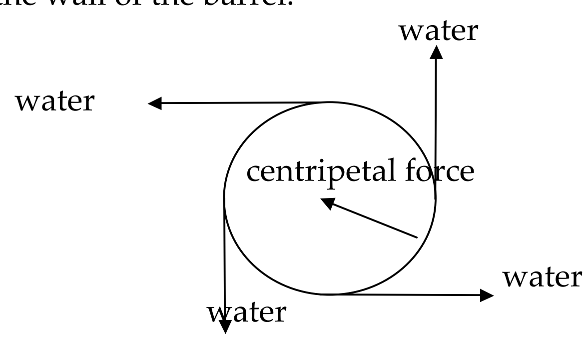
3.4 The plane is accelerating forward. The seat is connected to the plane and is accelerated forward. The back of the seat applies a forward force on you, accelerating you forward. Newton's third law of motion dictates that you will apply a force to the seat that is equal in magnitude and opposite in direction to the force that the seat applies to you.

3.8 Mass is a measure of an object's inertia-its tendency resist a change in its velocity. Mass is a property of an object and does not change with location. Weight is the force of gravity on an object. It can be calculated by the using the following formula: Wt = mg where 'm' is the object's mass and 'g' is the gravitational field strength and is equal to the acceleration of an object in free fall when air resistance is negligible. Because the value of 'g' changes with location, an object's weight changes with location.

3.20 When an object moves in a curved path, its direction and therefore its velocity is changing. The only way to change an object's velocity is to apply an unbalance force to it.

3.22 In order for the clothes to go in a circle, an unbalance force must be applied to them. The force is directed toward the center of the circle and is called a centripetal force. The barrel of the washing machine applies a centripetal force to the clothes but not to the water. The water goes out the holes in the wall of the barrel.



Problems pg. 58, Ch 3

3.1 $a = \frac{f}{m} \therefore f = ma = 7\text{kg}\left(3.5\frac{\text{m}}{\text{sec}^2}\right) = 24.5\frac{\text{kg}\bullet\text{m}}{\text{sec}^2} = 24.5 \text{ newtons}$

3.2 $a=\frac{f}{m} \therefore m=\frac{f}{a} = \frac{30\frac{\text{kg}\bullet\text{m}}{\text{sec}^2}}{.25\text{m/sec}^2} = 120\text{kg}$

3.3 $a=\frac{f}{m} = \frac{2 \text{x} 10^6 N}{1.2 \text{x} 10^6 kg} = 1.67\frac{m}{\text{sec}^2}$

3.4 a) weight $= mg = 50\text{kg}(\frac{9.8\text{m}}{\text{sec}^2}) = 490\frac{\text{kg m}}{\text{sec}^2} = 490 \text{ newtons}$

b) wt $= mg = 50\text{kg}(\frac{1.7\text{m}}{\text{sec}^2}) = 85 \text{ newtons}$

Ch.3 pg. 58, Problems continued.

3.5 $\quad \mathrm{wt} = \mathrm{mg} \;\therefore\; \mathrm{m} = \dfrac{\mathrm{wt}}{\mathrm{g}} = \dfrac{5\,\mathrm{x}\,10^{-6}\ \mathrm{kg\,m/sec^2}}{9.8\,\mathrm{m/sec^2}} = 5.1\,\mathrm{x}\,10^{-7}\mathrm{kg}$

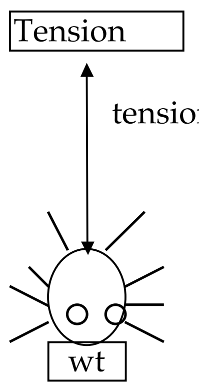
3.6 See table 3.1, pg. 39 for the coefficient of friction of synovial fluid.
$\mathrm{f} = \mu \mathrm{F_N} = .015(500\ \mathrm{N}) =$ $\underline{7.5\ \text{newtons.}}$

3.7 $\quad \mathrm{f} = \mu \mathrm{F_N} \quad \therefore\; \mathrm{F_N} = \dfrac{\mathrm{f}}{\mu} = \dfrac{.2\,\mathrm{N}}{.04} = 5\ \text{newtons}$

3.8 $\quad \mathrm{f} = \mu \mathrm{F_N} \quad \therefore \mu = \dfrac{\mathrm{f}}{\mathrm{F_N}} = \dfrac{300\,\mathrm{n}}{1000\,\mathrm{n}} = 0.3$

