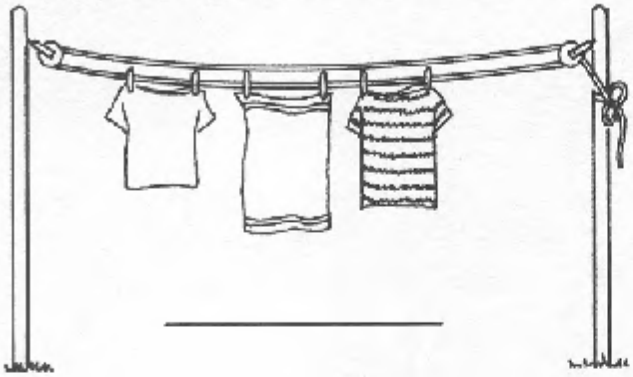
# SIMPLE MACHINES

Name _____

What types of simple machines are shown in the following pictures?



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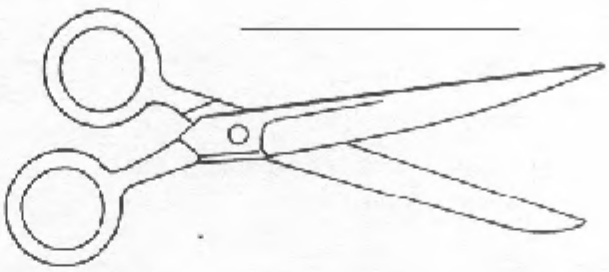

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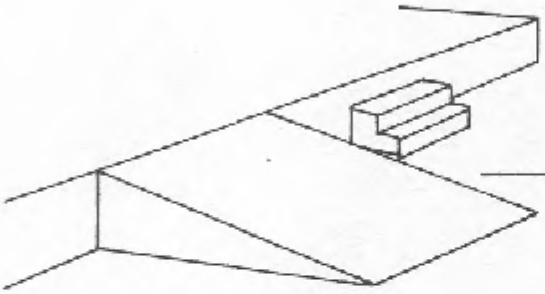

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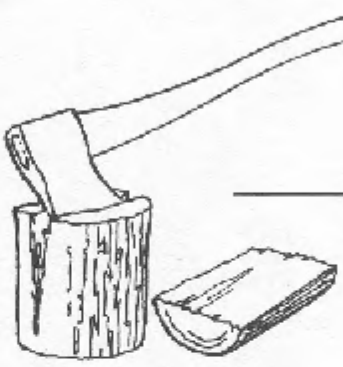

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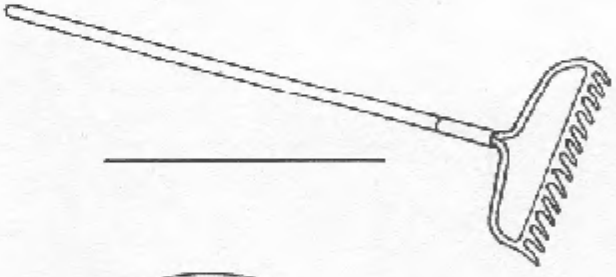

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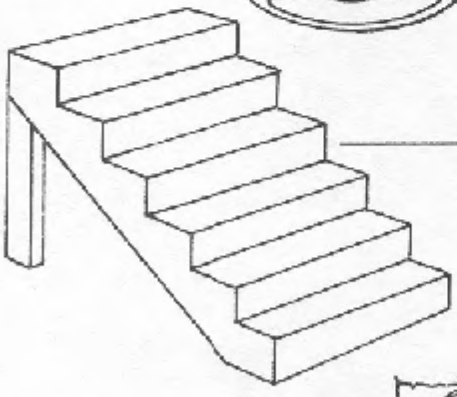

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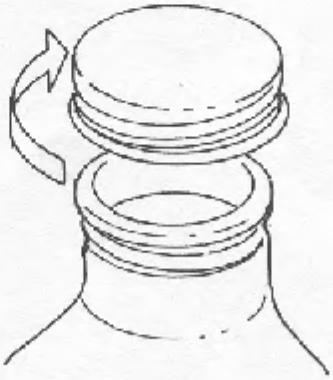

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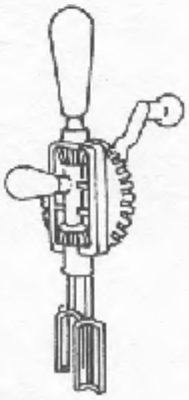

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# TYPES OF LEVERS

Name _____

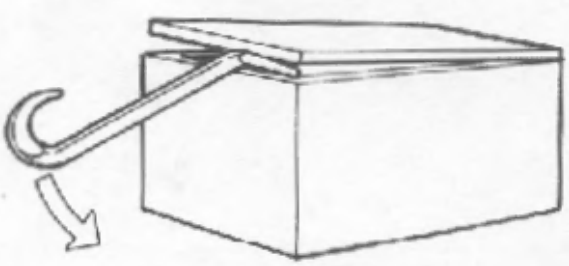
Classify the following levers as first, second or third class.


