Figure 9-47

Sol: Problem of static situation.

$\sum \vec{F} = 0$ Net force

$\sum \vec{\tau} = 0$ Net torque

Free body diagram



Let the person be sitting 'x' distance from right edge.

$\sum \vec{F} = 0 = N_1 + N_2 - M_t g - M_p g$

$\longrightarrow +$

We are interested in finding position of person when table just start to tip over. According to above diagram in this situation $N_1 \to 0$

$\Rightarrow \cancel{N_1}^{0} + N_2 - (M_t + M_p) g = 0$

$N_2 = (M_t + M_p) g = (\boxed{24.0}\,kg + \boxed{64.0}\,kg)(9.8\,m/s^2) = \boxed{862.4}\,N$

For torque equation assuming left leg of table as axis -

$\sum \tau = 0 = 0 + (1.20\,m)(N_2) - (0.60\,m)(M_t g) - (1.70 - x)(M_p g)$

$(1.20\,m)(\boxed{862.4}\,N) - (0.60\,m)(24\,kg \times 9.8\,m/s^2) - (1.70 - x)(64\,kg \times 9.8\,m/s^2)$

Solve for x

$x = \dfrac{-\boxed{172.48}\ kg\,m^2/s^2}{(64 \times 9.8)\ kg\,m/s^2} = -\boxed{0.275}\ m$

$|x| = \boxed{0.275}\ m.$

Note: -ve sign shows distance from right edge.

8. Giancoli6 9.P.020. [355827] **0/5 points** Show Details

A shop sign weighing $\boxed{235}$ N is supported by a uniform $\boxed{115}$ N beam as shown in Fig. 9-54.
Find the tension in the guy wire.

✗ $\boxed{642}$ N

Find the horizontal and vertical forces exerted by the hinge on the beam.

horizontal ✗ $\boxed{526}$ N ---Select--- ✗ $\boxed{\text{to the right}}$

vertical ✗ $\boxed{18.3}$ N ---Select--- ✗ $\boxed{\text{down}}$

$\tau = RF\sin\theta$

$F_s = \boxed{235}$ N

$Mg = \boxed{115}$ N

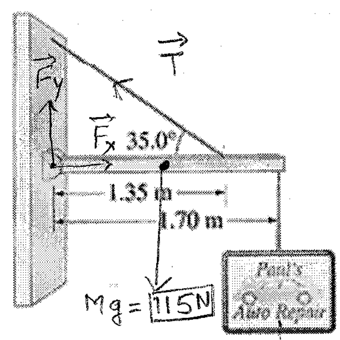


Figure 9-54

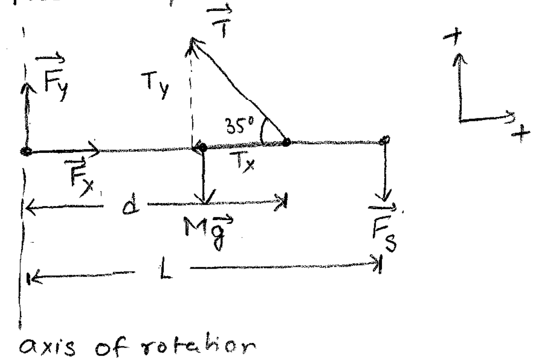
$F_s = \boxed{235}$ N

equilibrium condition.

Sol: Given: $d = 1.35$ m.

$L = 1.70$ m.

Free body diagram for beam



(a) Since it is in equilibrium net force and net torque are zero. Let axis of rotation be at left end.

Then,

$$\sum \vec{\tau} = \vec{\tau}_{F_y} + \vec{\tau}_{F_x} + \vec{\tau}_{Mg} + \vec{\tau}_T + \vec{\tau}_{F_s} = 0$$

$\tau_{F_y} = \tau_{F_x} = 0$ (Acting on the axis of rotation

$$\tau_{Mg} = \frac{L}{2} Mg \cancel{\sin 90^\circ}^{1} = \frac{(1.70\text{m})\boxed{115}\text{N}}{2} = \boxed{97.75}\ \text{Nm} \quad \text{clockwise } (-)$$

$$\tau_T = d\,T\sin 35^\circ = (1.35)\,T\sin(35^\circ) = 0.774\,T \quad \text{anti-clockwise } (+)$$

$$\tau_{F_s} = L\,F_s\,\cancel{\sin 90^\circ}^{1} = (1.70\text{ m})(\boxed{235}\text{ N}) = \boxed{399.5}\ \text{Nm} \quad \text{clockwise } (-)$$

$$\Rightarrow \quad 0 + 0 - \boxed{97.75} + 0.774\,T - \boxed{399.5} = 0$$

Prob (8) contd ...

