**DYNAMICS WORKSHEET 2 - FORCES**

Answers are supplied at the end of this set of problems.

1. Two tractors pull on a large boulder to shift it out of the way of a new fence line. One tractor pulls with a force of 3000 N west and the other tractor pulls with a force of 2500 N in a southerly direction because of the terrain. Determine the resultant force acting on the boulder. If the boulder has a mass of 1000 kg calculate the acceleration of the boulder due to the resultant force acting on it.
2. Three coplanar horizontal forces each of magnitude 10 N act on a body of mass 5 kg as shown below. Determine the magnitude of the net force acting on the body and the magnitude of the resultant acceleration.  
     
   
3. A sled of mass 10 kg sits on a horizontal surface as shown below.  
     
      
     
     
   A force is exerted on the sled by means of a rope inclined at 60o to the horizontal. If the tension in the rope is 150 N and the frictional force between the sled and the horizontal surface is 55 N, will the sled move under these conditions? Explain. If the sled does move determine the size of the acceleration with which it moves.
4. A barge of total mass 300 kg is pulled by a single rope attached to a tugboat of mass 1000 kg. If the drag on the tug and the barge is one-tenth of their respective weights, and the total forward force exerted by the tug is 5130 kg force (ie 5130 x 9.8 N), find the magnitude of:  
   1. the total force resisting the forward motion of the tug and barge;
   2. the acceleration of the tug/barge system;
   3. the unbalanced accelerating force on the barge;
   4. the tension in the towing rope.
5. An astronaut of mass MA = 80 kg stands on the horizontal floor of a spaceship moving vertically upwards with acceleration a. If the acceleration due to gravity on the astronaut is g = 9.8 ms-2, write a mathematical expression for and calculate the value of the reaction force R between the astronaut and the floor of the spaceship when:  
   1. a = 0;
   2. a = 8 ms-2 upwards;
   3. a = 8 ms-2 downwards.

# ANSWERS TO DYNAMICS WORKSHEET 2

1. Resultant force = 3905 N in a direction of W39.8oS & acceleration = 3.9 ms-2 in the same direction as the resultant force.
2. Magnitude of net force = 20 N & magnitude of resultant acceleration = 4 ms-2.
3. Horizontal force to the left on sled is 75 N, which is greater than the friction force to the right. Therefore, the sled will move to the left with an acceleration of 2 ms-2. If you did not get the right acceleration, ask yourself how much of the 75 N to the left accelerates the sled – all of it or just some of it? Some of it must overcome friction!
4. (a) 1274 N, (b) 37.7 ms-2, (c) 11 307 N, (d) 11 601 N.
5. (a) R = MA g = 784 N upwards; (b) R = MA g + MA a = 1424 N upwards; (c) R = MA g - MA a = 144 N upwards.