

How Machines Do Work (pages 114–121)

What Is a Machine? (pages 115–117)

Key Concept: A machine makes work easier by changing at least one of three factors. A machine may change the amount of force you exert, the distance over which you exert your force, or the direction in which you exert your force.

- A **machine** makes work easier. Machines can make work easier in three ways:
 1. Machines can change the amount of force.
 2. Machines can change the distance over which a force is exerted.
 3. Machines can change the direction of a force.
- The force exerted on a machine is the **input force**. The input force times the distance is the **input work**.
- The force the machine exerts on an object is the **output force**. The output force times the distance is the **output work**.
- The input work and output work are always equal. A machine cannot change the amount of work.

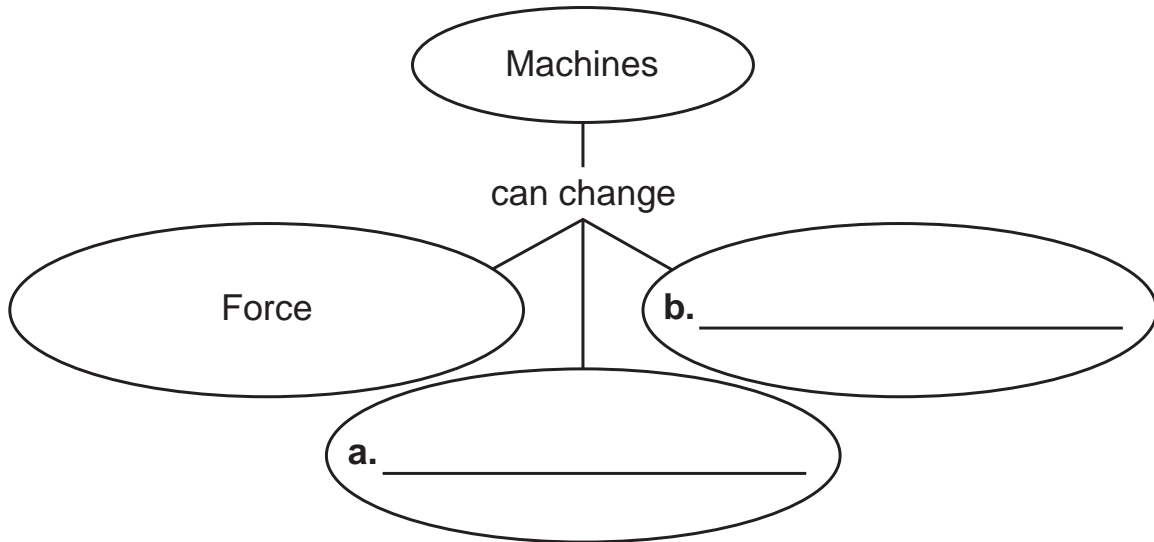
Answer the following questions. Use your textbook and the ideas above.

1. Is this sentence true or false? Machines make work easier? _____
2. Circle the letter of each way machines can make work easier.
 - a. by changing the direction of a force
 - b. by changing the amount of force
 - c. by changing the amount of work

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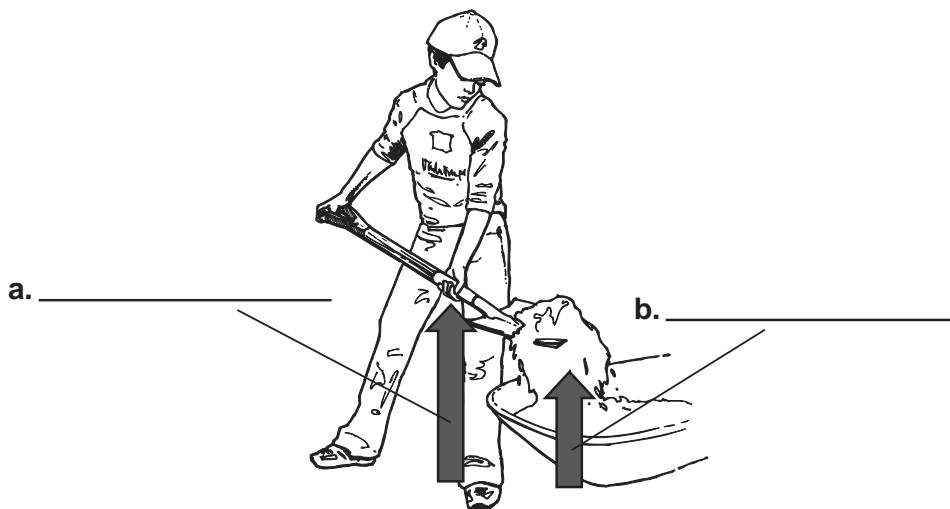
3. Read the words in the box. Use the correct words to fill in the blanks in the concept map about machines.

Distance Work Direction



4. Read the words in the box. Use the words to label the picture.

Input force Output force



Work and Machines ▪ *Adapted Reading and Study***Mechanical Advantage** (pages 118–119)

Key Concept: A machine's mechanical advantage is the number of times a machine increases a force exerted on it.

- A machine's **mechanical advantage** is a number that tells how a machine's output force compares to the input force. In other words, mechanical advantage tells how a machine changes force.
- Some machines have an output force that is greater than the input force. These machines have a mechanical advantage that is more than 1.
- Some machines have an output force that is less than the input force. These machines have a mechanical advantage that is less than 1.
- Some machines have an output force that is equal to the input force. The machines have a mechanical advantage that is exactly 1.

Answer the following questions. Use your textbook and the ideas above.

5. Read each word in the box. In each sentence below, fill in one of the words.

more than 1	less than 1	exactly 1
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- a. If a machine's output force is equal to its input force, it has a mechanical advantage of _____.
- b. If a machine's output force is greater than its input force, it has a mechanical advantage of _____.

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6. What is mechanical advantage?
 - a. a number that tells how a machine changes force
 - b. a number that tells the size of a machine
 - c. a number that tells how fast a machine does work

Efficiency of Machines (pages 119–121)

Key Concept: To calculate the efficiency of a machine, divide the output work by the input work and multiply the result by 100 percent.

- A machine's **efficiency** is a number that tells how the machine's output force compares to the input force. Efficiency is a percent.
- Real machines always have an efficiency that is less than 100%. That is because all real machines have some friction. Some of the input work is used to overcome friction.
- A machine with an efficiency close to 100% turns most of the input work into output work.
- A machine with a lower efficiency turns less of the input work into output work.

Answer the following questions. Use your textbook and the ideas above.

7. A number that tells how a machine's output force compares to the input force is the machine's _____.
8. Which of these machines turns the most input work into output work?
 - a. Machine 1: Efficiency 80%
 - b. Machine 2: Efficiency 50%
 - c. Machine 3: Efficiency 90%