Solving for tension. T

$$T = \frac{\boxed{97.75} + \boxed{399.5}}{0.774} \text{ N} = \boxed{642.4} \text{ N} = \boxed{642} \text{ N}$$

(b) Since, net force is also zero, we have.

$$\sum \vec{F} = \vec{F_y} + \vec{F_x} + \vec{T} + M\vec{g} + \vec{F_s} = 0$$

x dir : $F_x - T_x = 0$

Y dir : $F_y + T_y - Mg - F_s = 0$

Now $T_x = T\cos 35^\circ = (\boxed{642.4} \text{ N})\cos 35^\circ = \boxed{526.2} \text{ N}$

$T_y = T\sin 35 = (\boxed{642.4} \text{ N})\sin 35^\circ = \boxed{368.5} \text{ N}$

$$F_x - (\boxed{526.2} \text{ N}) = 0$$

⇒ Horizontal force exerted by the hinge.

$$F_x = \boxed{526.2} \text{ N} = \boxed{526} \text{ N}$$

and

$$F_y = Mg + F_s - T_y$$

$$= (\boxed{115} \text{ N}) + (\boxed{235 \text{ N}}) - (\boxed{368.5} \text{ N}) = -\boxed{18.5} \text{ N}$$

-ve sign shows that it is acting downwards.

9. Giancoli6 9.P.027. [355828] **0/1 points** Show Details

Consider a ladder with a painter climbing up it. If the mass of the ladder is $\boxed{11.5}$ kg, the mass of the painter is $\boxed{68.5}$ kg, and the ladder begins to slip at its base when her feet are are 70% of the way up the length of the ladder, what is the coefficient of static friction between the ladder and the floor? Assume the wall is frictionless.

✗ 0.503

Given:

m = Mass of the ladder = $\boxed{11.5}$ kg

M = Mass of the painter = $\boxed{68.5}$ kg.

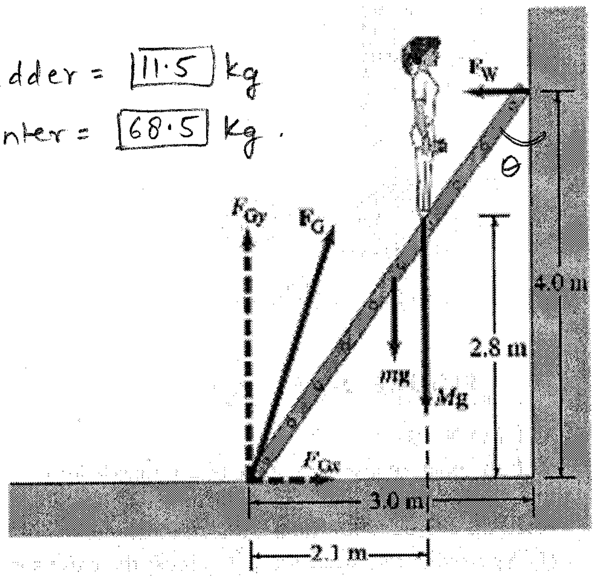
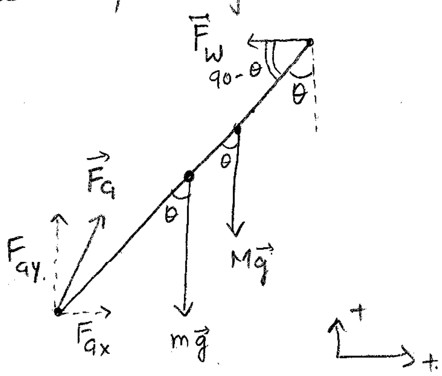


Figure 9-61

Free body diagram for Ladder.



Sol: We can find length of the ladder 'L' using pythagorus theorem,

$$L = \sqrt{(4.0)^2 + (3.0)^2} = 5.0 \text{ m}.$$

$$\cos\theta = \frac{4.0}{5.0} \; ; \quad \sin\theta = \frac{3.0}{5.0} \; ; \quad \tan\theta = \frac{3.0}{4.0}$$

Since, system is in equilibrium.

$$\sum \vec{F} = \vec{F}_G + m\vec{g} + M\vec{g} + \vec{F}_W = 0$$

x dir: $F_{Gx} - F_W = 0 \quad \Rightarrow \quad F_{Gx} = F_W$

y dir: $F_{Gy} - mg - Mg = 0 \quad \Rightarrow \quad F_{Gy} = mg + Mg = (m+M)g.$

$$F_{Gy} = \left(\boxed{11.5}\text{ kg} + \boxed{68.5}\text{ kg}\right)(9.8 \text{ m/s}^2)$$

$$= \boxed{784} \text{ kg}$$

Prob 9

Also net torque is zero. Let the axis of rotation be vertically going through base of the ladder.

$$\sum \vec{\tau} = \vec{\tau}_{\vec{F}_G} + \vec{\tau}_{m\vec{g}} + \vec{\tau}_{M\vec{g}} + \vec{\tau}_{\vec{F}_W} = 0$$

$\tau_{F_G} = 0$ acting at the axis of rotation.

$\tau_{mg} = \frac{L}{2} mg \sin\theta$ clockwise (−)

$\tau_{Mg} = (0.7L) Mg \sin\theta$ clockwise (−) painter is 70% up the ladder.

$\tau_{F_W} = L F_W \sin(90-\theta)$ $\sin(90-\theta) = \cos\theta$.

