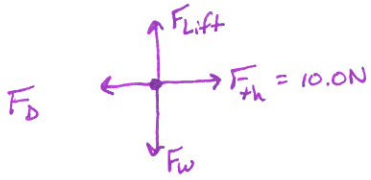
Newtonian Mechanics Review (Pre-AP) **Name:**_____

1. The air exerts a forward force of 10.0 N on the propeller of a 0.20 kg model airplane. If the plane accelerates forward at 2.0 m/s^2, what is the magnitude of the resistive force exerted by the air on the airplane?

FBD:



$\Sigma F_x = ma_x$

$10.0N - F_D = (.20kg)(2.0m/s^2)$

$10.0N - F_D = 0.4N$

$F_D = 9.6N$

2 s.f.

Ans: 9.6 N

2. A 5.0 gram bullet leaves the muzzle of a rifle with a speed of 320 m/s. What force (assumed constant) is exerted on the bullet while it is traveling down the 0.82 m long barrel of the rifle?

$5.0g = 0.0050kg$

$v_f^2 = v_0^2 + 2a\Delta x$

$320^2 = 0^2 + 2(a)(.82)$

$a = 62,439.02...\ m/s^2$

$F_{net} = ma$

$F_{net} = (.0050)(62,439.02...)$

$F_{net} = 312.195$

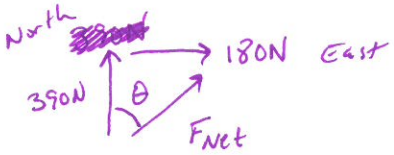
2 s.f.

Ans: 310N

3. The force of the wind on the sails of a sailboat is 390 N north. The water exerts a force of 180 N east. If the boat, including the crew, has a mass of 270 kg, what are the magnitude and direction of its acceleration?

(Weight cancelled by buoyant force from water.)

FBD - overhead view



$\theta = \tan^{-1}\frac{180}{390}$

$\theta = 24.775°$ E of N

$F_{net} = \sqrt{390^2 + 180^2}$

$429.5346...N$

$F_{net} = ma$

$429.5346... = (270kg)(a)$

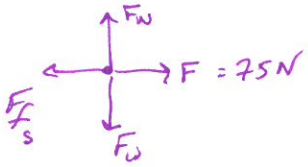
$a = 1.59086$ 2sf.

1.6

Ans: 1.6 m/s^2 25° E of N (or 65° N of E)

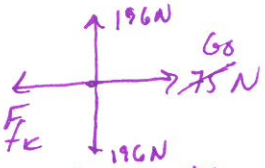
Answer to #4 is $\mu_s = 0.383$, $\mu_k = 0.306$ Answer to #5 is a = -1.20m/s^2, $\mu_k = 0.122$, d = 45.0m

4. A dockworker loading crates on a ship finds that a 2.0×10^1 kg crate, initially at rest on a horizontal surface, requires a 75 N horizontal force to set it in motion. However, after the crate is in motion, a horizontal force of 6.0×10^1 N is required to keep it moving at constant speed. Find the coefficients of static and kinetic friction between the crate and floor.



$F_w = 20(9.8)$
$= 196N$
$F_w = F_N = 196N$

$\Sigma F = ma = 0$
$F_{f_s} = 75N$
$\mu_s F_N = 75N$
$\mu_s (196) = 75$
$\mu_s = 0.38265\ldots$



$F_K = \mu_K F_N$
$196N = \mu_K (196)$
$60 = \mu_K (196)$
$\mu_K = 0.306122\ldots$
2 s.f.

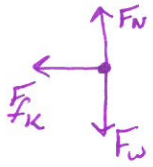
Ans: $\mu_s = 0.38$
Ans: $\mu_K = 0.31$

5. A hockey puck is hit on a frozen lake and starts moving with a speed of 12.0 m/s. 5.00 seconds later, its speed is 6.00 m/s. What is its average acceleration? What is the average value of the coefficient of kinetic friction between puck and ice? How far does the puck travel during this 5.00 s interval?

$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t}$

$a = \frac{6 - 12}{5}$

$a = -1.20 m/s^2$



$\Sigma F = ma$
$F_K = ma$
$(\mu_K F_N) = ma$
$\mu_K (F_w) = ma$
$\mu_K (mg) = ma$
$\mu_K g = a$
$\mu_K (9.80 m/s^2) = 1.20 m/s^2$
$\mu_K = 0.12244897$

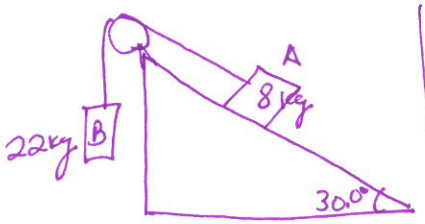
$v_{AVE} = \frac{12+6}{2} = 9 m/s$

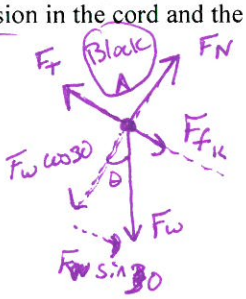
$\Delta x = (v_{AVE})(t)$
$= (9 m/s)(5.00 s)$
$= 45.0 m$

Ans: $-1.20 m/s^2$
Ans: 0.122
Ans: 45.0 m

Answer to #1 is F = 9.6N, Answer to #2 is F = 310N, Answer to #3 is a = 1.6 m/s^2 65° North of East

6. Block A (mass 8.00kg) is moving up a 30.0 degree incline and is attached by a cord to block B (mass 22.0 kg) hanging over the end of the incline via a pulley. If the coefficient of kinetic friction between block A and the incline is 0.28, find the tension in the cord and the acceleration of the system.





$\Sigma F_y = ma_y$ (2 forces)

$F_N - F_W \cos 30° = (8)(0)$

$F_N = F_W \cos 30$

$F_N = (8)(9.8)\cos 30°$

$F_N = 67.8964\,N$

Block B: F_T (2 forces), $F_{W_B} = (22)(9.8) = 215.6$

$\Sigma F_B = m_B a$

$215.6\,N - F_T = 22a$

(3 forces) $\Sigma F_x = ma_x$

$F_T - F_W \sin 30° - F_{f_K} = (8)(a)$

$F_T - (8)(9.8)\sin 30° - \mu_K F_N = 8a$

$F_T - 39.2 - (.28)(67.8964) = 8a$

$F_T - 58.211 = 8a$

$F_T - 58.211 = 8a$

$+\ 215.6 - F_T = 22a$

$157.389 = 30a$

$a = 5.246$

$a = 5.2\,m/s^2$

$F_T - 58.211 = 8(5.246\ldots)$

$F_T = 100.18$

$1.0 \times 10^2\,N$

Ans: $5.2\,m/s^2$

Ans: $1.0 \times 10^2\,N$