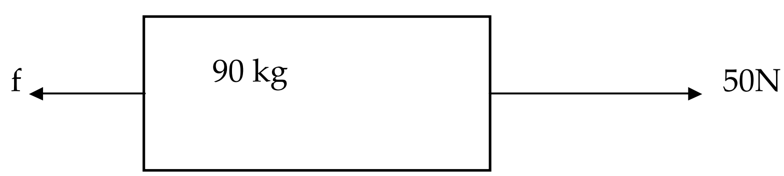
Check Table 3.1 for Steel on Steel dry

3.9 Tension in the thread = the weight of the spider.



tension= wt = mg = 1 x 10^{-4} kg(9.8 m / sec^2)= $\underline{9.8\ \mathrm{x}\ 10^{-4}\ \ \text{newtons}}$

3.11

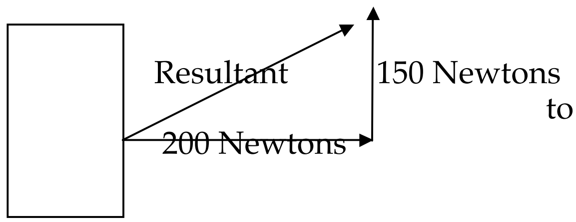


$$a = \frac{f}{m} = \frac{50n + f}{90kg} = 0.35\frac{m}{\sec^2} \;\therefore\; f = 90\,kg(.35\frac{m}{\sec^2}) - 50n = -18.5\,newtons$$

The negative sign indicates that the frictional force is backward. You should write your answer as f = **<u>18.5 newtons backward.</u>**

Ch. 3 pg. 59 continued.

3.20

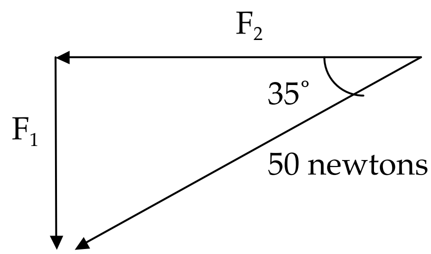


We will use the Pythagorean theorem to find the magnitude of the resultant.

$c = \sqrt{a^2 + b^2}$ $\therefore$ $c = \sqrt{150^2 + 200^2} = 250$ newtons is the magnitude of the resultant. The direction of the resultant can be found by using the trig. rule for the tangent of an angle.

$Tan\,\theta = \dfrac{opposite}{adjacent} = \dfrac{150}{200} = 0.75 \therefore \theta = 36.9^\circ$ You should write your answer as <u>250 newtons 36.9° north of east or equivalently, **250 newtons at 53.1**</u>°.

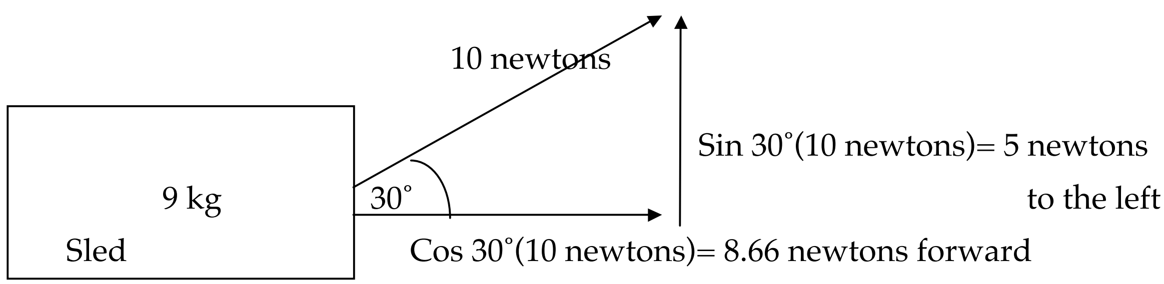
3.22



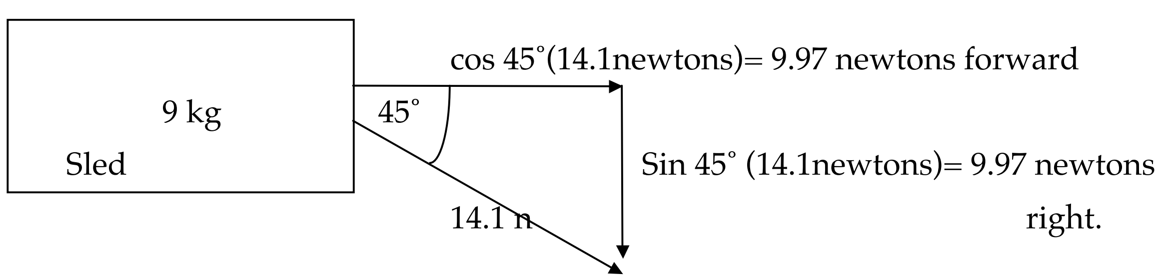
Sin 35° = F_1 / 50 newtons.
Therefore, F_1 = Sin35°(50 N)= 28.7 newtons.

