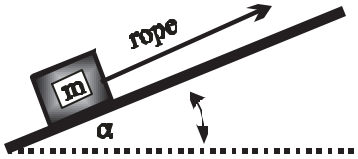
PHYSICS HOMEWORK #31 NEWTON'S LAWS

SECOND LAW $\Sigma F=ma$

Newton's Second Law of Motion

The acceleration of an object is directly proportional to the force applied, inversely proportional to the mass of the object and in the same direction as the accelerating force!

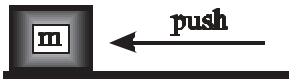
1. A crate, which has a mass of m = 45.0 kg., is being accelerated at 3.20 m/sec^2 up a frictionless inclined plane, which meets the horizontal at an angle of $\alpha = 35.0^o$ relative to the horizontal, by a rope as shown to the right.
   a. Complete the free body diagram showing all the forces acting on the crate as it moves up the incline at a constant speed.
   b. What will be the magnitude of the normal force acting on the crate?
   c. What will be the magnitude of the tension T in the rope?



2. A crate, which has a mass of 55.0 kg. is being accelerated straight up by a rope at a rate of 3.80 m/sec^2. What will be the tension in the rope?

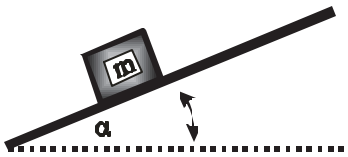
Make a freebody diagram for EVERY problem!

3. A crate, which has a mass of 55.0 kg., is being pushed along a horizontal surface by a force of F = 125.0 Newtons so that the crate is accelerating to the left at a constant rate of a = 1.10 m/sec^2.
   a. Complete the free body diagram showing all the forces acting on the crate.
   b. What will be the magnitude of the frictional force acting on this crate?
   c. What is the coefficient of sliding friction between the crate and the horizontal surface?



4. A block of wood, which has a mass of m = 5.00 kg., is at rest on a horizontal surface which has a coefficient of sliding friction of $\mu = 0.43$. A spring scale is attached to a hook on the end of the block and is pulled until the reading on the scale is 47.0 N. As a result the block accelerates to the right.
   a. What is the magnitude of the normal force acting on this block?
   b. What is the magnitude of the frictional force on this block as it slides to the right?
   c. What is the rate of acceleration of this block?

5. A crate, which has a mass of 65.0 kg., is sitting at rest on an inclined plane, which has a coefficient of sliding friction of $\mu = 0.430$, as shown to the right. The end of the incline is lifted until the angle of the incline reaches $\alpha = 27.0^o$, at which point the crate accelerates down the incline at a constant rate.
   a. Complete the free body diagram showing all the forces acting on the crate.
   b. What is the magnitude of the normal force acting on this crate?
   c. What is the magnitude of the frictional force acting on this crate?
   d. What is the rate of acceleration of this crate as it slides to the bottom of the inclined plane?



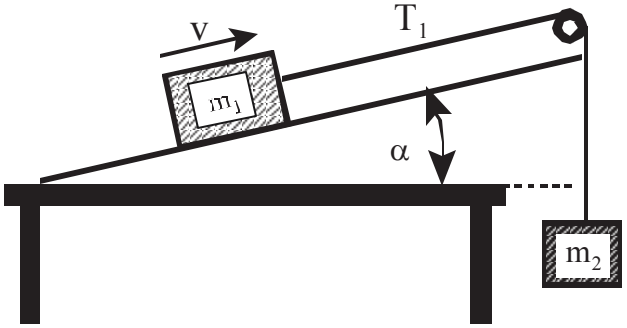
6. A sled, which has a mass of m = 125 kg., is sitting on an icy horizontal surface. A rope is attached to the front end of the sled such that the angle between the rope and the horizontal is $\alpha = 28.0^o$ and a force of 585 N is applied to the rope. As a result the sled accelerates to the right at a rate of 3.30 m/sec^2.
   a. Complete the free body diagram showing all the forces acting on the sled.
   b. What is the magnitude of the frictional force acting on this sled?
   c. What is the magnitude of the normal force acting on the sled?
   d. What is the coefficient of sliding friction between the sled and the icy horizontal surface?
   e. What will be the displacement of this sled at the end of 5.0 seconds?

