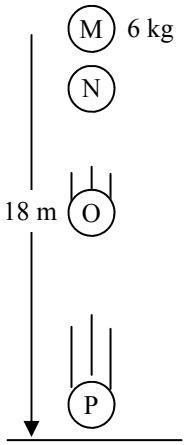
Physics Final Review

1. A 6kg object is 18m up in the air. It is dropped from rest as shown below. Assume there is no air friction.

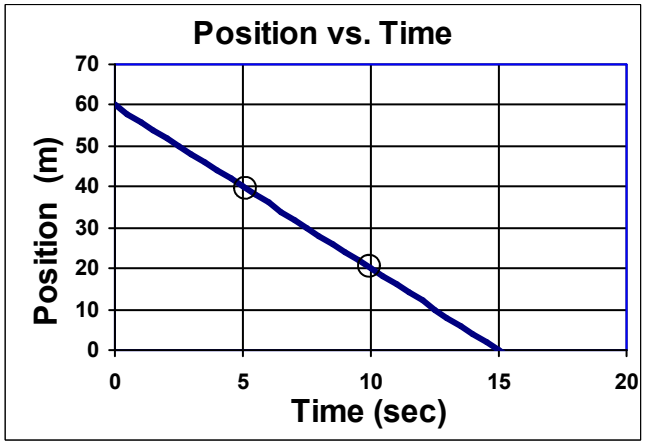


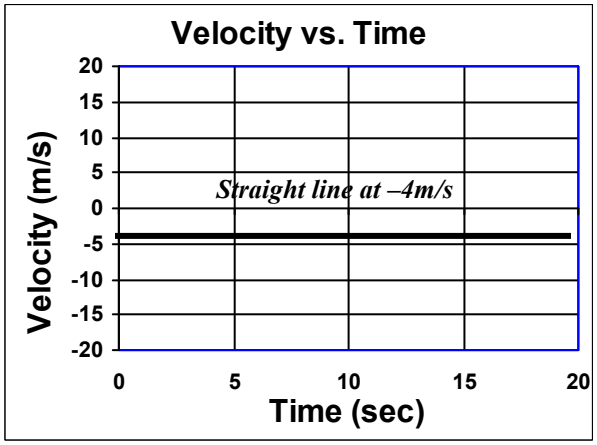
A. What is the mass of the object? ***6 kg***
B. What is the weight of the object? **60 N** ***(Fw = mg; or 58.8N if using 9.8)***
C. What would be the weight of this object in space? ***0N (no gravity in space)***
D. Calculate the object's energy at point M. ***Ep = mgh = 6(10)18 = 1080 joules***

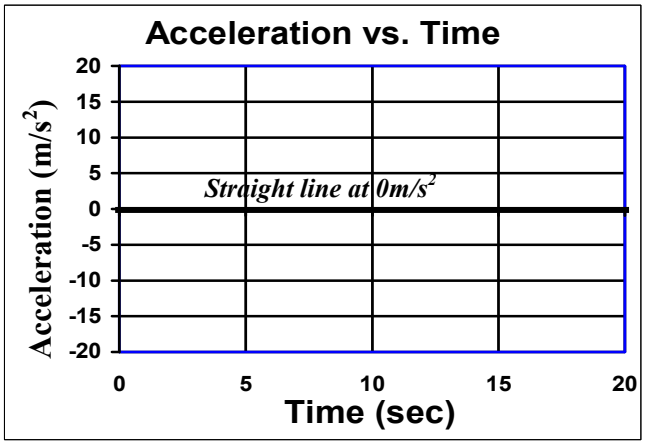
E. What kind of energy does it have at O? ***Potential and kinetic***
F. How much energy does it have at P? ***1080 J***

G. What is the acceleration of the object at point M? ***-9.8 m/s^2***
H. What is the acceleration of the object at point O? ***same***
I. What is the displacement of the object (Δy, *its vertical change of position*)? ***-18m***
J. What is the initial velocity of the object? ***0 m/s***
K. Use a kinematic equation to calculate how much time it takes to hit the ground.

$$\Delta y = (v_i t) + \left(\frac{1}{2} a (t)^2\right) \qquad -18 = -4.9t^2$$
$$-18 = 0 + \left(\frac{1}{2}(-9.8)(t)^2\right) \qquad 3.67 = t^2$$
$$t = 1.9 \text{ sec}$$



