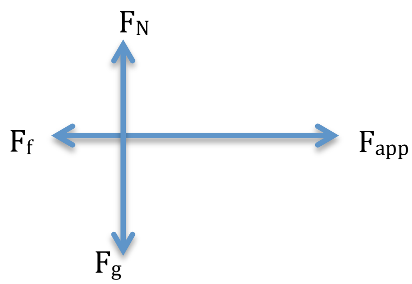
Honors Physics
Chapter 4 – Review Problems

Name ____________________
Date ____________________

For each problem, on a separate sheet of paper draw a picture of the situation, the free body diagram(s) necessary, and solve the problem. All work must be shown. Remember to solve the problem algebraically first.

1. A girl pushes a 1.04 kg book across a table with a horizontal applied force of 15.0 N. If the coefficient of kinetic friction between the book and the table is 0.35, find its acceleration.



$F_{app} = 15.0$ N

$F_g = mg = (1.04\text{ kg})(-9.8\text{ m/s}^2) = -10.192$ N

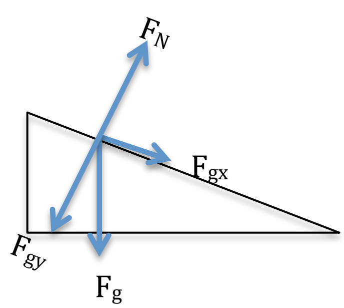
$F_N = -F_g = -(-10.192\text{ N}) = 10.192$ N

$F_f = -\mu_k F_N = -(0.35)(10.192\text{ N}) = -3.5672$ N

$$F_{net} = ma = F_f + F_{app}$$

$$a = \frac{F_f + F_{app}}{m} = \frac{-3.5672\ N + 15.0\ N}{1.04\ kg} = 11.0\frac{m}{s^2}$$

2. A box with a mass of 22.0 kg is placed on a ramp that is at an angle of 38.0 degrees above the horizontal. What is the magnitude of the component of the weight that is parallel to the surface of the ramp?



$F_g = mg = (22.0\text{ kg})(9.8\text{ m/s}^2) = 215.6$ N

$F_{gx} = F_g \sin\Theta = (215.6\text{ N})(\sin(38.0^\circ)) = 133$ N

It is positive because it is pointed down the incline to the right and I have defined positive as down and to the right.

3. A desk with a mass of 67.4 kg rests on a floor where the coefficient of static friction between the surfaces is 0.45. How much force would be required to get the desk to start sliding?

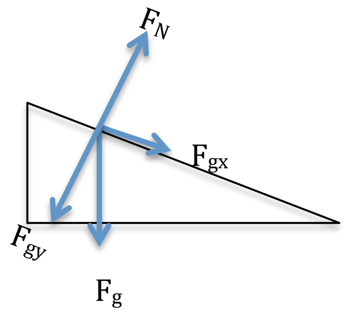
$F_g = mg = (67.4\text{ kg})(-9.8\text{ m/s}^2) = -660.52$ N

$F_N = -F_g = -(-660.52\text{ N}) = 660.52$ N

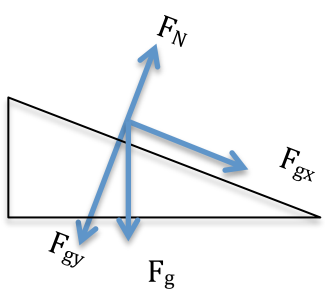
$F_f = \mu_s F_N = (0.45)(660.52\text{ N}) = 297$ N

To get started the applied force must be greater than or equal to 297 N

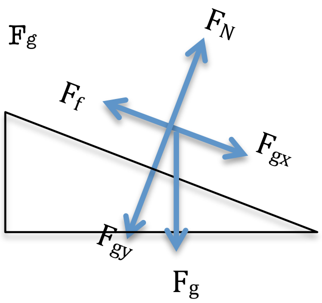
4. If the desk is problem #3 is on a ramp with an angle of 22.0 degrees to the horizontal, how much force must be applied to get the desk to move?

	$F_g = mg = (67.4\ kg)(9.8\ m/s^2) = 660.52\ N$ $F_{gy} = F_g \cos\Theta = -(660.52)(\cos(22.0^\circ)) = -612.42\ N$ $F_N = -F_{gy} = -(-612.42\ N) = 612.42\ N$ $F_f = \mu_s F_N = (0.45)(612.42\ N) = 275.59\ N$ Must apply 275.59 N or greater for the desk to move Note - $F_{gx} = F_g \sin\Theta = (660.52\ N)(\sin(22.0^\circ)) = 247\ N$, thus the weight of the desk does not overcome static friction. Thus, must apply 275.59 N – 247 N = 29 N to get the box to start moving.

5. A 54.3 kg block is placed on an inclined plane that is 42.4 degrees from the horizontal. What is the acceleration of the block? Ignore friction.

	$F_g = mg = (54.3\ kg)(-9.8\ m/s^2) = -532.14\ N$ $F_{gx} = F_g \sin\Theta = (532.14\ N)(\sin(42.4^\circ)) = 358.8\ N$ $F_{gy} = F_g \cos\Theta = -(532.14\ N)(\cos(42.4)) = -392.96\ N$ $F_N = -F_{gy} = -(-392.96\ N) = 392.96\ N$
$F_{net} = ma = F_{gx}$ $a = \frac{F_{gx}}{m} = \frac{358.8}{54.3\ kg} = 6.61\frac{m}{s^2}$	

6. The same block in problem #5 is placed on the same inclined plane from problem #4. However, now there is friction. If the coefficient of kinetic friction is 0.25, what is the acceleration of the block?



Block from problem five has a mass of 54.3 kg. The incline from problem 4 is at an angle of 22 degrees.

F_g = mg = (54.3 kg)(9.8 m/s^2) = 532.14 N

F_{gy} = F_g cosΘ= -(532.14 N)(cos (22.0^o)) = -493.39 N

F_N = -F_{gy} = -(-493.39 N) = 493.39 N

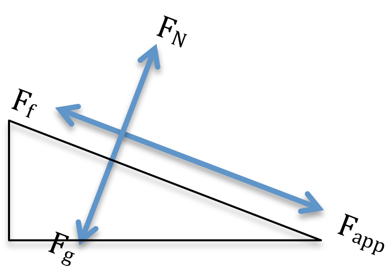
F_f = -$\mu_k F_N$ = -(0.25)(493.39 N) = -123.34 N (notice that this is negative because I defined left as negative and right as positive)

F_{gx} = F_g sinΘ= (532.14 N)(sin (22.0^o)) = 199.34 N

$$F_{net} = ma = F_f + F_{gx}$$

$$a = \frac{F_f + F_{gx}}{m} = \frac{-123.34\,N + 199.34\,N}{54.3\,kg} = 1.40\frac{m}{s^2}, positive\ so\ acceleration\ down\ the\ plane$$

7. Same block from problem #6. If the distance of the inclined plane is 5.2 m, how long does it take the block to reach the end of the plane?



Assume initial velocity is 0 m/s.
Displacement is 5.2 m.
Acceleration is 1.40 m/s^2

$$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$\Delta t = \sqrt{\frac{2\Delta x}{a}} = \sqrt{\frac{2\,(5.2\,m)}{1.40\,\frac{m}{s^2}}} = 2.73\ seconds$$