_____

_____

_____

_____



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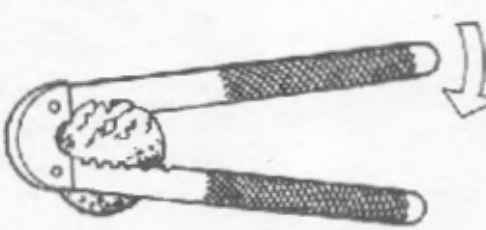

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# CALCULATING WORK

Name _____

Work has a special meaning in science. It is the product of the force applied to an object and the distance the object moves. The unit of work is the joule (J).

| | |
|---|---|
| W = Force x Distance | |
| W = F x d | Force = newtons |
| | Distance = meters |

Solve the following problems.

1. A book weighing 1.0 newton is lifted 2 meters. How much work was done?

   Answer: _____

2. A force of 15 newtons is used to push a box along the floor a distance of 3 meters. How much work was done?

   Answer: _____

3. It took 50 joules to push a chair 5 meters across the floor. With what force was the chair pushed?

   Answer: _____

4. A force of 100 newtons was necessary to lift a rock. A total of 150 joules of work was done. How far was the rock lifted?

   Answer: _____

5. It took 500 newtons of force to push a car 4 meters. How much work was done?

   Answer: _____

6. A young man exerted a force of 9,000 newtons on a stalled car but was unable to move it. How much work was done?

   Answer: _____

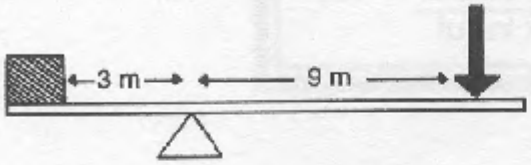
# MECHANICAL ADVANTAGE

Name _____

What is the mechanical advantage of the following simple machines?

$$MA = \frac{F_R}{F_E}$$ where $F_R$ = resistance force, $F_E$ = effort force

1.

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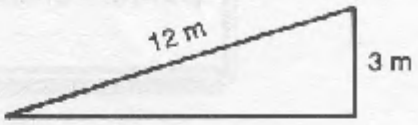


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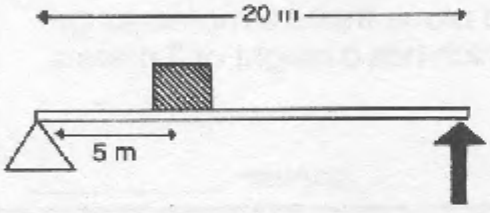


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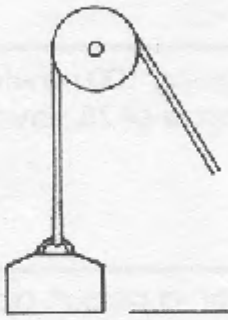

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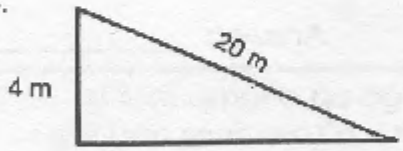


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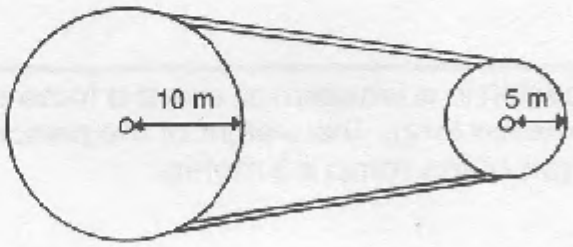


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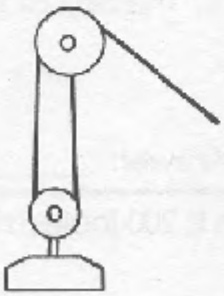

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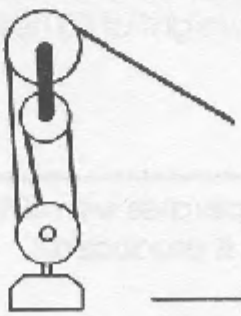

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# CALCULATING EFFICIENCY

Name _____

The amount of work obtained from a machine is always less than the amount of work put into it. This is because some of the work is lost due to friction. The efficiency of a machine can be calculated using the following formula.

$$\text{percent efficiency} = \frac{\text{work output}}{\text{work input}} \times 100$$

What is the efficiency of the following machines?

