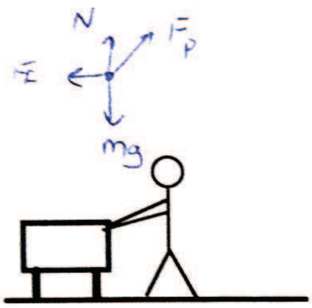
Worksheet 2

1. A person pulls on a 50 kg desk with a 200N force acting at 30° angle above the horizontal. The desk does not budge.

Draw a force diagram for the desk.



a. Write the equation that describes the forces that act in the ~~x~~ y-direction.

$$\Sigma F_{\cancel{x}y} = 0$$
$$N + F_p \sin\theta - mg = 0$$

b. Write the equation that describes the forces which act in the ~~y~~ x-direction.

$$\Sigma F_x = \cancel{ma}\ 0$$
$$F_f - F_p \cos\theta = 0$$

c. Determine the x and y components of the force of tension.

$$F_{px} = F_p \cos\theta = 200\,N(\cos 30) = 173.2\ N$$

$$F_{py} = F_p \sin\theta = (200\,N)(\sin 30) = 100\ N$$

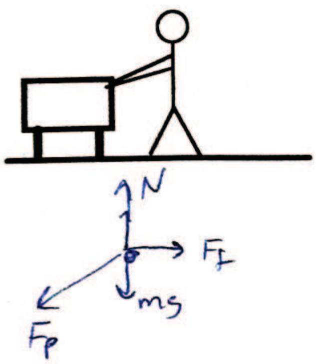
d. Determine the value of the frictional force. Do the same for the normal force.

$$\Sigma F_x = 0$$
$$F_f - F_p\cos\theta = 0$$
$$F_f = F_p\cos\theta$$
$$\boxed{F_f = 173.2\,N}$$

$$F_N = mg - F_p \sin\theta = (50\,kg)(10\,m/s^2) - 200\,N \sin 30 = \boxed{400\,N}$$

2. Suppose in the diagram above, the person were *pushing* down at a 30° angle with 200 N of force. The desk still does not move.

Draw a force diagram for the desk.



a. Write the equation that describes the forces that act in the x-direction.

$$\Sigma F_x = 0$$
$$F_f - F_p\cos\theta = 0$$

b. Write the equation that describes the forces that act in the y-direction.

$$\Sigma F_y = 0$$
$$N - mg - F_p \sin\theta = 0$$

c. Determine the value of the frictional force. Do the same for the normal force.

$$F_f = F_p\cos\theta$$
$$F_f = (200\,N)(\cos 30°) = \boxed{173\ N}$$

$$\Sigma F_y = 0$$
$$N = mg + F_p \sin\theta = (50\,kg)(10\,m/s^2) + (200\,N)\sin 30 = \boxed{600\,N}$$

Name________________________________

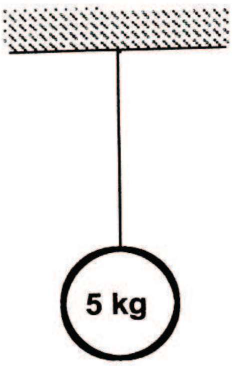
Date __________ Pd____

Worksheet 3

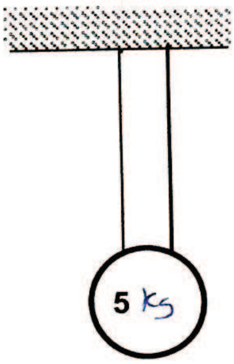
For each of the problems below, carefully draw a force diagram of the system before attempting to solve the problem.

