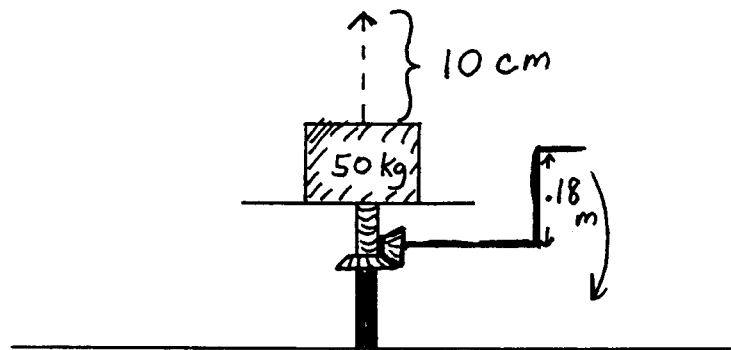


PHYS 106 Spring 2003  
"How Things Work" Problem Set #2

Concise explanations of 1 or 2 sentences for each part are best.

1. "Case 4" on page 75 of your text (Bowling). Do all parts a, b, c and d.
2. An automobile jack containing various gears can be used to lift very heavy weights with only a small applied force.
  - (a) Explain in general how it is possible to apply a small force with your hand, and yet have a large force applied to the heavy weight.
  - (b) Consider the automobile jack sketched below. As the handle is turned in a circle, the mass on top slowly rises at constant speed. What force in Newtons must be exerted by the top of the jack (i.e. how much does the 50 kg mass weigh)?



- (c) Suppose that you lift the 50 kg mass through a height of 10 cm. Ignoring the small losses to friction, how many Joules of energy do you expend?
- (d) How many food calories do you burn, assuming all the food energy goes into raising the weight? There are 4186 Joules in one food calorie.
- (e) If it takes you 20 seconds to raise the mass, what is your power output, in watts, during that time? Be sure to explain your calculation.
- (f) If the radius of the circle through which you turn the handle is 0.18 meters, and your hand makes 33 complete revolutions as you raise the weight, calculate the force in Newtons that your hand must exert on the handle. Be sure to explain your calculation and state whether or not your answer seems to make sense. (*Hint: you will need to know the formula for the circumference of a circle.*)

3. An ice skater is spinning on an ice rink with her arms extended horizontally.
  - (a) She then pulls her arms in close to her body. What happens and why?
  - (b) She repeats the experiment, except this time she has a dumbbell (weight) in each hand. How will the result be different and why?
4. If you throw a tennis ball across a room, it will approximately follow a parabolic path (an arc). Consider what happens if you throw a hammer (stick of wood weighted at one end) across a room. If it rotates while it travels, there is one particular point in the hammer that will follow the parabolic path. What is that location called? What is an easy way to determine that point, simply by using the tip of a finger?
5. "Case 6" on page 294 of your text (Electric eye). Do all parts a, b, c, d and e.
6. Consider an ordinary photocopier (xerographic copier).
  - (a) Briefly explain the role of the photoconductor in the machine.
  - (b) Suppose everything in the machine is working properly except the fuser. What will be wrong with the copies?
7. "Case 7" on page 294 of your text (MRI). Do only parts a, b, c, and d. Omit part e.

End of problem set.