**Group Practice Problems ch 5**

Every solution must include:

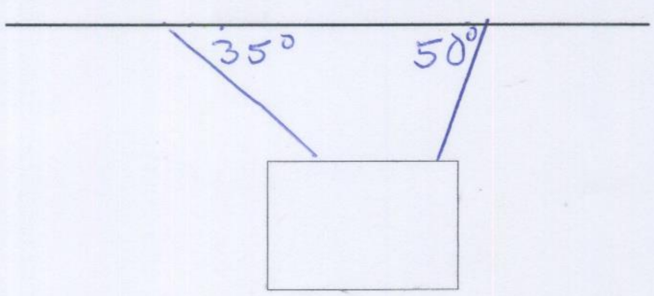
> a sketch of the situation. Include a list of the forces acting on your object. Also make note of the directions of the velocity and the acceleration.
>
> a free-body diagram on the axes you have chosen.
>
> Newton's second law in symbol form. If you have a two-dimensional problem, you should have this twice, for the x- and y- directions.
>
> The forces on your free-body diagram, broken into components as needed and placed appropriately into Newton's $2^{nd}$ law.

1. Only three forces act on an object which is moving at a constant velocity. Force A has a magnitude of 80 N and is directed along the positive Y-axis. Force B has a magnitude of 60 N and is directed along the negative x-axis. Find the magnitude and direction of the third force, C.

2. A crate sits at rest on a ramp angled at $22^0$ above the horizontal. The weight of the crate is 40 N. Find the magnitudes of <u>all</u> the other forces acting on the crate.

3. This problem uses the same ramp and crate as problem 2. Suppose that the magnitude of the friction were only 5.0 N, while the weight remains 40 N. Find
    a. the net force on the crate in both x and y directions.
    b. the acceleration of the crate in both x and y directions.

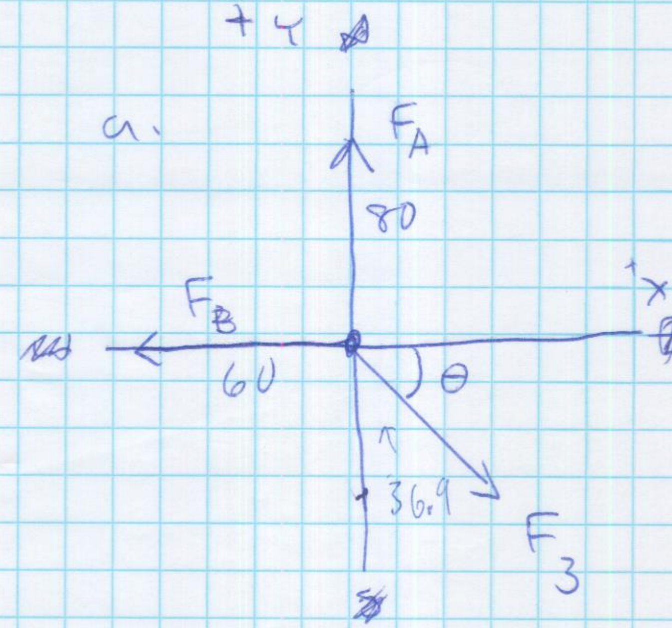
4. A sign (mass = 16 kg) hangs from two separate wires, as shown. The wires hang at different angles, as shown, and therefore have different tensions. Find the tension in each wire.



1.

b. Net Force = 0
to keep v const.
$1^{st}$ Law

a.




c.