Answers to opposite side: 7a. 52.0 N b. 2.37 m/sec^2 c. 0.741 sec d. 1.76 m/sec 8a. 2.40 m/sec^2 8b. 60.0 N c. 195 N 9a. 8.03 m/sec^2 b. 66.5 N 10a. 22.3 N b. 22.3 N c.75.0 N d. 126 N

PHYSICS HOMEWORK #32 NEWTON'S LAWS

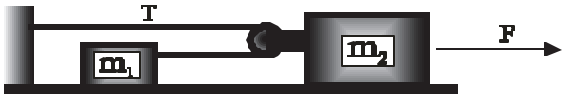
SECOND LAW $\Sigma F=ma$

7. A mass of $m_1 = 6.00$ kg is sitting on an inclined plane, which meets the horizontal at an angle of $\alpha = 22.0^o$, which has a coefficient of sliding friction of $\mu = 0.290$, and which is L = 3.50 meters long, as shown to the right. A string is attached to mass m_1, it is strung over a pulley, and is then attached to a second mass $m_2 = 7.0$ kg. which is initially a distance of h = 65.0 cm above the floor. As a result m_1 accelerates up the incline at a constant rate.



   a. What is the magnitude of the tension T in the string connecting the two masses?
   b. What will be the rate of acceleration of this system?
   c. How long will it take for mass m_2 to reach the floor ?
   d. What will be the speed of m_2 just as it reaches the floor ?

8. Two masses are sitting on a horizontal surface as shown to the right. The coefficient of sliding friction between these two masses and the horizontal surface is $\mu_k = 0.520$. A string is attached to the end of mass $m_1 = 8.00$ kg. This string is then looped around a pulley and is finally attached to the left vertical surface. The pulley is attached to mass $m_2 = 12.0$ kg as shown and then a force F is applied to m_2 such that m_2 accelerates toward the right at a constant rate of $a_2 = 1.20$ m/sec^2.

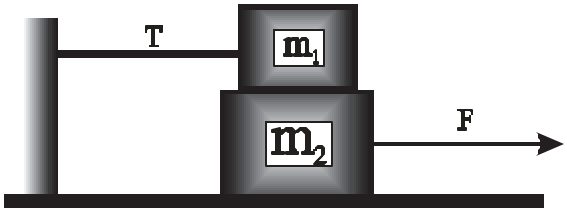


   a. What will be the corresponding acceleration a_1 of mass m_1 ?
   b. What will be the tension T in the string that is accelerating mass m_1 ?
   c. What will be the magnitude of the force F required to accelerate this system at the given acceleration ?

9. Two masses, $m_1 = 3.00$ kg and $m_2 = 7.00$ kg. are sitting on a horizontal surface, which has a coefficient of kinetic friction of $\mu_k = 0.150$, as shown to the right. The two masses are attached together by a string in which the tension is T. A force F = 95.0 N is applied to the system as shown so as to accelerate the two masses to the left at a constant rate a.

   a. What will be the rate of acceleration of this system ?
   b. What will be the tension T in the string connecting the two masses together?

10. Two masses are arranged as shown. m_1 has a mass of 6.00 kg and is attached to the vertical surface on the left with a string in which the tension is T. m_2 has a mass of 9.00 kg, is sitting on the horizontal surface and is being pulled to the right by a force F so that m_2 is accelerating to the right at a constant rate of a = 3.20 m/sec^2. The coefficient of sliding friction between m_1 and m_2 is $\mu_1 = 0.380$ while the coefficient of sliding friction between m_2 and the horizontal surface is $\mu_2 = 0.510$.



   a. What will be the tension T in the string?
   b. What is the magnitude of the frictional force between m_1 and m_2?
   c. What will be the magnitude of the frictional force between m_2 and the horizontal surface?
   d. What will be the magnitude of the force F required to accelerate m_2 to the right at 3.20 m/sec^2 ?

Answers to opposite side: 1b. 361 N c. 397 N 2. 748 N 3b. 64.5 N c. 0.12 4a. 49 N b. 1.1 N 4c. 5.2 m/sec^2 5b. 568N c. 244 N d. 0.692 m/sec^2 6b. 104 N c. 950 N d. 0.109 e. 41.3 m