Cos 35° = F_2 / 50 newtons.
Therefore, F_2 = Cos 35° (50 N)= 41 newtons.

3.23 Step 1. Separate the 10 newton force into forward and left components.



Step 2. Separate the 14.1 newton force into forward and right components.



Ch. 3 pg. 59 continued.
Problem 23 continued.

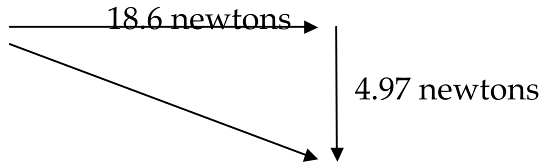
Step 3. Combine forward forces and then combine right-left forces.

8.66 newtons + 9.97 newtons = 18.6 newtons forward.

9.97 newtons - 5 newtons = 4.97 newtons to the right.

Step 4. Determine the sum of the forward and right components.

resultant =

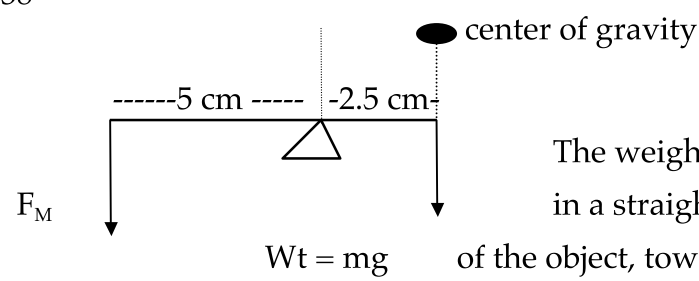


$\sqrt{18.6^2 + 4.97^2} = 19.3\,\text{newtons}$. Tan ø = 4.97/18.6 = .2672 ø= 15.0°

Step 5. Now lets see what we've got. The total force that the boys are applying is 19.3 newtons 15.0° to the right of forward. However, there is a frictional force back of 10 newtons. Therefore, the net force on the sled is 19.3-10 = 9.3 newtons, 15.0° to the right of forward. The acceleration of the sled is found from Newton's second law:

$$a = \frac{f}{m} = \frac{9.3n}{9\,kg} = 1.03\frac{m}{\sec^2}$$ 15° to the right of forward.

3.38



The weight of an object can be viewed as acting in a straight line from the center of gravity of the object, toward the center of the earth.

F_M is the unknown force produced by the splenius muscle. The mass of the head 'm'=5kg.

Wt = mg = 5 kg(9.8m/sec^2) = 49 newtons

We can solve this problem by using the concept that when a system is in rotational equilibrium, the clockwise and counterclockwise torques are equal.

Clock wise torque = Counter clock wise torque;

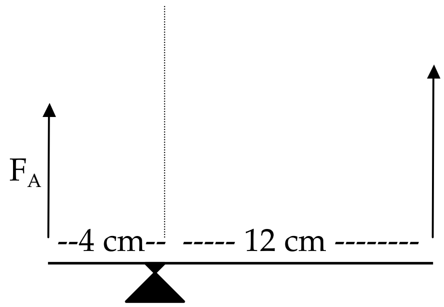
Therefore;

$$49n(2.5cm) = F_M(5cm)$$

$F_M = \frac{49n(2.5\,cm)}{5\,cm} = 24.5\,\text{newtons}$. Which is a fairly large force. No wonder my neck aches as I type this manual.

Ch.3 pg. 61

3.39



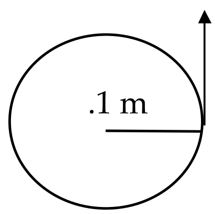
F_N = 784 newtons. I found this from wt = mg = 80 kg(9.8m/sec^2)=784n

Clockwise torque = Counter clockwise torque
F_A(4cm)=784n(12cm)

$$F_A = \frac{784\text{n}\,(12\text{cm})}{4\,\text{cm}} = \underline{2350\,\text{newtons}}$$

3.45 What acceleration, in m/s^2, is experienced by materials that are 10 cm from the center of rotation of a centrifuge that spins at 4,000 revolutions per minute?