1. A man expends 100 J of work to move a box up an inclined plane. The amount of work produced is 80 J.

   Answer: _____

2. A box weighing 100 newtons is pushed up an inclined plane that is 5 meters long. It takes a force of 75 newtons to push it to the top, which has a height of 3 meters.

   Answer: _____

3. Using a lever, a person applies 60 newtons of force and moves the lever 1 meter. This moves a 200 newton rock at the other end by 0.2 meters.

   Answer: _____

4. A person in a wheelchair exerts a force of 25 newtons to go up a ramp that is 10 meters long. The weight of the person and wheelchair is 60 newtons and the height of the ramp is 3 meters.

   Answer: _____

5. A boy pushes a lever down 2 meters with a force of 75 newtons. The box at the other end with a weight of 50 newtons moves up 2.5 meters.

   Answer: _____

6. A pulley system operates with 40% efficiency. If the work put in is 200 joules, how much useful work is produced?

   Answer: _____

# CALCULATING POWER

Name _____

Power is the amount of work done per unit of time. The unit for power, joules/second, is the watt.

$$\text{Power} = \frac{\text{work}}{\text{time}}$$

work = joules
time = seconds

Solve the following problems.

1. A set of pulleys is used to lift a piano weighing 1,000 newtons. The piano is lifted 3 meters in 60 seconds. How much power is used?

