**Simple Machine Questions and Answers**

How Machines Do Work? (707)

1. What is a simple machine?
2. What is an input force and output force?
3. What is an input work and output work?
4. Figure 7: *The amount of input work done by the gardener equals the amount of output work done by the shovel.* When are you doing more work—using a shovel or using your hands?
5. What is one way a pulley makes work easier?

Changing Force/ Distance/ Direction (708-709)

1. Does a machine change the amount of work required to do a task?
2. What does a machine do?
3. How does the cable system on a weight machine make raising the weights easier?
4. Figure 8: Look at the arrows indicating input work and output work:
    a. Do any of the machines shown here produce more output work than input work?
    b. *No machine produces more work than is input*. If machines don't decrease the work required to do a task, how can they be helpful?
    c. Which machine shown here makes work easier by changing the direction of the input force?

Mechanical Advantage (710)

1. Define mechanical advantage.
2. What do you need to know to calculate mechanical advantage?
3. What kinds of machines have a mechanical advantage greater than 1?
4. What kinds of machines have a mechanical advantage of less than 1?
5. What kinds of machines have a mechanical advantage of exactly 1?
6. What is the ideal mechanical advantage of a pulley, such as one used on a flagpole? Explain.
7. Name a machine that multiplies the distance over which the input force acts.
8. What is true about the mechanical advantage of a simple machine that increases distance?
9. Are machines with a mechanical advantage of less than 1 useful? Explain.
10. Math: Analyzing Data (Page 711) – The input force and output force for three different ramps are shown in the graph.
    1. What variable is plotted on the horizontal axis?
    2. If an 80-N input force is exerted on Ramp 2, what is the output force?
    3. Find the slope of the line for each ramp.
    4. Why does the slope represent each ramp's mechanical advantage? Which ramp has the greatest mechanical advantage?

Efficiency (711)

1. What is efficiency of a machine?
2. Why is output work always less than input work in real situations?
3. A person is described as an efficient worker. What other phrases could describe this person?
4. Friction is a force that opposes motion. If friction in a machine increases, what happens to the machine's efficiency?
5. Is any machine 100% efficient?
6. Why is it important to maintain machines?

Calculating Efficiency (712)

1. Efficiency is expressed as a percentage. It is important to divide output work by input work (rather than the reverse). If your calculations result in an efficiency greater than 100%, is your answer reasonable? Why?
2. Write down the Math Sample problem.
3. You do 20 J of work while using a hammer. The hammer does 18 J of work on a nail. What is the efficiency of the hammer?
4. Suppose you left your lawn mower outdoors all winter. Now it's rusty. Of your 250,000 J of work, only 100,000 J go to cutting the lawn. What is the efficiency of the lawn mower now?

Assessment

**1. a.** What is a machine?
**b.** In what three ways can machines make work easier?
**c.** How does a screwdriver make work easier?
**2. a.** What is the mechanical advantage of a machine?
**b.** What is the mechanical advantage of a machine that changes only the direction of the applied force?
**c.** If a machine has an input force of 40 N and an output force of 80 N, what is its mechanical advantage?
**3. a.** What must you know in order to calculate a machine's efficiency?
**b.** What is an ideal machine?
**c.** How is a real machine like an ideal machine, and how is it different?
**4.** The input work you do on a can opener is 12 J. The output work the can opener does is 6 J. What is the efficiency of the can opener?
**5.** Suppose the efficiency of a manual pencil sharpener is 58%. If the output work needed to sharpen a pencil is 4.8 J, how much input work must you do to sharpen the pencil?

Real and Ideal Machines (713)

1. M. C. Escher's print Waterfall illustrates an ideal machine. Why won't Escher's waterfall machine work in real life?
2. What is a machine's ideal mechanical advantage?

Simple Machine (716)

1. What are the six basic kinds of simple machines?

Inclined planes (717)

1. What is an inclined planes? Give examples.
2. Figure 12: When you use a ramp, what happens to the distance over which you exert your force?
3. How does a ramp help you to move heavy objects?
4. What is the formula to determine the ideal mechanical advantage of an inclined plane?
5. Why does an inclined plane have a mechanical advantage greater than 1?

Wedge (718)

1. What is a wedge? Give examples.
2. Other than the examples of wedges shown in your book, what are other examples of wedges?
3. What other simple machine are wedges most similar to?
4. **Materials**: butter knife, claw hammer, simple can opener, nail
    a. Which of these tools are wedges?
    b. Which tool would be best to open a juice can?
    c. How does the wedge on the can opener use input force to open a can?
5. What is the formula to determine the ideal mechanical advantage of a wedge?

Screws (719)

1. What are screws? Give examples.
2. Write the formula for the ideal mechanical advantage of a screw.
3. *The threads of a screw change the distance over which the input force is applied*. What are two ways to increase the ideal mechanical advantage of a screw?
4. A screw increases the input distance. How does this affect output force?
5. Figure 15: How does the length around the threads of a screw compare to an inclined plane?

Levers (720)

1. What are levers? Give examples.
2. What are some everyday examples of levers?
3. What is a fulcrum?
4. What is the formula to determine the ideal mechanical advantage of levers?
5. What point on a lever does not move?

Types of Levers (721)

1. Figure 17: Make a compare/contrast table that analyzes the three classes of levers.
2. In which class of lever is the fulcrum located between the input force and the output force?

Wheel and Axle (722-724)

1. What are wheel and axle? Give examples.
2. Figure 18: *a screwdriver is an example of a wheel and axle. The output force over a shorter distance*. Which has a larger radius, the wheel or the axle?
3. When using a screwdriver, do you apply the input force to the wheel or the axle?
4. What is the formula to determine the ideal mechanical advantage of Wheel and Axle?

Pulley (724)

1. What is a pulley? Give examples.
2. Read under the headings **How It Works and Types of Pulleys**. Write facts from these two paragraphs. Create a concept map describing pulleys.
3. How can a pulley make work easier?
4. A pulley is attached to the object that is being moved. What kind of pulley is it?
5. What is the ideal mechanical advantage of a pulley?

Types of Pulleys (725)

1. *A fixed pulley and a movable pulley are the two basic types of pulleys. A block and tackle combines a fixed and movable pulley*. Comparing and contrast – Which type of pulley has the greatest mechanical advantage?

Simple Machines in the Body (726)

1. What kind of simple machine is your lower arm?
2. What type of simple machine do your front teeth resemble?
3. Identify other types of levers in the human body.

Compound Machines (727)

1. What is a compound machine? Give examples.
2. What is one compound machine you have used today?
3. What is the ideal mechanical advantage of a compound machine?

Assessment

**1.**
    a. **Listing** List the six kinds of simple machines.
    b. **Classifying** What type of simple machine is a door stopper? A rake? A windmill? A slide?
    c. **Developing Hypotheses** Can you consider your thumb to be a lever? Why or why not?

**2.**
    a. **Identifying** What is the ideal mechanical advantage of each type of simple machine?
    b. **Inferring** How can you increase a pulley's mechanical advantage?
    c. **Drawing Conclusions** How is calculating the ideal mechanical advantage of an inclined plane similar to calculating that of a screw?

**3.**
    a. **Reviewing** How many simple machines are needed to make a compound machine?
    b. **Describing** How do you find the mechanical advantage of a compound machine?