

# Newton's Laws

Assignment # 3

Due Tuesday, October 29, 2019

Show Your Work and Draw your FBDs (and fill them in)

1. James pulls a sled with a mass of 80kg across his lawn. He pulls with 150N of force. a) Determine the force of friction if the acceleration is  $0.5\text{m/s}^2$ . b) What is the coefficient of friction?
2. Newton is out on his wind surfer that is made to go on ice. The coefficient of static friction is 0.2 and the coefficient of kinetic friction is 0.08. The total mass of him and the windsurfer is 120kg.
  - a) Determine the force of static friction.
  - b) Determine the force of kinetic friction.
  - c) The wind provides a force of 250N. What is his acceleration when he first starts?
  - d) What is his acceleration after he gets moving?
3. Your boss has asked you to move some boxes in a warehouse. In each box is a refrigerator that has a mass of 80kg. a) If the  $\mu_s$  is 0.25 would you be able to move the box with a force of 180N? b) What is the minimum force required to make the boxes move? c) What would be the required coefficient of friction in order to move the boxes with a constant velocity if the applied force was 100N?
4. An 100 kg sled is moving at 10 m/s over smooth ice when it enters a rough stretch of ice 20 m long in which the force of friction is 160 N. a) What is the acceleration of the sled? b) With what speed does the sled emerge from the rough stretch? (You might need to use kinematics)
5. You're eccentric uncle is moving and he has asked you, as his most intelligent and physically fit relative, to help him move furniture from his 3 story apartment. You are all about the concept of work smarter not harder, so you decide to get your friend to help you with this task. You decide to lower furniture over the balcony. The heaviest item is a 300kg item. You calculate that the greatest acceleration that will be experienced at any point is  $1\text{m/s}^2$ . At your disposal, you have 2 ropes, one will hold 3000N, the other will hold 4000N. a) Which one would you use and why (show your work)?

Multiple Choice Questions for Reference (Answer the questions on Schoology)

1. If you doubled the applied force on an object the force of friction would:
2. If you doubled the mass of an object being pulled horizontally, the force of friction would:
3. If you doubled the coefficient of friction, the force of friction would:
4. A large heavy equipment tire is dragged across a concrete shop floor. The tire weighs 980N. The force required to keep the tire moving is at least:
5. A steel crate with a weight of 220lbs is pulled across a steel deck on a truck. What is the force of friction when you slide this crate along the floor at a constant velocity?
6. A cable is used to move an elevator that weighs 1000N. If the tension in the cable is 1100N during the movement, the acceleration of the elevator is

Practice Problems

1. A cable is required to lift an object, with an acceleration, from the floor to a height of 8m in 4 seconds. If the maximum weight of any object lifted will be 1000lbs., how much tension should the cable be able to support? **(1100lbs)**
2. Your boss has asked you to move some boxes in a warehouse. In each box is a refrigerator that has a mass of 60kg. a) If the  $\mu_s$  is 0.25 would you be able to move the box with a force of 200N? b) What is the minimum force required to make the boxes move? **(Yes, >147N)**

3. A large crate has a mass of 200kg and the coefficient of static friction between the box and the floor is 0.4. If you apply 400N will it move? What is the minimum force required to start the crate moving? **(No, >784N)**
  
4. Raymond is dragging bags of potatoes on a pallet across a floor in a large storage building. He applies a force of 250N of force to start moving the bags. If the mass of the bags is 100kg and the force of static friction is 196N determine:
  - a) The coefficient of static friction. **(0.2)**
  - b) The acceleration of the pallet. **(0.54m/s<sup>2</sup>)**
  - c) What would happen to the net force if he pulled 50kg bags instead of 100kg bags, assuming he still applied the same force? Explain or determine the magnitude of the new net force.**(152N)**
  
5. The record for the longest skid marks on public road was reportedly set in 1960 by a 1200kg Jaguar on the M1 highway in England. The marks were 290m long. The coefficient of kinetic friction was found to be 0.50. a) How fast was the vehicle moving when the brakes were applied? b) How long would the skid marks be if a 3000kg truck were travelling at the same velocity and the coefficient of friction stays the same? **(53.31m/s, 0.29km)**
  
6. A steel crate with a weight of 3920N is pulled across a steel deck on a truck. a) What is the force of friction when you slide this crate along the deck? b) What force is required to move the block with an acceleration of 2.5m/s<sup>2</sup>?
  
7. Marc is texting while driving his car when he runs into the back of a parked lunch truck (the kind that make hot lunches and parks near businesses). The lunch truck has a mass of 4200kg and as a result of the collision has a velocity of 5m/s within 1 sec. a) Determine the force that the car put on him. b) Determine the acceleration of the car if its mass is 1240kg. (Note: no one was seriously injured in the collision) **(21kN, -16.94m/s<sup>2</sup>)**
  
8. You have found yourself in a precarious situation. You are up in your kid's tree house and it is raining, preventing you from climbing down the tree without risking injury. The tree house is 5m above the ground so you can't jump safely. Your mass is 65kg and the rope will hold a maximum tension of 600N.
  - a) Can you hang and slowly lower yourself down? Why or why not? **(No)**
  - b) What is your downward acceleration? **(-0.57m/s<sup>2</sup>)**
  - c) How long will it take to reach the ground? **(4.19s)**