1. Determine the tension in each cable in case A and case B.

Case A



Case B



A

$\Sigma F_y = 0$

$T - mg = 0$

$T = mg$

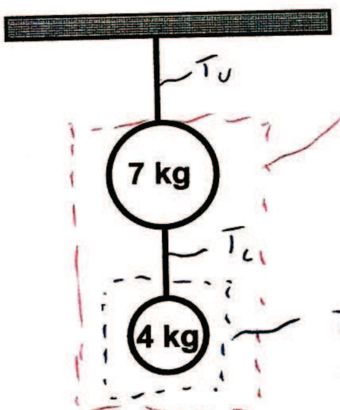
$T = (5\,kg)(10\,m/s^2) = 50\,N$

B

$\Sigma F_y = 0$

$T_1 + T_2 = mg$

2. Determine tension in each cable. (Hint: There is more than one way to define the system.)



$\Sigma F = 0$

$T_U - (M_1 + M_2)g = 0$

$T_U = (M_1 + M_2)g$

$T_U = [(7\,kg) + (4\,kg)]\,10\,m/s^2$

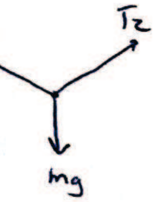
$= \boxed{110\,N}$

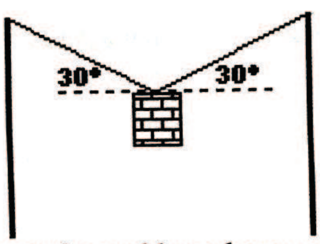
$\Sigma F = 0$

$T_L - mg = 0$

$T_L = mg = (4\,kg)(10\,m/s^2) = \boxed{40\,N}$

3. The object hung from the cable has a weight of 25 N. Write the equation for the sum of the forces in the y-direction. What is the tension in the cable?





$\Sigma F_y = ma$

$\Sigma F_y = 0$

$T_{y_1} + T_{y_2} - mg = 0$

The y components of each cable are equal!

$2T_y - mg = 0$

$2T_y = mg$

$T_y = \frac{mg}{2}$

$T_y = \frac{25\,N}{2}$

$T_y = 12.5\,N$ – This is only the y component!

$\sin\theta = \frac{T_y}{T}$

$T = \frac{T_y}{\sin\theta}$

$T = \frac{12.5\,N}{\sin 30} = \boxed{25\,N}$

This is the Tension in EACH cable

Repeat the problem above with a 5° angle. How does the tension compare?

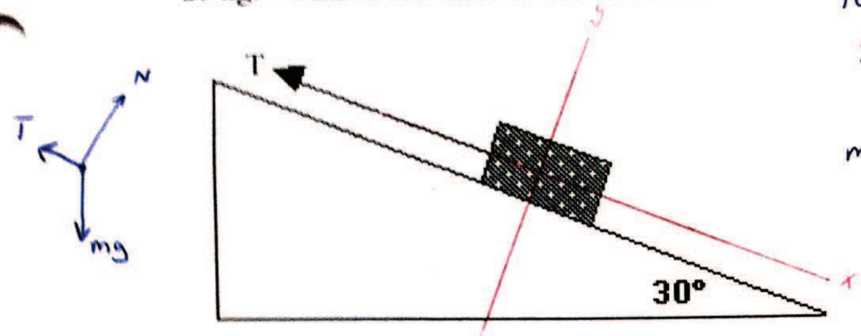
Use the same FBD, Notice that the y-components must still add up to 25 N!

$T = \frac{T_y}{\sin\theta}$

$= \frac{12.5\,N}{\sin 5}$

$= \boxed{143.4\,N \text{ in each cable!!}}$

4. The box on the *frictionless* ramp is held at rest by the tension force. The mass of the box is 20 kg. What is the value of the tension force?



Tension lies along our new x-axis

$\sum F_x = ma$

$\sum F_x = 0$

$mg \sin\theta - T = 0$

$T = mg \sin\theta$

$T = (20\text{ kg})(10) \sin 30$

$= \boxed{100\text{ N}}$

What is the value of the normal force?

