In these problem types you will be expected to provide the following:

- FBD (free body diagram)
- givens - write as a vector, but will use only magnitude in equations
- base equations used to derive the big awesome equations 1st principles
- substitutions
- intermediate values for mixed operations
- final answer rounded to proper number of sig figs.

In time you will develop your own style or way of presenting the information.

Remember, you are telling a story using mathematics as the language. And, typically, they start with "once upon a time there was a net force....".

Forces Applied At Angles

Ex. 1: Wendy pushes a couch by applying a force of 250**.** N [E 20^{o} down]. The couch moves against a kinetic friction force of 132.6 N. The couch has a mass of 28.7 kg.

a) What is the horizontal acceleration of the couch?

b) What is the coefficient of kinetic friction between the feet of the couch and the floor?

Ex. 2: Nicolas pulls a wagon by applying a force of 150**.** N [N 40 ^{o} up]. The wagon is moving with a constant speed. The coefficient of kinetic friction between the runners and the grass is 0.421.

a) What is the force of kinetic friction opposing this motion?

b) What is the mass of the wagon?

Ex1) $\vec{F_A} = 250.\ N\ [E20^\circ\ \text{down}]$

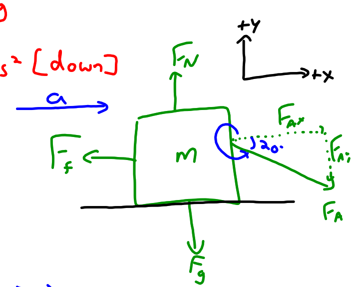
$\vec{F_f} = 132.6N\ [W]$

$m = 28.7kg$

$\vec{g} = 9.81 m/s^2\ [\text{down}]$

$\vec{a}_x = ?$

$\mu = ?$



$F_f = \mu F_N$

$$\vec{F}_{Net,x} = \Sigma \vec{F_x} = \vec{F_{Ax}} + \vec{F_f}$$

$$= \frac{F_{Ax} - F_f}{m} = \frac{m a_x}{m}$$

$$a_x = \frac{F_{Ax} - F_f}{m} = \frac{F_A \cos(\theta) - F_f}{m}$$

$$= \frac{(250\ N)\cos(\overset{20^\circ}{\cancel{340}}) - 132.6N}{28.7kg}$$

$$= \frac{234.92N - 132.6N}{28.7kg} \quad 102.32$$

$$= 3.5653\ m/s^2 = \boxed{3.57\ m/s^2}$$

b) $F_f = \mu F_N \longrightarrow \mu = \frac{F_f}{F_N}$

$$\vec{F}_{Net,y} = \Sigma \vec{F_y} = \vec{F_N} + \vec{F_g} + \vec{F_{Ay}}$$

$$= F_N - F_g - F_{Ay} = m a_y = 0N$$

$$F_N - F_g - F_{Ay} = 0$$

$$F_N = F_g + F_{Ay}$$

use interior angle of Δ

use 20°

$$F_N = mg + F_A \sin(\theta)$$

$$= (28.7kg)(9.81 m/s^2) + (250.N)\sin(340^\circ)$$

$$= 367.05N$$

$$\mu_k = \frac{F_f}{F_N} = \frac{132.6\cancel{N}}{367.05\cancel{N}} = 0.36125$$

$$= \boxed{0.361}$$

Ex 2

$\vec{F}_A = 150.\text{N}$ [N 40° up]

$\mu = 0.421$

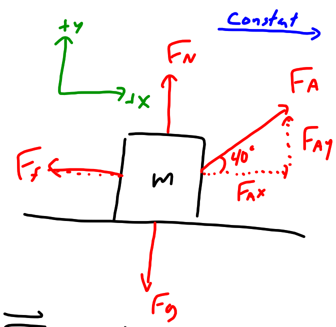
$\vec{g} = 9.81 \text{ m/s}^2$ (down)

$\vec{a}_x = 0 \text{ m/s}^2$

$\vec{a}_y = 0 \text{ m/s}^2$

$F_F = ?$

$m = ?$



$\vec{F}_{Net,x} = \sum \vec{F}_x = \vec{F}_{Ax} + \vec{F}_f$

$= F_{Ax} - F_f = ma_x = 0\text{N}$

$\therefore F_{Ax} = F_f$

$F_f = F_A \cos(\theta)$

$= (150.\text{N})\cos(40°)$

$= 114.907\text{N}$

$= \boxed{115\text{N}}$

b) $\vec{F}_{Net,y} = \sum \vec{F}_y = \vec{F}_g + \vec{F}_N + \vec{F}_{Ay}$

$= F_N - F_g + F_{Ay} = 0\text{N}$

$F_g = F_N + F_{Ay}$

$= \frac{F_f}{\mu} + F_A \sin(\theta)$

$F_f = \mu F_N$

$F_N = \frac{F_f}{\mu}$

$= \frac{(114.907\text{N})}{0.421} + (150\text{ N})\sin(40°)$

$= 272.937\text{N} + 96.418\text{N}$

$F_g = 369.355\text{ N}$

$m = \frac{F_g}{g} = \frac{369.355\text{N}}{9.81 \text{ m/s}^2} = 37.651\text{ kg}$

$\boxed{37.7\text{ kg}}$