Name ______________________________ Date ____________________ Class ____________

Exploring Work, Direction, and Weight

In cases where the force that's doing work is applied in exactly the same direction as the motion of the thing being worked upon, it is easy to calculate the amount of work performed. As the figure below shows, sometimes the force is applied at an angle to the movement of the object. When this happens, not all of the force contributes to the work being done. How do you calculate the amount of work when this happens?

The fraction of the applied force that actually contributes to the work depends upon the angle formed by the direction of the force and the direction of the object's motion. For example, in the figure below, the force of the person pulling the sled is at a 60° angle to the sled's movement. Only half (0.5) of that force contributes to the work, as the table shows. Knowing this, it is easy to calculate the total work:

2 N (the force exerted) × 0.5 (the fraction of the force doing work) × 0.5 m (the distance moved) = 0.5 J

Each row of this table gives information about a situation where force is applied to an object to cause movement, including the fraction of the force that contributes to the movement. On a separate sheet of paper, calculate the amount of work performed, and complete the last column.

Angle Between Direction of Force and Movement	Total Force	Fraction of Force Doing Work	Distance of Movement	Total Work (in Joules)
0°	10 N	1.0	5 m	
30°	10 N	0.87	5 m	
45°	10 N	0.71	5 m	
60°	10 N	0.5	5 m	
90°	10 N	0.0	5 m	

Answer the questions below on a separate sheet

1. As the angle between the direction of the applied force and the direction of movement increases from 0° to 90°, what happens to the fraction of the force that contributes to the work?
2. Why was no work done in the situation on line five of the table?
3. Did you need to know the mass of the moving objects to calculate the amount of work?