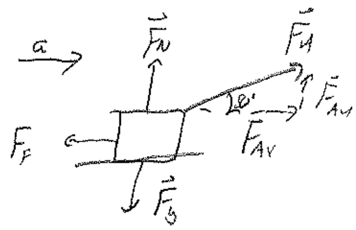
Forces Applied at an Angle

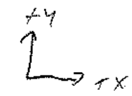
#1) $m = 98.4\ kg$

$\vec{F}_A = 950.\ N$ [E 50° up]

$\mu_k = 0.296$

$\vec{a}_y = 0\ m/s^2$, $\vec{g} = 9.81\ m/s^2$ [down]





a) $F_{Ay} = F_A \sin(\theta) = (950.\ N)\sin(50°) = 727.74\ N = \boxed{728\ N}$

b) $F_{Net,y} = F_N + F_{Ay} - F_g = 0\ N$

$$\therefore F_N = F_g - F_{Ay} = mg - F_{Ay}$$
$$= (98.4\ kg)(9.81\ m/s^2) - (727.74\ N)$$
$$= 237.56\ N = \boxed{238\ N}$$

c) $F_f = \mu F_N = (0.296)(237.56\ N) = 70.318 = \boxed{70.3\ N}$

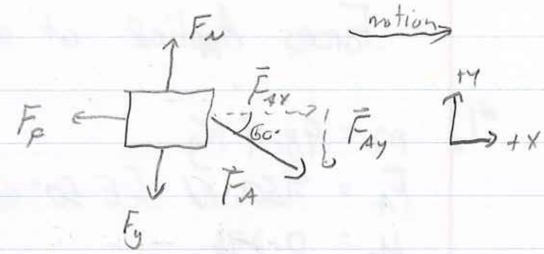
calculates magnitude only, $\vec{F}_f$ is [W]

d) $F_{Ax} = F_A \cos(\theta) = (950.\ N)\cos(50°) = 610.65\ N = \boxed{611\ N}$

e) $F_{Net,x} = \frac{F_{Ax} - F_f}{m} = \frac{ma_x}{m}$

$$a_x = \frac{F_{Ax} - F_f}{m} = \frac{(610.65\ N) - (70.318\ N)}{(98.4\ kg)} = 5.49116\ m/s^2$$
$$= \boxed{5.49\ m/s^2}$$

#2) $\vec{F}_A = 675\,N$ [E 60° down]
$m = 8.5\,kg$
$\vec{a}_x = 0\,m/s^2$
$\vec{a}_y = 0\,m/s^2$
$\vec{g} = 9.81\,m/s^2$ [down]



a) $F_{Ay} = F_A \sin(\theta) = (675\,N)\sin(60°) = 584.57\,N = \boxed{585\,N}$

b) $F_{Net,y} = F_N - F_g - F_{Ay} = 0\,N$

$\therefore F_N = F_g + F_{Ay} = (8.5\,kg)(9.81\,m/s^2) + (584.57\,N)$
$= 667.95\,N$
$= \boxed{668\,N}$

c) $F_{Ax} = F_A \cos(\theta) = (675\,N)\cos(60°) = 337.5\,N = \boxed{338\,N}$

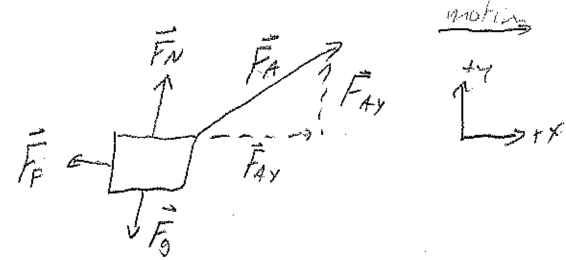
d) $F_{Net,x} = F_{Ax} - F_F = 0\,N$

$\therefore F_F = F_{Ax} = \boxed{338\,N}$ ← same magnitude opposite direction

e) $F_F = \mu F_N \rightarrow \mu = \frac{F_F}{F_N} = \frac{(337.5\,N)}{(667.95\,N)} = 0.50528$

$= \boxed{0.505}$

Forces Applied at an Angle



#3 $m = 12.9\ kg$
$\vec{a}_x = 0.234\ m/s^2\ [E]$
$\vec{F}_F = 16.2\ N\ [W]$
$\mu = 0.188$
$\vec{g} = 9.81\ m/s^2\ [down]$
$a_y = 0\ m/s^2$
$\vec{F}_N = ?$
$\vec{F}_A = ?$

a) $F_F = \mu F_N \rightarrow F_N = \frac{F_F}{\mu} = \frac{16.2 N}{0.188} = 86.1702\ N = \boxed{86.2 N}$

b) $F_{Net,y} = F_N - F_g + F_{Ay} = 0 N$

$\therefore F_{Ay} = F_g - F_N = mg - F_N$
$= (12.9\ kg)(9.81\ m/s^2) - 86.1702\ N$
$= 40.379\ N = \boxed{40.4\ N}$

c) $F_{Net,x} = F_{Ax} - F_F = ma_x$

$\therefore F_{Ax} = ma_x + F_F$
$= (12.9\ kg)(0.234\ m/s^2) + 16.2\ N$
$= 19.2186\ N$

