5. A coin placed 30.0 cm from the center of a rotating horizontal turntable slips when its speed is 50.0 cm/s. (a) What force causes the centripetal acceleration when the coin is stationary relative to the turntable? (b) What is the coefficient of static friction between the coin and turntable?

17. ▲ A pail of water is rotated in a vertical circle of radius 1.00 m. What is the pail's minimum speed at the top of the circle if no water is to spill out?

11. A 4.00-kg object is attached to a vertical rod by two strings as shown in Figure P6.11. The object rotates in a horizontal circle at constant speed 6.00 m/s. Find the tension in (a) the upper string and (b) the lower string.

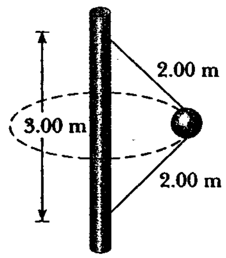


Figure P6.11

13. A 40.0-kg child swings in a swing supported by two chains, each 3.00 m long. The tension in each chain at the lowest point is 350 N. Find (a) the child's speed at the lowest point and (b) the force exerted by the seat on the child at the lowest point. (Ignore the mass of the seat.)

14. A roller-coaster car (Fig. P6.14) has a mass of 500 kg when fully loaded with passengers. (a) If the vehicle has a speed of 20.0 m/s at point Ⓐ, what is the force exerted by the track on the car at this point? (b) What is the maximum speed the vehicle can have at point Ⓑ and still remain on the track?

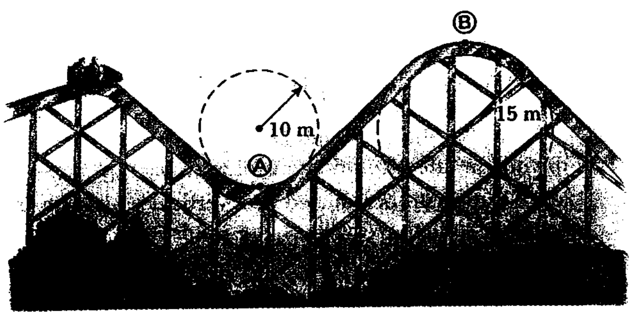


Figure P6.14

26. A skydiver of mass 80.0 kg jumps from a slow-moving aircraft and reaches a terminal speed of 50.0 m/s. (a) What is the acceleration of the skydiver when her speed is 30.0 m/s? What is the drag force on the skydiver when her speed is (b) 50.0 m/s? (c) When it is 30.0 m/s?

30. The mass of a sports car is 1 200 kg. The shape of the body is such that the aerodynamic drag coefficient is 0.250 and the frontal area is 2.20 m^2. Ignoring all other sources of friction, calculate the initial acceleration the car has if it has been traveling at 100 km/h and is now shifted into neutral and allowed to coast.

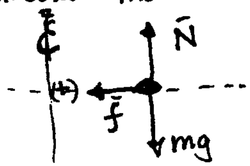
Ch 6.5

$v = 50\ cm/s = 0.50\ m/s$

$R = 30\ cm = 0.30\ m$

a) friction is responsible for the circular motion.

SIDE VIEW



$m\vec{a} = \Sigma \vec{F}'s$

$ma_{rad} = \Sigma F_{rad}$ $\qquad ma_z = \Sigma F_z's$

$ma_{rad} = f_{static}$ $\qquad ma_z = N - mg$ (0 because coin stays at same height)

max speed

max static friction

$m a_{rad} = \mu_s N$

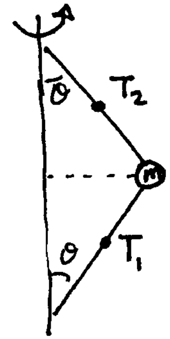
$m \frac{v^2}{R} = \mu_s mg$

$\frac{(0.50)^2}{0.30} = \mu_s (9.8)$

$\mu_s = 0.085$

Ch 6.11

SIDE VIEW

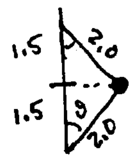


$m = 4\ kg \quad v = 6\ m/s$

Inward is positive radial direction.

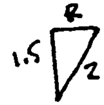
radial & vertical

$m\vec{a} = \Sigma \vec{F}'s$



$\cos\theta = \frac{1.5}{2.0}$

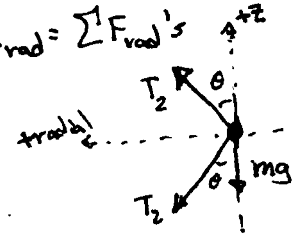
$\theta = 41.41°$



$(1.5)^2 + (R)^2 = 2^2$

$R = 1.323\ m$

$ma_{rad} = \Sigma F_{rad}'s \qquad ma_z = \Sigma F_z's$



$m a_{rad} = T_1 \sin\theta + T_2 \sin\theta$ (where $a_{rad} = \frac{v^2}{R}$)

$m a_z = T_2\cos\theta - T_1\cos\theta - mg$ (where $a_z = 0$)