$\Sigma F_x = ma_x$

$-F_B + F_3 \cos\theta = 0$

$F_B = F_3 \cos\theta$

$60 = F_3 \cos\theta$

$\Sigma F_y = ma_y$

$F_A - F_3 \sin\theta = 0$

$F_A = F_3 \sin\theta$

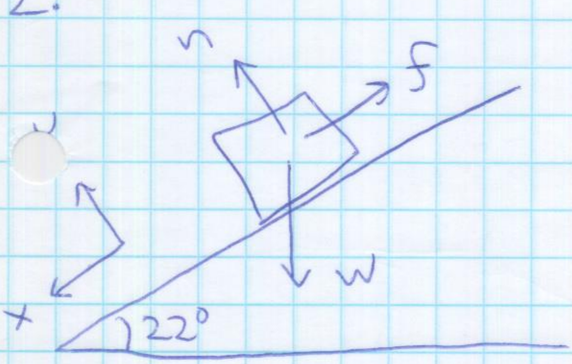
$80 = F_3 \sin\theta$

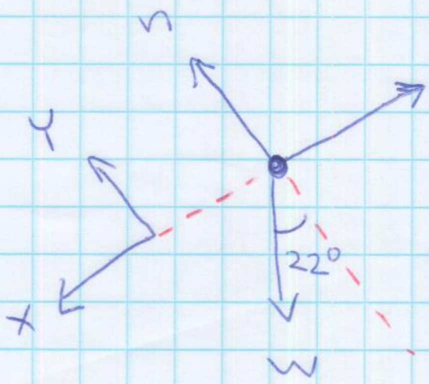
$$\frac{80}{60} = \frac{F_3 \sin\theta}{F_3 \cos\theta} = \tan\theta$$

$$\theta = 53.1^\circ$$

$$F_3 = \frac{60}{\cos 53.1} = 100 \text{ N}$$

2.




at rest.

$v = 0, \quad a = 0$

If it were to move, it would move along ramp. So angle x, y as shown.

$\Sigma F_x = m a_x$

$W \sin 22° - f = 0$

$f = W \sin 22°$
$= 40 \sin 22°$
$= 15 \text{ N}$

$\Sigma F_y = m a_y$

$n - W \cos 22° = 0$

$n = W \cos 22°$
$= 40 \cos 22°$
$= 37 \text{ N}$

3. Same pictures, but now $f = 5$ N.

$\Sigma F_x = m a_x$

$W \sin 22° - f = \Sigma F_x$

$\Sigma F_x = 40 \sin 22 - 5$
$= 10 \text{ N}$

$\Sigma F_y = m a_y$

$n - W \cos 22° = \Sigma F_y$

$\Sigma F_y = 37 - 40 \cos 22°$
$= 0$

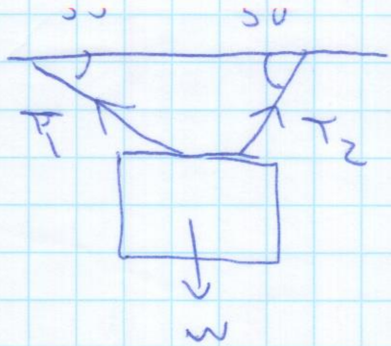
$a_x = \frac{\Sigma F_x}{m}$

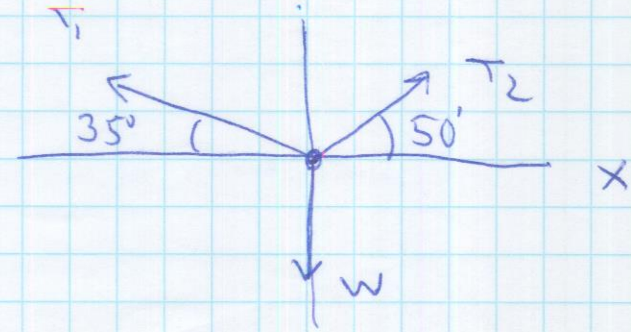
$a_y = 0$

$m = \frac{W}{g} = \frac{40 \text{ N}}{9.8 \text{ m/s}^2}$
$= 4.08 \text{ kg}$

$a_x = \frac{10 \text{ N}}{4.08 \text{ kg}} = 2.45 \text{ m/s}^2$

4.




$\Sigma F_x = m a_x$

$T_2 \cos 50 - T_1 \cos 35 = 0$

$T_2 = T_1 \dfrac{\cos 35}{\cos 50}$

$\Sigma F_y = m a_y$

$T_1 \sin 35 + T_2 \sin 50 - w = 0$

$T_1 \sin 35 + T_2 \sin 50 = mg$

$T_1 \sin 35 + \left(T_1 \dfrac{\cos 35}{\cos 50}\right) \sin 50 = mg$

$T_1 \left[\sin 35 + \dfrac{\cos 35}{\cos 50} \sin 50\right] = mg$

$T_1 \left[.5736 + \dfrac{(.819)(.766)}{.643}\right] = (16\ kg)(9.8\ \frac{m}{s^2})$

↓ have already accounted for direction

$T_1 = 101\ N$

$T_2 = T_1 \dfrac{\cos 35}{\cos 50} = 129\ N$