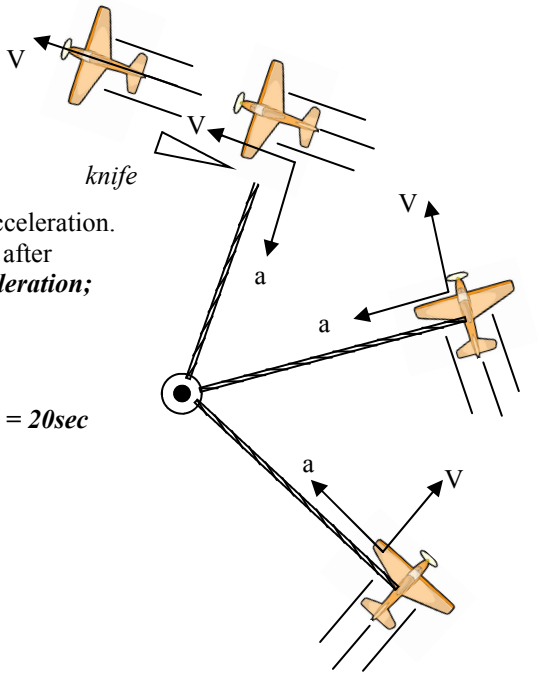




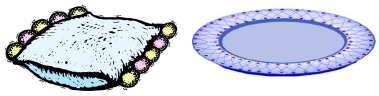
2. A. What is the speed of the object shown on the position vs. time graph above?
Slope = speed = (20-40)/5 = −4 m/s

B. What is the initial position of the object? ***60 m***

C. Transfer the position vs. time graph to the other two graphs.

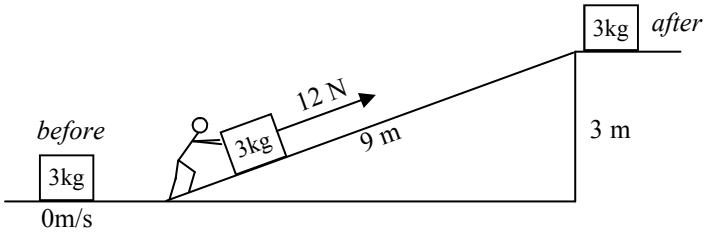


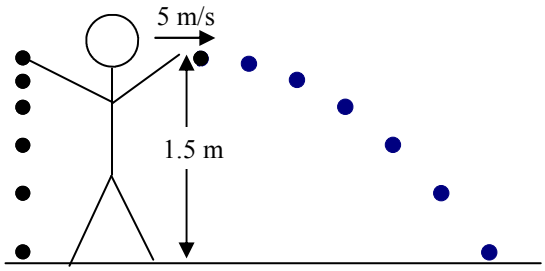
3. A toy plane attached to a rope is flying in a circle around a pole.
   A. What force is holding onto the plane? ***Tension in the rope***
   B. For each position draw and label the direction of the plane's velocity and acceleration.
   C. At one point a knife cuts the rope. Draw the path that the plane will follow after the rope is cut. ***Acceleration is inward (along rope) as a centripetal acceleration; the velocity is always forward (due to inertia)***
4. Motor A has a rating of 300 W. Motor B has a rating of 200 W.
   A. Which motor is more powerful? ***Motor A***
   B. How long would it take Motor A to do 6000 J of work? ***P = W/t, so t = W/P = 20sec***
   C. How long would it take Motor B to do 6000 J of work? ***30 sec***
   D. Which motor did the work quicker? ***Motor A***
   E. Which motor did more work? ***Did the same amount.***
5. True or false (and why)?: "*A more powerful object can do more work.*"
   False—a more powerful object can do the same work, just faster.



6. Two identical eggs are dropped from the same height. One egg ands on a pillow and the other on a metal plate.
   A. What kind of energy do they start with? ***potential***
   B. What kind of energy are they gaining? ***kinetic***
   C. How does the total energy change as it falls? ***Stays constant***
   D. Which has the greatest speed at the bottom? ***Same (same initial height)***
   E. Since they both stop after they hit, which one experiences the greater change of momentum? ***Same. Same initial height, same v, same p.***
   F. Which one experiences a bigger impulse? ***Same. Impulse = Δp.***