$m\frac{v^2}{R} = T_1\sin\theta + T_2\sin\theta$

$= [T_1 + T_2]\sin\theta$

$0 = T_2\cos\theta - T_1\cos\theta - mg$

$T_2\cos\theta = T_1\cos\theta + mg$

$T_2 = \frac{1}{\cos\theta}[T_1\cos\theta + mg]$

$T_2 = T_1 + \frac{mg}{\cos\theta}$

$m\frac{v^2}{R} = [T_1 + T_1 + \frac{mg}{\cos\theta}]\sin\theta$

$m\frac{v^2}{R} = [2T_1 + \frac{mg}{\cos\theta}]\sin\theta$

$4\frac{(6)^2}{1.323} = [2T_1 + \frac{4(9.8)}{\cos 41.4°}]\sin 41.4°$

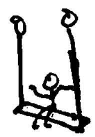
$164.59 = [2T_1 + 52.26]$

$T_1 = 56.2$ Newtons

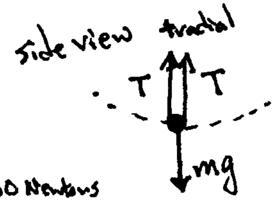
$T_2 = 56.2 + \frac{4(9.8)}{\cos 41.4°}$

$T_2 = 108.5$ Newtons

Ch6.13



Anchor point of chains is the "center"



(+) radial direction

$$m\vec{a} = \sum \vec{F}'s$$

we are only worried about radial forces in this problem

T=350 Newtons

$m = 40$ kg

$R = 3$ m

$$m a_{rad} = \sum F_{rad}'s$$

$$m a_{rad} = T + T - mg$$

$$m \frac{v^2}{R} = 2T - mg$$

$$40 \frac{v^2}{3} = 2(350) - 40(9.8)$$

$$v = 4.81 \text{ m/s}$$

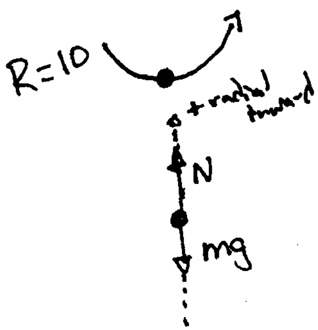
~~The net upward~~ The upward force on the child (actually inward radial direction) is 700 Newtons

Ch6.14

$m = 500$ kg

$R = 10$ m

$v = 20$ m/s

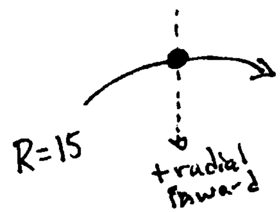


$$m a_{rad} = \sum F_{rad}$$

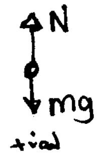
$$m \frac{v^2}{R} = N - mg$$

$$500 \frac{(20)^2}{10} = N - 500(9.8)$$

$$N = 2490 \text{ Newtons}$$



$$m a_{rad} = \sum F_{rad}$$



$$m \frac{v^2}{R} = mg - N$$

As the speed increases, N will decrease.

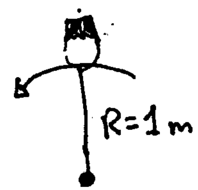
The smallest N can be is ~zero.

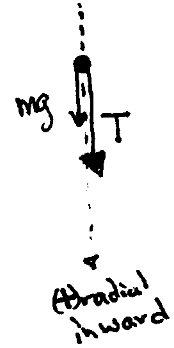
$$m \frac{v^2}{R} = mg - 0$$

$$500 \frac{v^2}{15} = 500(9.8) - 0$$

$$V = 12.1 \text{ m/s}$$

Ch 6.17





$$ma_{rad} = \sum F_{rad}\text{'s}$$

$$m\frac{v^2}{R} = mg - T$$

As the bucket is spun slower, the Tension will decrease. The smallest T can be is ~ zero.

$$m\frac{v^2}{R} = mg - 0$$

$$\cancel{m}\frac{v^2}{R} = \cancel{m}g$$

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

$$v = 3.13 \text{ m/s}$$

Ch 6.26

$m = 80$ kg

terminal speed = 50 m/s

a) What is acceleration when speed 30 m/s?

So we'll need to make assumptions here.

Use the high-speed drag force $\frac{1}{2}D\rho Av^2$

we aren't provided the drag coeff D nor the Area A

$$ma_y = \text{Drag} - mg$$

$$= \frac{1}{2}D\rho Av^2 - mg$$

The terminal Velocity is 50 m/s, at which the $a_y \to 0$

$$0 = \frac{1}{2}D\rho A(50)^2 - 80(9.8)$$

$$D\rho A = 0.627$$

we'll use this product of quantities

a) at 30 m/s

$$ma = \frac{1}{2}D\rho Av^2 - mg$$

$$80a = \frac{1}{2}(0.627)30^2 - 80(9.8)$$

$$a = -6.27 \text{ m/s}^2$$

b) Drag force when 50 m/s?

Since this is the terminal speed Drag = mg

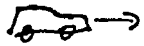
$$80(9.8) = 784 \text{ Newtons}$$

– or use the other formula

c) Drag force when 30 m/s²

$$\frac{1}{2}D\rho Av^2 = \frac{1}{2}(0.627)30^2 = 282 \text{ Newtons}$$

Ch 6.30



$m = 1200\ kg$ $V = 100\ \frac{km}{h} = 27.8\ m/s$

$D = 0.25$

$A = 2.20\ m^2$

Ignore any other frictional forces

$\frac{1}{2} D \rho A v^2 = \frac{1}{2}(0.25)\left[1.2\ kg/m^3\right](2.20)(27.8)^2$

$= 255$ Newtons

$m a_x = \sum F_x\text{'s}$

$m a_x = -\text{Drag}$

$1200\ a_x = -255$

$a_x = -0.21\ m/s^2$