Work & Kinetic Energy

Quick Concepts
A. What are the definitions of *work* and *kinetic energy*?

B. How are *work* and *kinetic energy* related?

C. If a force does negative work to something, what is the force trying to do?

Calculations
1. A 100 Newton wind is blowing a 75 kg ice-boarder across a frozen frictionless pond for a distance of 50 meters. The ice-boarder started at rest.
    a. How much work did the wind do on the ice-boarder?

    b. What was the kinetic energy of the ice-boarder at the end of the 50 meters?

    c. How fast was the ice-boarder going at the end of the 50 meters?

2. A 1750 kg car is driving down the road with a speed of 15 m/s. The car speeds up through a force of 3500 N over a distance of 75 meters.
    a. What is the initial kinetic energy of the car?

    b. How much work did the force do on the car?

    c. What is the final kinetic energy of the car?

    d. What is the final velocity of the car?

3. Betty pushes her physics book (m=2 kg) with a speed of 4 m/s. She lets go, and the book slides to stop in 0.75 meters.
    a. What was the initial kinetic energy of the book?

    b. What was the final kinetic energy of the book?

    c. How much work did friction do?

    d. What was the force of friction on the book?

4. A 60 kg skier has a kinetic energy of 6750 J at the bottom of a hill, and skids to a stop in a distance of 35 meters.
    a. What was the velocity of the skier just before the skid?

b. What was the average force of friction on the skier while skidding? (Hint: how much work did friction do?)

5. You are pulling your 25 kg cousin in a toy wagon with a force of 150 N directed up at an angle of 40° and at a constant velocity. You pull for a distance of 250 meters.
   a. How much work did you do on your cousin?

   b. How much work did friction do on your cousin?

   c. Why did your cousin gain no kinetic energy?

6. Al is pulling Charlene (m=70 kg) with a force of 25 N for a distance of 20 meters. At the end of the 20 meters, Charlene has a speed of 3 m/s. Charlene's initial speed was 0 m/s.
   a. How much work did Al do on Charlene?

   b. What is Charlene's final kinetic energy?

   c. How much work did friction do? (Hint: Why are your answers to a and b different?)

   d. What was the average force of friction?

7. You are dragging a 25 kg sled across the snow with a force of 50 N at an angle of 30° above the horizontal. The sled starts at rest, and you drag it for 7 meters.
   a. How much work did you do on the sled?

   b. If the snow were frictionless, how fast would the sled be going at the end?

   c. If there was a friction force of 23 N, how much work would friction have done?

   d. So what would be the final speed if there was 23 N of friction?

Answers:
1. a) 5000 J   b) 5000 J   c) 11.6 m/s
2. a) 197,000 J   b) 263,000 J   c) 460,000 J   d) 22.9 m/s
3. a) 16 J   b) 0 J   c) -16 J   d) -21.3 N
4. a) 15 m/s   b) -193 N
5. a) 28,700 J   b) -28,700 J   c) friction
6. a) 500 J   b) 315 J   c) -185 J   d) -9.3 N
7. a) 303 J   b) 4.92 m/s   c) -161 J   d) 3.37 m/s