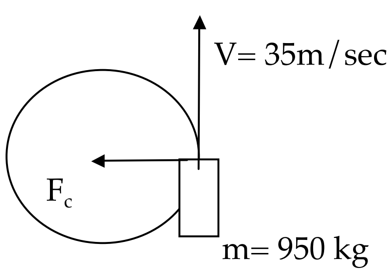
First convert 10 cm to meters: $10\text{ cm}\bullet\frac{1m}{100cm} = 0.10m$



$$V = \frac{\text{distance}}{\text{time}} = \frac{4000\,\text{rev.}(\frac{2\pi\bullet 0.10\text{m}}{\text{rev}})}{60\,\text{sec}} = 41.9\frac{\text{m}}{\text{sec}}$$

To determine the object's centripetal acceleration use: $a = \frac{\text{v}^2}{\text{r}} = \frac{(41{,}9\frac{\text{m}}{\text{sec}})^2}{0.10\text{m}} = 17{,}546\frac{\text{m}}{\text{sec}^2}$

3.46



An object that is moving in a circle, accelerates toward the center,

$A_c = \frac{V^2}{r}$ centripetal acceleration

because there is a centripetal force

$F_C = mA_C$ acting on it.

F = ma
m = 950 kg
r = 200 meters

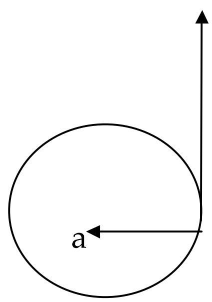
b) $a = \frac{\text{v}^2}{\text{r}} = \frac{(35\frac{\text{m}}{\text{sec}})^2}{200\text{m}} = 6.13\frac{\text{m}}{\text{sec}^2}$ a) $F = ma = 950\,\text{kg}\,(6.13\frac{\text{m}}{\text{sec}^2}) = 5820\,\text{Newtons}$

c) $\frac{6.13\frac{\text{m}}{\text{sec}^2}}{9.8\frac{\text{m}}{\text{sec}^2}} = 0.625\,g$

Chapter 3 continued

3.47 a) $a_c = \dfrac{v^2}{r} = \dfrac{(25\,\frac{m}{sec})^2}{.275\ m} = 2273\,\dfrac{m}{sec^2}$ b) $a_c = \dfrac{v^2}{r} = \dfrac{(310\,\frac{m}{sec})^2}{.5\,m} = 192{,}200\,\dfrac{m}{sec^2}$

3.48

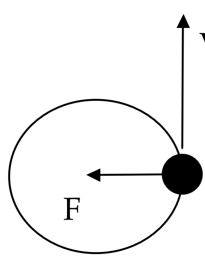


$$V = \frac{400\,km}{hr} = \frac{400 \times 10^3 m}{3600\,sec} = 111\,\frac{m}{sec}$$

The equation for centripetal acceleration is $a_c = \dfrac{v^2}{r}$;

$$a_c = \frac{v^2}{r} = \frac{(111\,\frac{m}{sec})^2}{1000\,m} = 12.3\,\frac{m}{sec^2}$$

3.49

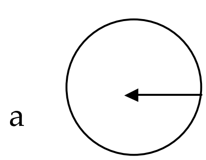


$$V = \frac{45\,rev}{60\,sec}\left(\frac{2\pi\ 1\,m}{rev}\right) = 4.71\,\frac{m}{sec}$$

$$a = \frac{v^2}{r} = \frac{(4.71\,\frac{m}{sec})^2}{1\,m} = 22.2\,\frac{m}{sec^2}$$

F=ma= 1.2 kg(22.2 m/sec^2) <u>**= 26.6 newtons**</u>

3.50



a=10g= 98 m/sec^2 a=v^2/r therefore

$$v = \sqrt{ar} = \sqrt{98\,\frac{m}{sec^2}(25\,m)} = 49.5\,\frac{m}{sec}$$

To convert to revolutions per min. note that an object moving in a circle goes 2 π r in 1 revolution and there are 60 seconds in 1 minute. $49.5\,\dfrac{m}{sec}\left(\dfrac{1\,rev}{2\pi\ 25\,m}\right)\left(\dfrac{60\,sec}{min}\right) = 18.9\,\dfrac{rev}{min}$