HW #4
SP211 Vanhoy

Due Mon 21 Sept

Seven Book problems

Serway Ch 6 Problems: 5, 11, 13, 14, 17, 26, 30

Zero multiple choice

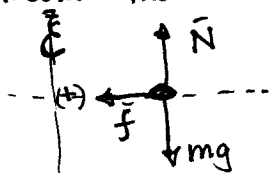
Ch 6.5

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

$R = 30\ cm = 0.30\ m$

a) friction is responsible for the circular motion.

SIDE VIEW



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

$ma_{rad} = \sum F_{rad}$

$ma_z = \sum F_z's$

$ma_{rad} = f_{static}$

$m\cancel{a_z} = N - mg$

0 because coin stays at same height

max speed

max static friction

$ma_{rad} = \mu_s N$

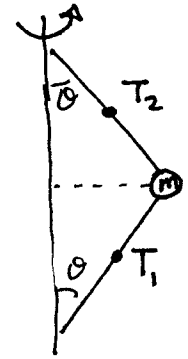
$\cancel{m}\frac{v^2}{R} = \mu_s \cancel{m} g$

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

$\mu_s = 0.085$

Ch 6.11

SIDE VIEW

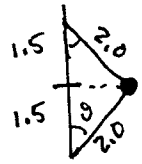


$m = 4\ kg \quad v = 6\ m/s$

Inward is positive radial direction.

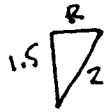
radial & vertical

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



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

$\theta = 41.41^\circ$

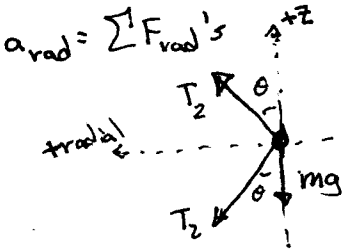


$(1.5)^2 + (R)^2 = 2^2$

$R = 1.323\ m$

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

$ma_z = \sum F_z's$



$m\cancel{a_{rad}} = T_1 \sin\theta + T_2 \sin\theta$

$\frac{v^2}{R}$

$m\cancel{a_z} = T_2\cos\theta - T_1\cos\theta - mg$

0

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

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

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

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

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

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

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

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

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

$164.59 = [2T_1 + 52.26]$

$T_1 = 56.2$ Newtons

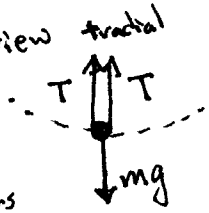
$T_2 = 56.2 + \frac{4(9.8)}{\cos 41.4^\circ}$

$T_2 = 108.5$ Newtons

Ch6.13

Anchor point of chains is the "center"

side view



(+) 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

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

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

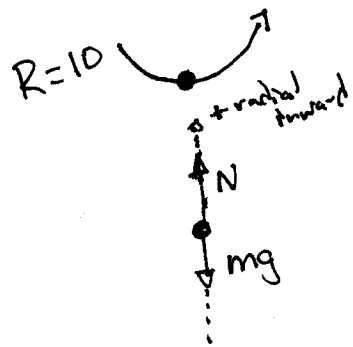
$$m \frac{v^2}{R} = 2T - mg$$

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

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

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

Ch6.14



m = 500 kg

R = 10 m

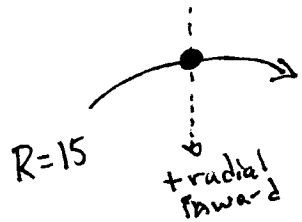
v = 20 m/s

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

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

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

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



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

+rad

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

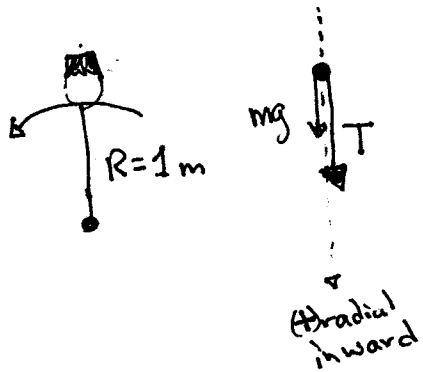
As the speed increases, N will decrease. The smallest N can be is ~zero.

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

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

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

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

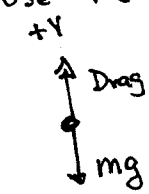
$m = 80$ kg

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 $\frac{1}{2}D\rho A v^2$



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

$$ma_y = \text{Drag} - mg$$
$$= \frac{1}{2}D\rho A v^2 - mg$$

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

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

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

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

b) Drag force when 50 m/s?

Since this is the terminal speed Drag = mg

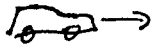
$80(9.8) = 784$ Newtons

– or use the other formula

c) Drag force when 30 m/s^2

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

Ch 6.30



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

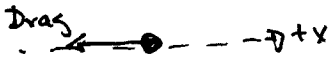
$D = 0.25$

$A = 2.20\ m^2$

Ignore any other frictional forces

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

$$= 255 \text{ Newtons}$$



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

$$m a_x = -\text{Drag}$$

$$1200\ a_x = -255$$

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