$F_A = \sqrt{F_{Ax}^2 + F_{Ay}^2} = \sqrt{(19.2186 N)^2 + (40.379 N)^2}$

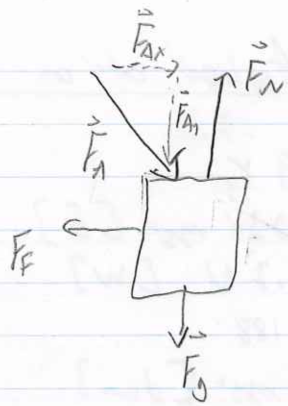
$= 44.719\ N$

$\theta = \tan^{-1}\left(\frac{F_{Ay}}{F_{Ax}}\right) = \tan^{-1}\left(\frac{40.379 N}{19.2186 N}\right) = 64.548°$

$\boxed{\vec{F}_A = 44.7\ N\ [E\ 64.5°\ up]}$

#4

$\mu_k = 0.215$
$\vec{F}_A = 33.6\,N$ [E 28° down]
$m = ?$
$\vec{a}_x = 0\,m/s^2$
$\vec{a}_y = 0\,m/s^2$
$\vec{g} = 9.81\,m/s^2$ [down]



$$F_{Net,x} = F_{Ax} - F_f = 0\,N \rightarrow F_{Ax} = F_f$$

$$F_{Net,y} = F_N - F_g - F_{Ay} = 0\,N \rightarrow F_g = F_N - F_{Ay}$$

$$F_f = F_A \cos(\theta) = (33.6N)\cos(28°) = 29.667\,N$$

$$F_f = \mu F_N \rightarrow F_N = \frac{F_f}{\mu} = \frac{(29.667N)}{0.215} = 137.986\,N$$

$$F_g = F_N - F_{Ay} = F_N - F_A \sin\theta$$

$$= (137.986N) - (33.6N)\sin(28°)$$

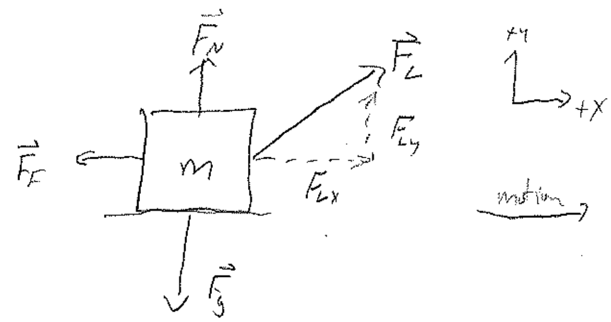
$$= 122.212\,N$$

$$F_g = mg \rightarrow m = \frac{F_g}{g} = \frac{122.212N}{9.81\,m/s^2} = 12.4579\,kg$$

$$= \boxed{12.5\,kg}$$

Forces Applied at an Angle

#5) $m = 63.85\ kg$
$\mu_K = 0.4262$
$\vec{F}_L = 250.\ N\ [E\ 30°\ up]$
$\vec{F}_M = ?$
$\vec{a}_x = 1.009\ m/s^2$
$\vec{F}_F = 247.8 N\ [W]$
$\vec{a}_y = 0\ m/s^2$
$\vec{g} = 9.81\ m/s^2\ [down]$



F_{Mx} might be W or E
F_{My} might be up or down
Lets assume both positive

$$F_{Net,x} = F_{Lx} + F_{Mx} - F_F = ma_x$$

$$F_{Mx} = ma_x + F_F - F_{Lx}$$

$$= (63.85 kg)(1.009 m/s^2) + (247.8N) - (250.N)\cos(30°)$$

$$= \underline{95.7}18 N$$ (1 decimal) ("+" so assumption correct: it is to the right)

$$F_{Net,y} = F_{Ly} + F_{My} + F_N - F_g = 0\ N$$

$$F_{My} = F_g - F_N - F_{Ly}$$

$$= mg - \frac{F_F}{\mu} - F_L \sin\theta$$

$$= (63.85\ kg)(9.81 m/s^2) - (247.8N/0.4262) - (250.N)\sin(30)$$

$$= -\underline{80.0}49 N$$ ("−" so assumption of up is wrong and it is actually down)

#5) con't

$F_M = \sqrt{F_{Mx}^2 + F_{My}^2}$

$= \sqrt{(95.718\,N)^2 + (-80.049\,N)^2}$

$= 124.779\,N$

$\theta = \tan^{-1}\left(\frac{F_{My}}{F_{Mx}}\right) = \tan^{-1}\left(\frac{-80.049N}{95.718N}\right) = -39.906°$

$= -39.9°$

$= -40.°$

$\boxed{F_M = 125\,N\,[E\ 40.°\ down]}$