Name _____ Date _____ Class _____

Math Skills

LESSON 2

Solve for Efficiency

A machine's efficiency is the ratio of the output work to the input work. This can be represented by the equation below, where efficiency is given in %, W_{out} = output work (in joules), and W_{in} = input work (in joules).

$$\text{efficiency} = \frac{W_{out}}{W_{in}}$$

You can rearrange the equation to solve for either of the other variables.

$$W_{out} = \text{efficiency} \cdot W_{in} \qquad W_{in} = \frac{W_{out}}{\text{efficiency}}$$

Sal does **300** J of work pulling the rope on a pulley to lift a barrel. The output work of the pulley is **270** J. What is the efficiency of the pulley?

Step 1 Identify the variable you will solve for and choose the appropriate equation. You are solving for efficiency.

$$\text{efficiency} = \frac{W_{out}}{W_{in}}$$

Step 2 Substitute the known values to solve the equation.

$$\text{efficiency} = \frac{270}{300}$$

$$\text{efficiency} = 0.9$$

Step 3 Multiply by **100** to convert the decimal to a percentage.

$$0.9 \cdot 100 = 90\%$$

The efficiency of the pulley is **90%**.

Practice

1. Jill does 270 J of work pulling the rope on a pulley to lift a crate. The output work of the pulley is 235 J. What is the efficiency of the pulley?

2. A machine needs 250 J of input work to do 140 J of output work. What is the efficiency of the machine?

3. Rea does 60 J of work with a lever. The output work of the lever is 55 J. What is the efficiency of the lever?

4. Morgan does 50 J of work with a lever that has an efficiency of 92%. What is the output work of the lever?

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Math Skills LESSON 2

Solve for Mechanical Advantage

A machine's mechanical advantage is the ratio of the output force exerted to the input force applied. This can be shown by the equation below, where MA = mechanical advantage (no units), F_{out} = output force (in newtons), and F_{in} = input force (in newtons).

$$MA = \frac{F_{out}}{F_{in}}$$

You can rearrange the equation to solve for either of the other variables.

$$F_{out} = MA \cdot F_{in} \qquad F_{in} = \frac{F_{out}}{MA}$$

Sue is separating two boards with a crowbar. She applies a force of **300** N to the end of the crowbar. The force exerted on the board is **900** N. What is the mechanical advantage of the crowbar?

Step 1 Identify the variable you will solve for and choose the appropriate equation. You are solving for mechanical advantage.

$$MA = \frac{F_{out}}{F_{in}}$$

Step 2 Substitute the known values to solve the equation.

$$MA = \frac{900}{300}$$

$$MA = 3$$

The mechanical advantage of the crowbar is **3.**

Practice

1. Priya uses a nutcracker to break an almond. She applies a force of 22 N on the nutcracker. The force exerted on the almond is 66 N. What is the mechanical advantage of the nutcracker?

2. Karim applies an input force of 28 N to a rake. The rake has an output force of 14 N. What is the mechanical advantage of the rake?

3. Amal uses a pulley to lift a concrete block. She applies a force of 95 N. The force exerted on the concrete block is 95 N. What is the mechanical advantage of the pulley?

4. Jain applies an input force of 100 N to a lever that has a mechanical advantage of 3. What is the output force?