Chapter 14   **Work, Power, and Machines**

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

This section describes mechanical advantage and efficiency and how to calculate these values. Ways to maximize mechanical advantage and efficiency are discussed.

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.

Mechanical Advantage	
Vocabulary	**Definition**
Mechanical advantage	

Mechanical Advantage (pages 421–423)

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

2. For a given input force, what affects the output force that a nutcracker can exert on a nut? _____ _____

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

4. How is the actual mechanical advantage of a machine determined? _____

5. Greater input force is required to move an object along a ramp with a rough surface, compared to a ramp with a smooth surface, because a greater force is needed to overcome _____.

6. 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. _____

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

8. A machine's _____ is the mechanical advantage in the absence of friction.

9. What type of materials do engineers use to increase the mechanical advantage of a machine?

_____

Calculating Mechanical Advantage (pages 424–425)

10. 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.

_____

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

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

Ideal Mechanical Advantages of Ramps		
Horizontal Distance	Vertical Rise	IMA
1.5 meters	0.5 meters	
12 meters	1.5 meters	
3.6 meters	0.3 meters	

13. Is the following sentence true or false? If the input distance of a machine is greater than the output distance, then the IMA for that machine is greater than one. _____

Efficiency (pages 425–426)

14. Why is the efficiency of a machine always less than 100 percent? _____

_____

15. 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. _____

16. What is a significant factor affecting a car's fuel efficiency?

_____

17. Calculate the efficiency of a machine with a work output of 120 J and a work input of 500 J. _____

18. 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   d. 200 W

19. Reducing friction _____ the efficiency of a machine.