$= L F_W \cos\theta$ anti-clockwise +.

$$\Rightarrow \quad 0 - \frac{\cancel{L}}{2} mg \sin\theta - (0.7)\cancel{L} Mg \sin\theta + \cancel{L} F_W \cos\theta = 0$$

$$F_W = \frac{\left[\frac{mg}{2} + 0.7Mg\right]\sin\theta}{\cos\theta} = \left(\frac{m}{2} + 0.7M\right) g \tan\theta$$

$$F_W = \left(\frac{\boxed{11.5}}{2} kg + (0.7)\boxed{68.5} kg\right)(9.8 \, m/s^2) \frac{3.0}{4.0} = \boxed{394.7} \, N$$

$\Rightarrow$ Force due to ground (x-component), which is the static friction force is

$F_{Gx} = F_W = \boxed{394.7} \, N$

$F_{Gx} = F_f \le \mu_s N$ for min. μ_s it is equal sign.

$\Rightarrow F_{Gx} = \mu_s F_{Gy}$ F_{Gy} is normal force at that point.

$$\mu_s = \frac{F_{Gx}}{F_{Gy}} = \frac{\boxed{394.7} \, N}{\boxed{784} \, N} = \boxed{0.503}$$

10. Giancoli6 9.P.012. [355830] **0/2 points** Show Details

Find the tension in the two wires supporting the $\boxed{49}$ kg traffic light shown in Fig. 9-46. (Assume that $\theta_1 = \boxed{50°}$ and $\theta_2 = \boxed{40°}$.)

✗ $\boxed{368}$ N (left hand wire)

✗ $\boxed{309}$ N (right hand wire)

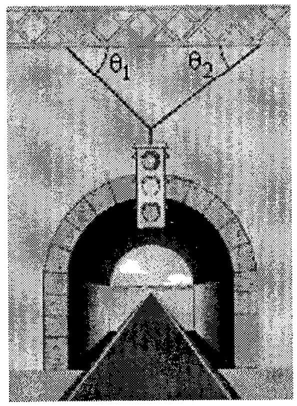
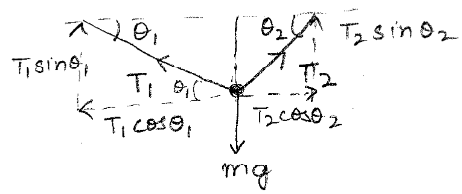


Figure 9-46

Sol: Since traffic light is static net force on it is zero

Free body diagram



$$\sum \vec{F} = 0 = \vec{T_1} + \vec{T_2} + m\vec{g}$$ vector eq.

x dir: $-T_1 \cos\theta_1 + T_2 \cos\theta_2 = 0$

$$T_2 = T_1 \frac{\cos\theta_1}{\cos\theta_2}$$

Y dir: $T_1 \sin\theta_1 + T_2 \sin\theta_2 - mg = 0$

$$T_1 \sin\theta_1 + T_1 \frac{\cos\theta_1}{\cos\theta_2} \overset{\tan\theta_2}{\sin\theta_2} = mg$$

$$T_1 \left(\frac{\sin\theta_1 \cos\theta_2 + \cos\theta_1 \sin\theta_2}{\cos\theta_2} \right) = mg$$

using Trig identity
$\sin(A+B) = \sin A \cos B + \cos A \sin B$

$$T_1 = \frac{mg \cos\theta_2}{\sin(\theta_1 + \theta_2)}$$

$$T_1 = \frac{(\boxed{49}\,kg)(9.8\,m/s^2)\cos\boxed{40°}}{\sin(\boxed{50°} + \boxed{40°})} = \boxed{368} \text{ N}$$

$$\Rightarrow T_2 = (\boxed{368}\text{ N}) \frac{\cos\boxed{50°}}{\cos\boxed{40°}} = \boxed{309} \text{ N}$$

11. Giancoli6 9.P.002. [355829] **0/1 points** Show Details

Calculate the torque about the front support post (B) of a diving board, Fig. 9-42, exerted by a $\boxed{52}$ kg person 3.0 m from that post. (Take the positive direction to be clockwise.)

✗ $\boxed{1530}$ m·N

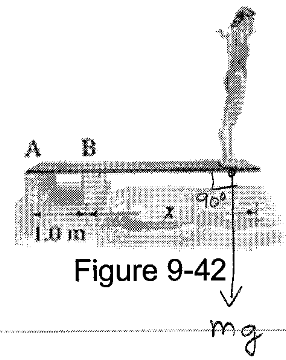


Figure 9-42

Sol: Torque $\tau = rF\sin\theta$

Given $r = 3.0$ m.

$F = mg = (\boxed{52}\text{ kg})(9.8\text{ m/s}^2) = \boxed{509.6}$ N

$\theta = 90^\circ$

$\tau = (3.0\text{ m})(\boxed{509.6}\text{ N})\ \cancel{\sin}^{1} 90^\circ = \boxed{1528.8}$ Nm

$= \boxed{1530}$ Nm.

choosing clockwise as positive.