Exercises

Unit Overview: Energy Exercises

1. Everything in the universe can be categorized as what two things?

2. What is energy?

3. What is work?

4. If someone carries a lawn chair to their roof to watch the meteor showers, is work done on the chair?

5. What if the chair falls off the roof? Is work done on the chair then?

6. If someone pushes a train with all their might but the train doesn't move, is work done?

7. What are two units used to measure work?

8. What is power?

9. What are two units to measure power?

10. Where does all the energy you get from food originate from?

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Energy Calculations

Work = Force x Distance

Power = Work / Time

1. A mouse that weighs 4 ounces jumps, step by step, up a 2 meter tall flight of stairs. What kind of work did that little guy do? (1 newton is 4 ounces)

2. If the mouse took 3 minutes (180 seconds) to do it, what power did he exert?

3. Bob's car breaks down. He needs to push on the car with a force of 1000 Newtons to get the car to go 30 meters (about 100 feet). How much work does he do?

4. If Bob takes 5 seconds to push the car 30 meters, how much power does he use?

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5. Just for fun, let's convert that to horsepower (1 Watt = .001 horsepower)

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Exercises

Lesson 1: Levers

1. Can you name the six simple machines?

2. It is easier to move things using a lever but what has to happen to lessen the force needed to move the load?

3. Describe a first-class lever. Can you give an example?

4. Describe a second-class lever. Can you give an example?

5. Describe a third-class lever. Can you give an example?

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Exercises

Lesson 1: Pulleys

1. If I'm talking about simple machines, what does load mean?

2. So what does effort mean when it comes to simple machines?

3. With the pulleys, as your effort got less and less, what happened to the amount of string you had to pull?

4. What is mechanical advantage?

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Warning: the following questions are "mathy". Don't worry about these if it gets in the way of your enjoyment or understanding of the lesson.

5. If a lever had a mechanical advantage of 10 and you wanted to lift a 50 pound watermelon, how many pounds of force would you have to use for the effort?

6. If a pulley had a mechanical advantage of 500 and you wanted to lift a 2,000 pound hippo, how many pounds of force would you have to use for the effort?

7. Same hippo different units. Newtons are the official unit of force. So to do this officially, a 2,000 pound hippo would take about 9,000 Newtons to lift. If you lift that hippo 2 meters, how much work did you do? Remember, work is force x distance.

8. One last question. This one's a little tricky. So if you lifted the hippo 2 meters, how much chain (because string's not going to cut it) did you pull?

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Answers to Energy Exercises

1. Matter and energy.

2. The ability of an object or system to do work on another object or system. Energy is defined in the physics books as the ability to do work.

3. Work is moving an object against a force over a distance (work = force x distance).

4. Yes. The chair has been moved a distance against the force of gravity.

5. Nope, the chair moves a distance, but it moves with the force of gravity. Work is moving something a distance against a force. In this case, the chair does not move against a force. No work is done.

6. Nope again! There's no distance moved so no work has been done.

7. Joules and calories.

8. The amount of work done in a given amount of time (power = work divided by time).

9. Watts and horsepower.

10. The sun. You are powered by the sun!

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Answers to Energy Calculations

1. work = force x distance, so

work = 1 newton x 2 meters

work = 2 Joules

2. power = work/time

power = 2/180

power = .01 Watts

3. work = force x distance

work = 1000 x 30

work = 30,000 Joules (go Bob!)

4. power = work x time

power = 30,000/5

power = 6,000 Watts (Wow! Big Bob!)

5. 6000 Watts x .001 = 6 horsepower (No Viper, but pretty impressive!)

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Answers to Simple Machines / Levers Exercises

1. The six machines are the inclined plane, the wheel and axle, the lever, the pulley, the wedge, and the screw.

2. The distance that the effort moves is much greater than the distance the load moves.

3. A first-class lever is a lever in which the fulcrum is located in between the effort and the load. Some examples are see-saw, a hammer (when it's used to pull nails), scissors, and pliers.

4. In a second-class lever, the load is between the fulcrum and the effort. Some examples are a wheel-barrow, a door, a stapler, and a nut-cracker.

5. The third-class lever has the effort between the load and the fulcrum. A few examples of this are tweezers, fishing rods, your jaw, and your arm.

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Answers to Pulley Exercises

1. The load is what you are lifting or moving.

2. Effort is the force needed to lift the load.

3. As the effort lessened, the amount of string (distance) got greater and greater.

4. Mechanical advantage is the factor by which a mechanism multiplies the force put into it.

5. 5 pounds. The lever has a mechanical advantage of 10 so it multiplies the force by 10. So 5 x 10 = 50. (By the way, when you cut up that watermelon, invite me over!)

6. 4 pounds. 4 x 500 = 2000

7. 18,000 Joules of work. 9,000 Newtons x 2 meters = 18,000 Joules.

8. 1,000 meters (3,280 ft) of chain!!!

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