The normal lies along the y axis

$\sum F_y = ma$

$\sum F_y = 0$

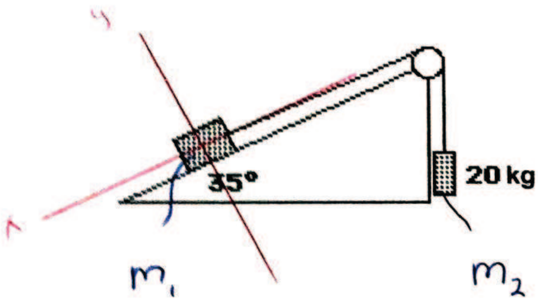
$N - mg \cos\theta = 0$

$N = mg \cos\theta$

$N = (20\text{ kg})(10\text{ m/s}^2) \cos 30$

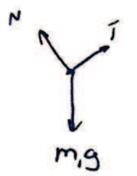
$= \boxed{173.2\text{ N}}$

5. In the system below the pulley and ramp are *frictionless* and the block is in static equilibrium. What is the **mass** of the block on the ramp?



You need $\underline{2}$ FBD's for this problem.

Box on ramp



Tensions are equal!!

hanging block

we only need worry about motion on x-axis

$\sum F_x = ma$

$\sum F_x = 0$

$mg \sin\theta - T = 0$

$T = mg \sin\theta$

$m = \dfrac{T}{g \sin\theta}$

$= \dfrac{200\text{ N}}{10(\sin 35)}$

$= \boxed{35\text{ kg}}$

$\sum F_y = ma$

$\sum F_y = 0$

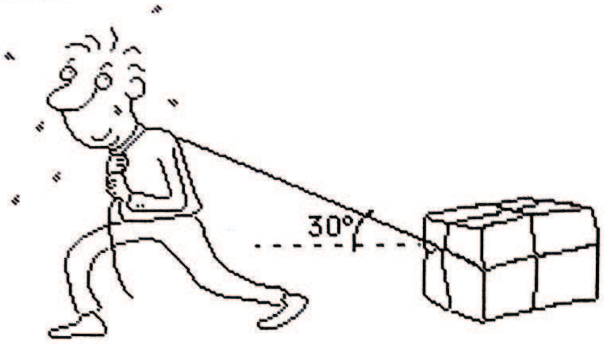
$T - m_2 g = 0$

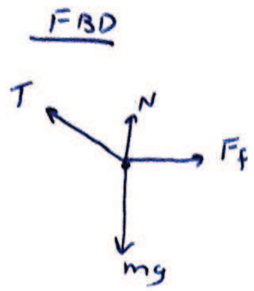
$T = m_2 g$

$T = (20\text{ kg})(10\text{ m/s}^2)$

$= 200\text{ N}$

6. A man pulls a 50 kg box *at constant speed* across the floor. He applies a 200 N force at an angle of 30°.





a. Sum the forces in the x-direction. What is the value of the frictional force opposing the motion?

$\Sigma F_x = ma$

$\Sigma F_x = 0$

$T\cos\theta - F_f = 0$

$F_f = T\cos\theta$

$= 200\,N\,(\cos 30)$

$= \boxed{173\ N}$

b. Sum the forces in the y-direction. What is the value of the normal force?

$\Sigma F_y = 0$

$N + T_y - mg = 0$

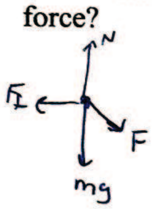
$N = mg - T\sin\theta$

$= (50\,kg)(10\,m/s^2) - 200\,(\sin 30)$

$= \boxed{400\,N}$

7. A man pushes a 2.0 kg broom *at constant speed* across the floor. The broom handle makes a 50° angle with the floor. He pushes the broom with a 5.0 N force.

a. Sum the forces in the y-direction. What is the value of the normal force?



$\Sigma F_y = ma$

$\Sigma F_y = 0$

$N - F\sin\theta - mg = 0$

$N = F\sin\theta + mg$

$= 5\,N\,(\sin 50) + (2\,kg)(10\,m/s^2) = \boxed{23.8\,N}$

b. Sum of the forces in the x-direction. What is the value of the frictional force opposing the motion?

$\Sigma F_x = ma$

$\Sigma F_x = 0$

$F\cos\theta - F_f = 0$

$F_f = F\cos\theta$

$= 5\,N\,(\cos 50)$

$= \boxed{3.2\ N}$

c. If the frictional force were suddenly reduced to zero, what would happen to the broom?

The broom will accelerate!