Name: _____

Date: _____

Section C D F

The Masters School
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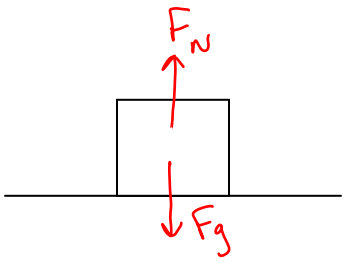
Physics

Forces II

1. A 5 kg object lies at rest on a bench. If the bench were to be lifted, slowly, how would the normal force and static friction force change as the angle of inclination increased? Draw Free Body Diagrams for the situations below, label forces, axes, $F_{net,x}$, $F_{net,y}$, and calculate F_N and F_s for each.

a. $\theta = 0$



$F_{net,x} = \emptyset$

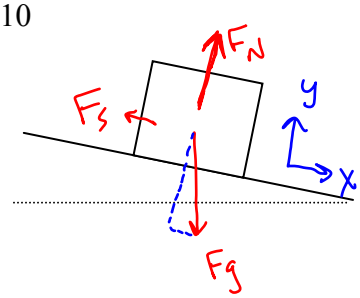
$F_{net,y} = F_N - F_g = 0$

$F_N = F_g$

$F_{N,\theta=0} = 49.05\ N$

$F_{s,\theta=0} = \emptyset$

b. $\theta = 10$



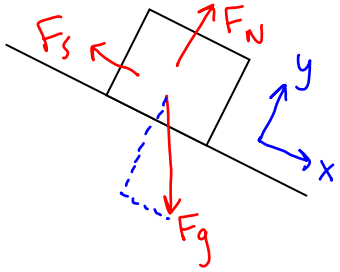
$F_{net,x} = F_{g,x} - F_s = 0$

$F_{net,y} = F_N - F_{g,y} = 0$

$F_{N,\theta=10} = 48.3\ N$

$F_{s,\theta=10} = 8.5\ N$

c. $\theta = 30$



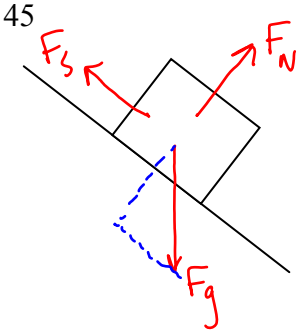
$F_{net,x} =$

$F_{net,y} =$

$F_{N,\theta=30} = 42.5\ N$

$F_{s,\theta=30} = 24.5\ N$

d. $\theta = 45$



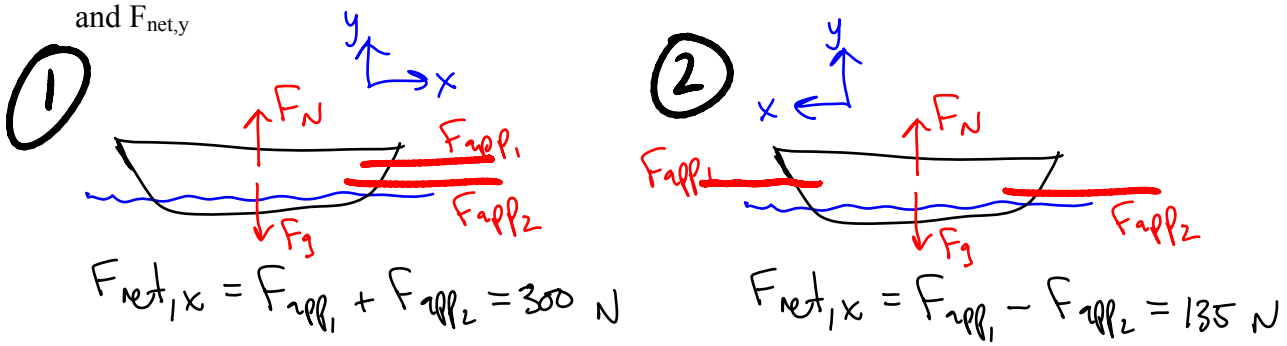
$F_{net,x} =$

$F_{net,y} =$

$F_{N,\theta=45} = 34.7\ N$

$F_{s,\theta=45} = 34.7\ N$

2. Two lifeguards pull on ropes attached to a raft. If they pull in the same direction, the raft experiences a net external force of 300 N to the right. If they pull in opposite directions, the raft experiences a net external force of 135 N to the left.
   a. Draw a free-body diagram representing the raft for each situation. This includes the forces, $F_{net,x}$ and $F_{net,y}$



$F_{net,x} = F_{app_1} + F_{app_2} = 300\ N$

$F_{net,x} = F_{app_1} - F_{app_2} = 135\ N$

   b. Find the force exerted by each lifeguard on the raft. (Disregard any other forces acting on the raft.)

$F_{app_1} - F_{app_2} = 135\ N$

$F_{app_1} = 135\ N + F_{app_2}$

$F_{app_1} + F_{app_2} = 300\ N$

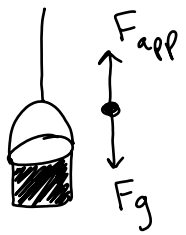
$135 + F_{app_2} + F_{app_2} = 300\ N$

$2F_{app_2} = 165\ N$

$F_{app_2} = 82.5\ N$

$F_{app_1} = 217.5\ N$

3. A 5 kg bucket of water is raised from a well by a rope. If the upward acceleration of the bucket is 1.2 m/s^2, find the force exerted by the rope on the bucket of water.



$F_{net,y} = F_{app} - F_g \neq 0$

$F_{net,y} = F_{app} - (5)(9.81)$

$F_{app} = 49.05 + F_{net,y}$

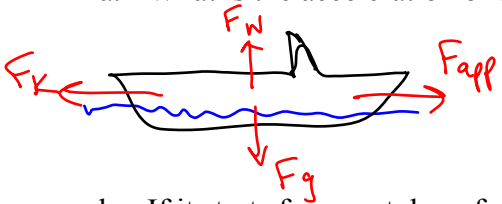
$F_{app} = 55.05\ N$

$F_{net,y} = m a_y$

$= 5(1.2)$

$F_{net_y} = 6\ N$

4. A boat moves through the water with a 2.9×10^3 N forward push by the motor, and a kinetic friction force caused by the water of 1.9×10^3 N.
   a. What is the acceleration of the 1200 kg boat?



$F_{net,x} = F_{app} - F_K \neq 0$

$F_{net,y} = F_N - F_g = 0$

$F_{net,x} = 2,900 - 1,900$

$F_{net,x} = 1,000\ N$

$F_{net,x} = m \cdot a$

$1000 = 1200 \cdot a$

$a = .83\ m/s^2$

   b. If it starts from rest, how far will it move in 3 s?

$\Delta x = ?$

$V_i = 0$

$V_f =$

$a = .83$

$\Delta t = 3$

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

$\Delta x = \frac{1}{2}(.83)(3)^2$

$\Delta x = 3.75\ m$

   c. What will its velocity be at the end of this time interval?

$V_f = V_i + a \Delta t$

$= (.83)(3)$

$V_f = 2.5\ m/s$