   Answer: _____

2. How much power is used if a force of 35 newtons is used to push a box a distance of 10 meters in 5 seconds?

   Answer: _____

3. What is the power of a kitchen blender if it can perform 3,750 joules of work in 15 seconds?

   Answer: _____

4. How much work is done using a 500-watt microwave oven for 5 minutes?

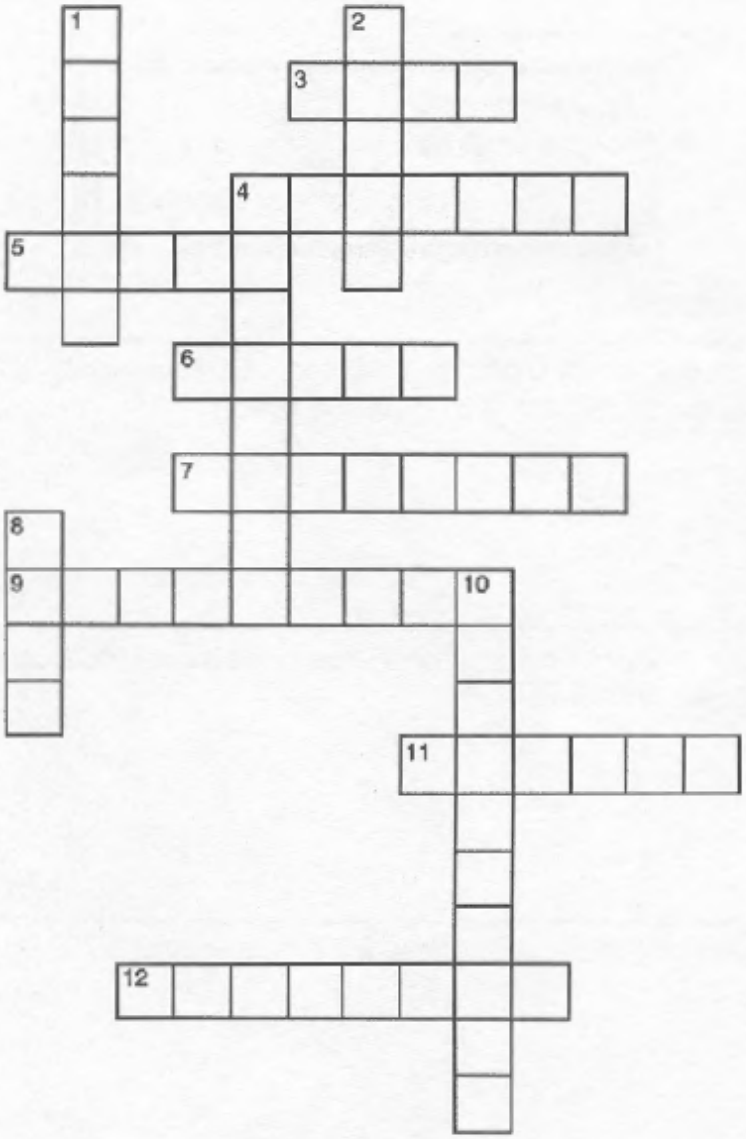
   Answer: _____

5. How much work is done using a 60-watt light bulb for 1 hour?

   Answer: _____

# FORCE AND WORK CROSSWORD

Name _____




## Across

3. Force times distance
4. Point around which a lever rotates
5. Amount of work done per unit of time
6. Can be considered a type of inclined plane wrapped around a cylinder
7. A machine makes work easier by reducing force and increasing _____ .
9. How many times a force is multiplied by a machine is the mechanical _____ .
11. An inclined plane is an example of a _____ machine.

## Down

1. Unit of force
2. Unit for work (newton-meter)
4. Force that reduces the efficiency of a machine
8. Joule per second
10. Work output divided by work input.
12. An automobile is an example of a _____ machine.

# POTENTIAL AND KINETIC ENERGY

Name _____

Potential energy is stored energy due to position. Kinetic energy is energy that depends on mass and velocity (movement).

Potential Energy = Weight x Height (P.E. = w x h)

Kinetic Energy = $^1/_2$ Mass x Velocity$^2$ (K.E. = $^1/_2mv^2$)

The units used are:
- Energy = joules
- Weight = newtons
- Height = meters
- Mass = kilograms
- Velocity = m/s

For a closed system, the sum of the potential energy and the kinetic energy is a constant. As the potential energy decreases, the kinetic energy increases.

Solve the following problems.

1. What is the potential energy of a rock that weighs 100 newtons that is sitting on top of a hill 300 meters high?

   Answer: _____

2. What is the kinetic energy of a bicycle with a mass of 14 kg traveling at a velocity of 3 m/s?

   Answer: _____

3. A flower pot weighing 3 newtons is sitting on a windowsill 30 meters from the ground. Is the energy of the flower pot potential or kinetic? How many joules is this?

   Answers: _____ _____

4. When the flower pot in Problem 3 is only 10 meters from the ground, what is its potential energy?

   Answer: _____

5. How much of the total energy in Problems 3 and 4 has been transformed to kinetic energy?

   Answer: _____

6. A 1200 kg automobile is traveling at a velocity of 100 m/s. Is its energy potential or kinetic? How much energy does it possess?

   Answers: _____ _____

# HEAT CALCULATIONS

Name _____

Heat is measured in units of joules or calories. The amount of heat given off or absorbed can be calculated by the following formula.

$\Delta Q = m \times \Delta T \times C$

heat = (mass in grams) (temperature change) (specific heat)

The specific heat of water = 1.0 cal/g C° or 4.2 joules/g C°

Solve the following problems.

1. How many calories are absorbed by a pot of water with a mass of 500 g in order to raise the temperature from 20° C to 30° C?

   Answer: _____

2. How many joules would be absorbed for the water in Problem 1?

   Answer: _____

3. If the specific heat of iron = 0.46 J/g C°, how much heat is needed to warm 50 g of iron from 20° C to 100° C?

   Answer: _____

4. If it takes 105 calories to warm 100 g of aluminum from 20° C to 25° C, what is the specific heat of aluminum?

   Answer: _____

5. If it takes 31,500 joules of heat to warm 750 g of water, what was the temperature change?

   Answer: _____

# HEAT AND PHASE CHANGES

Name _____

During a phase change, the temperature remains the same. For these calculations, we use the following formulas.

**For freezing and melting, heat = (mass in grams) (heat of fusion)**
**For boiling and condensation, heat = (mass in grams) (heat of vaporization)**
**The heat of fusion of water = 340 J/g**
**The heat of vaporization of water = 2,300 J/g**

Solve the following problems.

1. How many joules of heat are necessary to melt 500 g of ice at its freezing point?

   Answer: _____

2. How many kilojoules is this?

   Answer: _____

3. How much heat is necessary to vaporize 500 g of water at its boiling point?

   Answer: _____

4. If 5,100 joules of heat are given off when a sample of water freezes, what is the mass of the water?

   Answer: _____

5. If 57,500 joules of heat are given off when a sample of steam condenses, what is the mass of the steam?

   Answer: _____