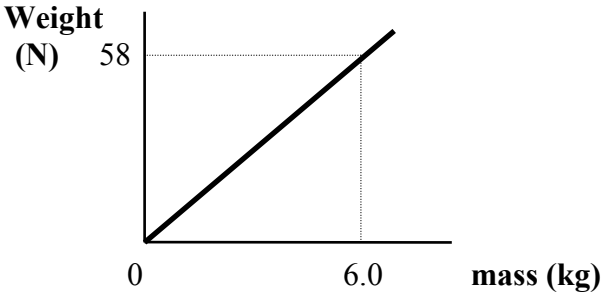
PHYSICS 12 DYNAMIC EQUILIBRIUM WORKSHEET 1

1. a) Determine the slope of the graph to the right.
   b) What slope would you *expect* from this graph? Explain your answer.



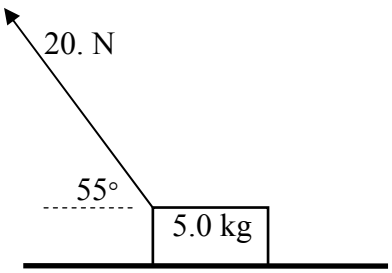
2. In an experiment, a student compares the normal force of a block of wood with the friction force that acts when the block is pulled along a countertop. She plots a graph of $\mathbf{F_f}$ vs. $\mathbf{F_N}$, draws a straight line through the points, and calculates the slope. What does this slope represent? Explain your answer.

3. A force of 18.0 N is used to pull a 2.0 kg block on a horizontal table where the coefficient of friction is 0.56. If the mass starts from rest,
   a) what is the acceleration?
   b) what is the velocity 2.6 s after the force starts acting?

4. A vertical rope is attached to a 35 kg mass. If the mass starts from rest and acquires an upward velocity of 1.6 m/s in 0.50 s,
   a) what is its acceleration?
   b) what is the tension in the rope?

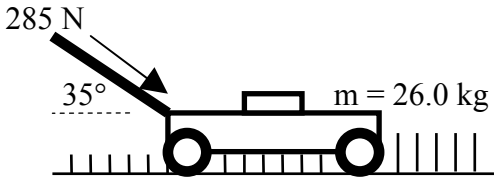
5. A 1.00×10^4 kg rocket is acted upon by an upward thrust of 1.18×10^5 N. If the rocket is 16.0 m tall, how much time is required for it to rise off the launching pad a distance equal to its own height?

6. A 55 kg student stands on a bathroom scale in an elevator of <u>total</u> mass 7.0×10^2 kg that is accelerating *upward* at 1.5 m/s^2.
   a) What is the tension in the cable that is pulling the elevator up?
   b) What would the student's apparent weight be in the elevator (i.e. the reading on the scale)?
   c) How would the student's apparent weight change if the elevator was accelerating *downward*?

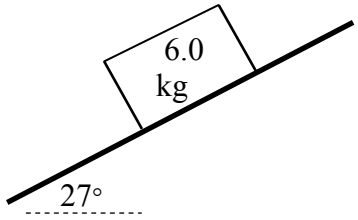
7. 

   Examine the diagram to the left.
   a) Find the normal force acting on the 5.0 kg block.
   b) If the block slides at constant speed,
      i) how large is the friction force?
      ii) what is the coefficient of friction between the block and the floor?

8. Groundskeeper Willie is out mowing the lawn. He pushes on the handle with a force as shown, and manages to accelerate the mower at a rate of 0.380 m/s^2. What is the coefficient of friction between mower and ground?

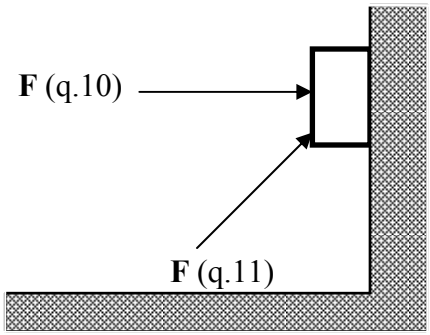


9. Examine the diagram to the right.
   a) Find the normal force acting on the 6.0 kg block.
   b) If the block slides downslope at constant speed,
      i) how large is the friction force?
      ii) what is the coefficient of friction between the block and the sloping surface?
   c) The slope angle is now increased to 40°. What is the acceleration of the system?



10. What *minimum* horizontal force **F** is needed to hold the 14.0 kg box stationary against the wall where the coefficient between box and surface is 0.19?

11. The wall is now scuffed with sandpaper so that the new coefficient of friction is 0.25. A new force of 310 N is applied on the box at an angle of 45° to the horizontal. Determine the magnitude and direction of the acceleration of the 14.0 kg box.



12. A 12 kg box is released from the top of an incline that is 5.0 m long and makes an angle of 40° to the horizontal. A 60. N friction force impedes the motion of the box.
   a) What will be the acceleration of the box
   b) How long will it take to reach the bottom of the incline?
   c) What is the coefficient of friction between the box and incline?

13. An inclined plane makes an angle of 30° with the horizontal. Neglecting friction, find the constant force, applied parallel to the incline, required to cause a 15 kg box to slide:
   a) up the incline with acceleration 1.2 m/s^2.
   b) down the incline with acceleration 1.2 m/s^2.

14. A 115 kg stationary crate is pulled by a horizontal force of 350 N. The coefficient of friction between crate and surface is as follows: $\mu_k = 0.170$; $\mu_s = 0.290$.
   a) Show that this force is large enough to begin moving the crate.
   b) Find the acceleration of the crate once it does move.
   c) If the force is now pulled at an angle of 12° to the horizontal, what is the new acceleration?

1. a) 9.7 N/kg b) 9.8 N/kg; eqn of line is $F_g = mg$ 2. slope = coefficient of friction; $F_f/F_N = \mu$ 3. a) 3.5 m/s^2 b) 9.1 m/s
4. a) 3.2 m/s^2 b) 460 N 5. 4.0 s 6. a) 7.9 x 10^3 N b) 6.2 x 10^2 N c) 4.6 x 10^2 N 7. a) 33 N b) i) 11.5 N; ii) 0.35
8. 0.53 9. a) 52 N b) i) 27 N; ii) 0.51 c) 2.5 m/s^2 10. 720 N 11. 1.9 m/s^2 12. a) 1.3 m/s^2 b) 2.8 s c) 0.67
13. a) 92 N b) 56 N 14. a) F_{Net} = 23.2 N, so movement will occur b) 1.38 m/s^2 c) 1.42 m/s^2