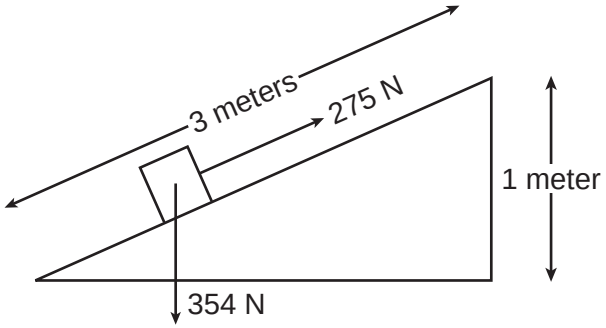
SECTION 1 Enrichment

Calculating Work

Directions: *Solve the following problems.*

1. A box weighing 354 N is pushed up an inclined plane that is 3m long. A force of 275 N is required, including friction.



a. What is the work done to slide the box?

b. How much work is done if the box is lifted 1 m instead?

c. Which method of lifting the box requires more work?

d. Which method of lifting the box would be easier?

2. How much power is generated if a person applies 200 N of force to move a bicycle 10 m in 5 s?

3. A 700-watt gasoline engine and a 300-watt electric motor both do 3 J of work. Which machine can do the work faster? Explain your answer.

4. In the English system, the unit of power is the horsepower. It is based on the amount of work the average horse can do. (1 horsepower = 746 watts).

a. If a car engine is rated at 125 horsepower, how many watts of power does it produce?

b. If a lawnmower engine is rated at 4 horsepower, how many watts of power is that?

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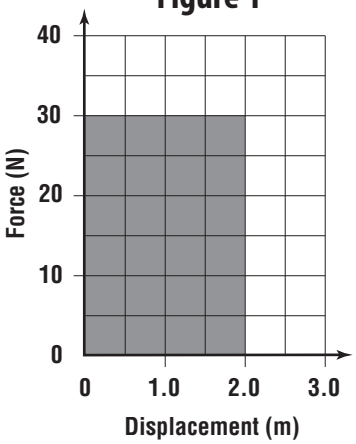
SECTION 2 Enrichment

Plotting Force and Displacement

Another way of analyzing the work done by a force is to do a force-displacement graph. The graph to the right is a plot of force vs. displacement for a 30 N box being lifted 2.0 m. The shaded area under the graph (Figure 1) equals the work input. ($W_{in} = F_e \times d_e$ = 30N × 2.0 m = 60 J) Since no machine was used to lift the box, the graph of work output would be the same.
($W_{out} = F_r \times d_r$ = 30N × 2.0 m = 60 J)

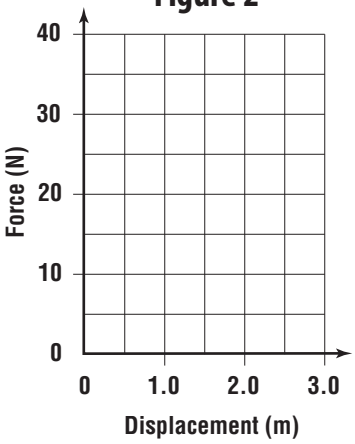
Figure 1



Directions: *Solve the following problems using force-displacement graphs.*

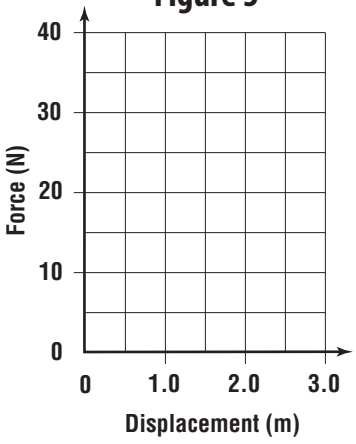
1. Draw a force-displacement graph in Figure 2 showing the work input and the work output when a box of books that needs a force of 40 N is lifted 1.5 m.

Figure 2



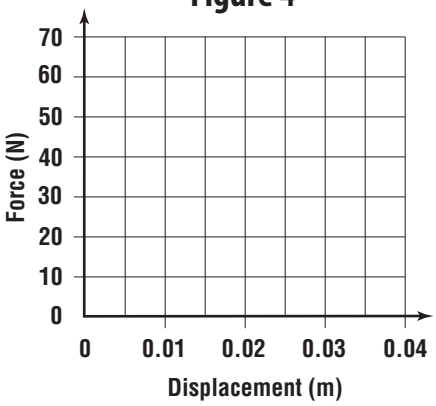
2. Draw a force-displacement graph in Figure 3 showing the work input and the work output for the same box if the books are lifted by a pulley system with an IMA of 2.

Figure 3



3. A force of 70 N is required to remove a bottle cap without using an opener. Draw a force-displacement graph in Figure 4 for the work output when the bottle cap is moved 1 cm.

Figure 4



4. Draw a force-displacement graph in Figure 4 for work input on the same bottle cap being removed by an opener resulting in an IMA of 3.5.

Meeting Individual Needs