Section 14.3 Mechanical Advantage and Efficiency
(pages 421–426)

This section describes mechanical advantage and efficiency and how to calculate these values. It also discusses ways to maximize mechanical advantage and efficiency.

Reading Strategy (page 421)

Building Vocabulary As you read the section, write a definition in the table for each vocabulary term in your own words. For more information on this Reading Strategy, see the Reading and Study Skills in the Skills and Reference Handbook at the end of your textbook.

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>Mechanical advantage</td>
<td>The number of times a machine increases force</td>
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Mechanical Advantage (pages 421–423)

1. The number of times that a machine increases an input force is the ______________ of the machine.

2. Circle the letter of the correct answer. For a given input force, what affects the output force that a nutcracker can exert on a nut?
   a. the location of the hand holding the nutcracker
   b. the angle of the legs of the nutcracker
   c. the position of the nut

3. Mechanical advantage describes the relationship between input force and ______________ force.

4. Is the following sentence true or false? A loading ramp with a rough surface has a greater mechanical advantage than one with a smooth surface. ______________
Chapter 14 Work, Power, and Machines

5. Because friction is always present, the actual mechanical advantage of a machine is never greater than its ideal mechanical advantage (IMA).

6. A machine’s ideal mechanical advantage is the mechanical advantage in the absence of friction.

Calculating Mechanical Advantage (pages 424–425)

7. Is the following sentence true or false? To calculate ideal mechanical advantage, divide input distance by output distance, and then divide the result by the force of friction. ____________

8. Is the following sentence true or false? An inclined plane is an example of a machine. ____________

9. Calculate the IMA of a ramp for the distances given in the table.

<table>
<thead>
<tr>
<th>Ideal Mechanical Advantages of Ramps</th>
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</thead>
<tbody>
<tr>
<td>Horizontal Distance</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>1.5 meters</td>
</tr>
<tr>
<td>12 meters</td>
</tr>
<tr>
<td>3.6 meters</td>
</tr>
</tbody>
</table>

Efficiency (pages 425–426)

10. Choose the letter of each statement that tells why the efficiency of a machine is always less than 100 percent.
   a. Machines get hot and need fans.  
   b. Friction must be overcome.  
   c. Gravity prevents machine parts from moving easily.

11. Is the following sentence true or false? To calculate the efficiency of a machine, divide the work output by work input, and then multiply by 100. ____________

12. Calculate the efficiency of a machine with a work output of 120 J and a work input of 500 J. ____________

13. Circle the letter of the work input for a machine with a work output of 240 J and an efficiency of 80 percent.
   a. 300 J  
   b. 200 J  
   c. 320 J