7. A 3 kg box is at rest at the bottom of a 9 m long ramp. Slim Jim pushes with 8N to move it to the top of a 3m tall ledge.
   A. How much work does Slim Jim do on the box?
      W = Fd = 12(9) = 108J
   B. How much energy does it have at the top of the ramp?
      Ep = mgh = 3(10)3= 90 J
   C. How efficient was this energy transfer?
      Eff = Wout/Win = Ep/W = 90/108 = 83%



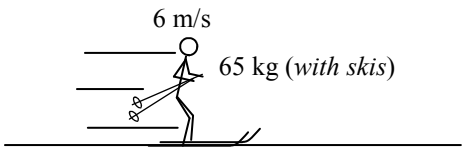


$$\Delta y = (v_i t) + \left(\frac{1}{2} a (t)^2\right) \qquad -3 = -9.8t^2$$

$$0.306 = t^2$$

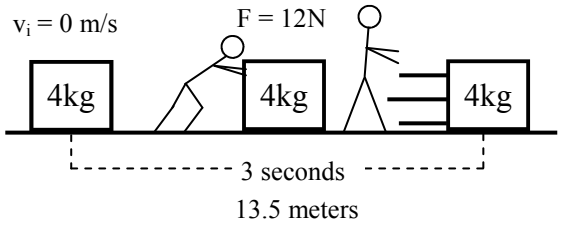
$$-1.5 = 0 + \left(\frac{1}{2}(-9.8)(t)^2\right) \qquad t = .55 \text{ sec}$$

8. Slim Jim drops a ball at the exact same time he throws a ball.
   A. What is the vertical displacement of the thrown ball? ***-1.5m***
   B. Which ball hits the ground first? ***Same time.***
   C. What is the initial vertical velocity of the dropped ball? ***0 m/s***
   D. What is the initial vertical velocity of the thrown ball? ***0 m/s***
   E. What is the vertical acceleration of each ball? ***-9.8m/s²***
   F. What is the horizontal acceleration of the thrown ball? ***0m/s²***
   G. What is the horizontal velocity of the thrown ball just before it hits the ground? ***5 m/s (since a_x = 0m/s² it is at constant speed)***
   H. How much time does it take for the thrown ball to hit the ground?
      t = 0.55 sec *(See work at left)*
   I. How far away does the thrown ball land? ***x = vt = 5(0.55) = 2.75m***



9. Slim Jim is skiing on frictionless snow.
   A. What is Slim Jim's mass? ***65 kg***
   B. What is Slim Jim's weight? ***650N (or 637 if using 9.8m/s^2)***
   C. How much momentum does Slim Jim have?
      p = mv = 65(6) = 390kgm/s
   D. If the snow is frictionless and he doesn't push with his poles, what is his acceleration? ***0 m/s^2***
   E. How fast will he be going after 4 seconds? ***6 m/s***
   F. How far will he go in for 4 seconds?
      V = d/t so d = Vt = 6(4) = 24m

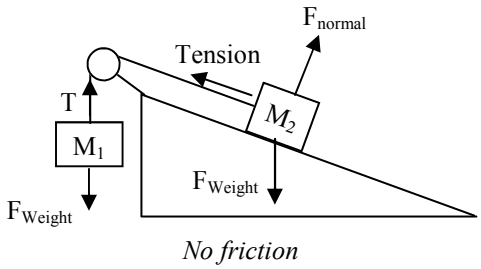
10. A 4 kg box is at rest on the ground. Slim Jim pushes on the box with 12N. After 3 seconds he has pushed it 13.5 meters and he let's go.
   A. How much work did he do on the box?
      W = Fd = 12(13.5) = 162 joules
   B. How much kinetic energy does it gain?
      W = ΔE = 162 joules
   C. How much impulse does he give the object?
      I = Ft = 12(3) = 36 kgm/s
   D. How much momentum does the object have afterwards?
      I = Δp = 36kgm/s
      Therefore you could find final velocity: v_{final} = 36/4 = 9m/s



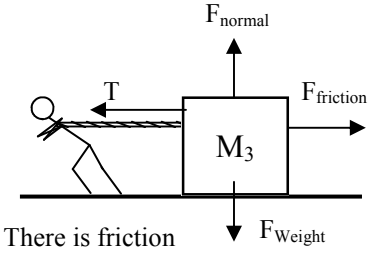
	Calculate the Net Force	Calculate the Acceleration
	***−30+25 = −5N***	***F = ma so a = F/m*** ***a = −5/10 = −0.5m/s^2***
	***−5+15 = 10N***	***a = 10/2 = 5m/s^2***
	***−25+25 = 0N***	***a = 0/20 = 0m/s^2***

