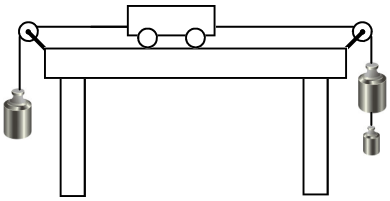
**A-Day: Due Tues., Oct 27**
**B-Day: Due Wed., Oct 28**

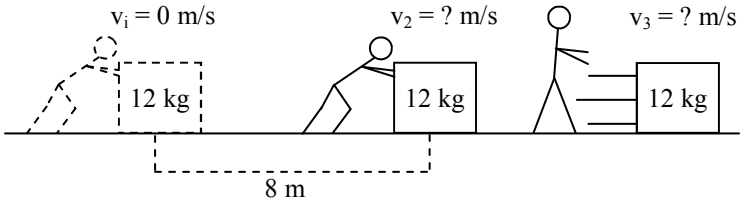
# 2009 Forces 3



1. A low friction cart is pulled by the three masses as seen at the left.
   A. Is the object at equilibrium?
   B. In which direction is the acceleration acting?

   C. How could the object be moving to the left?

   D. How could the object have a velocity of zero?

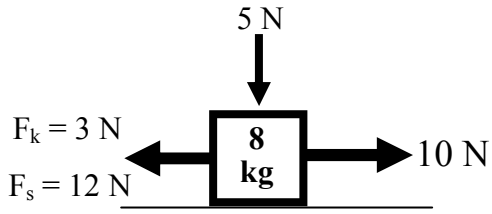



2. Slim Jim pushes on a 12 kg object for 10 seconds. It moves 8 m to the right while he is pushing.
   A. Below the picture use the kinematic equations to calculate the acceleration of the mass.

   B. Calculate the magnitude of Slim Jim's force.

   C. If the surface is frictionless, how does $v_3$ compare to $v_2$?

   D. If the surface has friction, how does $v_3$ compare to $v_2$?

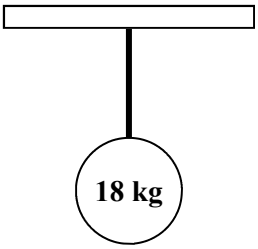



3. A. Will the object at the left start moving?
   B. Why or why not?
   C. If it is already moving, calculate the acceleration of the object.

   D. What is the weight of the object?

   E. What is the normal force acting on the object?

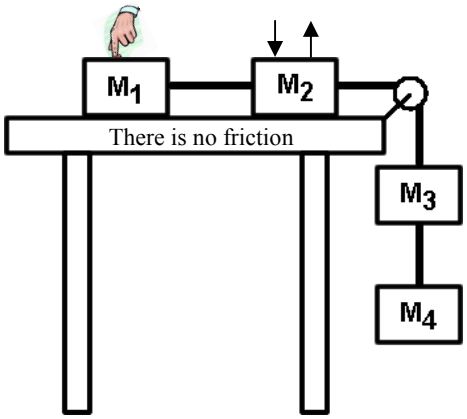
   F. Use the equation for friction to find the coefficients of static and kinetic friction ($\mu_s$ and $\mu_k$) for the surface.




4. A 18 kg object is suspended by a rope.
   A. Draw and label all of the forces acting on the object.
   B. What is the weight of the object?

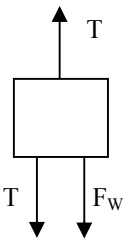
   C. Since it is hanging at rest, what is the acceleration of the object?

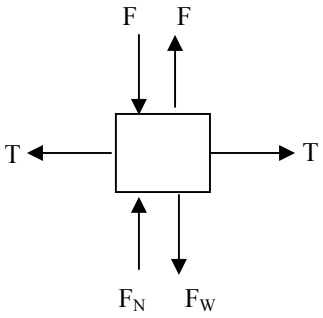
   D. Put all of the above into $\Sigma F = ma$ and calculate the force exerted by the rope.

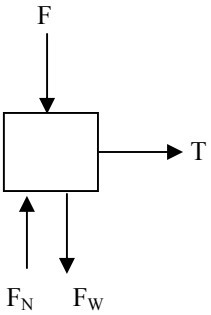


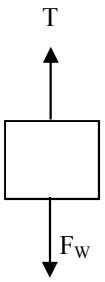

B. Write the x and y-direction equations for $M_2$.

5. The force diagrams below are for the four masses at the left.
   A. Identify each one by putting the correct mass in the boxes below.




**Torque**

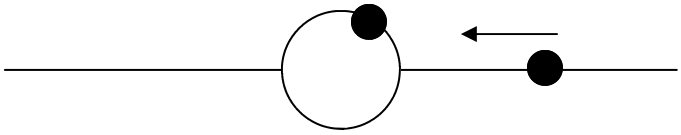
Perpendicular Force (*in N*)

Torque (*in Nm*) → $\tau = Fd$ ← Distance from pivot to where the force is attached (*in m*)

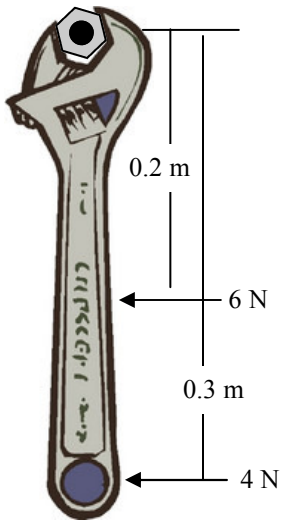
*A torque is a twist around a fixed point. You use a torque to open a jar or to tighten a bolt. Just like when you use a wrench, a longer wrench gives more torque. So, the farther away from the pivot you apply the force you give more torque. You also know that if you push along the length of the wrench you don't cause it to move or torque. Only the perpendicular part of the force causes torque.*

**Centripetal Acceleration**

Centripetal acceleration (*m/s²*) → $a_C = \frac{v_t^2}{r}$ ← Tangential velocity (*m/s*); Radius (*m*)



6. A. To get the bowling ball above to move to the left, which way do you have to push it?
   B. To get the bowling ball to move around the circle, which way do you have to push on the ball?




7. A wrench is used to torque the bolt at the left.
   A. Calculate the torque of the 6 N force.

   B. Calculate the torque of the 4 N force.

8. A car is moving 12 m/s around a corner of radius 40 m. How much centripetal acceleration does it have?

9. What gives the centripetal force for the following.
   A. A ball on a string.
   B. A car going around a corner.
   C. The earth around the sun.