11. A. Fill in the information at the right.
   B. Which object has the greatest net force acting on it? ***2 kg***
   C. Which object has the greatest acceleration? ***The 2 kg mass***
   D. Which object has the most inertia? ***The 20 kg object (most mass)***

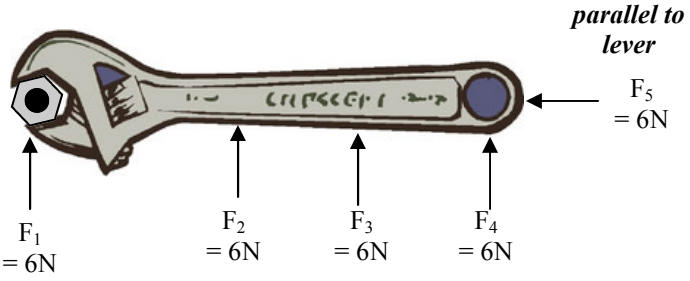
12. Draw and label force diagrams for all three masses.



No friction



There is friction

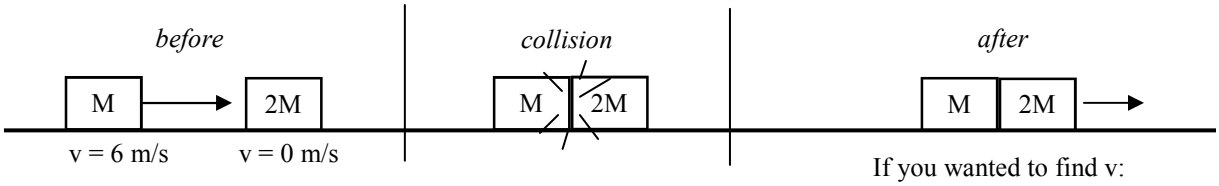


No torque: parallel to lever

No torque (on axis)

Greatest torque: greatest distance from pivot

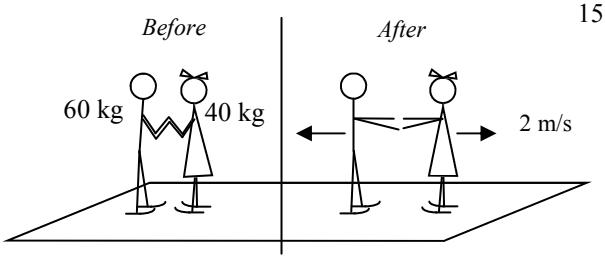
13. A wrench is attempting to torque a bolt.
    A. Which of the forces provide no torque? ***See diagram***
    B. Which of the forces provides the most torque? ***See diagram***
    C. Give another way to increase torque. ***Greater F.***



Net momentum = ***mv = 6M***

If you wanted to find v:
p = mv
6M = (3M)v
M's cancel
6 = 3v
v = 2 m/s

14. Two masses collide and stick together, as shown above.
    A. What is the initial momentum of the small mass? ***6M (kgm/s)***
    B. What is the initial momentum of the larger mass? ***0 kgm/s***
    C. What is the total momentum before the collision? ***6M kgm/s***
    D. Which mass feels more force during the collision, the small mass or the large mass? ***Equal (3rd Law)***
    E. After the collision, will the combined masses be moving slower or faster, compared to the speed of the small mass beforehand? ***Slower (same p, more mass, so less v)***
    F. What is the net momentum of the combined object afterwards? ***6M kgm/s***



$$\sum p_{before} = \sum p_{after}$$
$$0 = p_{Jim} + p_{Kim}$$
$$0 = 60v + 40(2)$$
$$0 = 60v + 80$$
$$-80 = 60v$$
$$v = -1.33 m/s$$

15. Slim Jim and Slim Kim at holding hands while at rest on frictionless ice. They push off from each other.
    A. What is the net momentum of the two beforehand? ***0kgm/s***
    B. What is the net momentum of the two afterwards? ***0kgm/s***
    C. Who feels a greater force? ***Equal (3rd Law)***
    D. Who has the faster velocity? ***Kim (less mass)***
    E. Who has the greater mass? ***Jim***
    F. Who has the greater final momentum? ***Same (but opp. directions)***
    G. Under the diagram, calculate Jim's final velocity.