

WORKSHEET

53

MATH IN SCIENCE: PHYSICAL SCIENCE

MATH SKILLS USED

Division
Decimals*Mechanical Advantage*

Use the equation for mechanical advantage to see how machines multiply force.

The **mechanical advantage** of a machine is the factor by which the machine multiplies force. The mechanical advantage of a machine can be used to determine how well a machine works and whether it can perform a particular job.

EQUATION: mechanical advantage (MA) = $\frac{\text{output force}}{\text{input force}}$

SAMPLE PROBLEM: What is the mechanical advantage of a lever that requires an input force of 20 N and lifts an object that weighs 60 N?

$$\text{mechanical advantage } (MA) = \frac{60 \text{ N}}{20 \text{ N}}$$

$$MA = 3$$

Practice Your Skills!

Use the equation for mechanical advantage to answer the following questions:

1. Amanda uses a wheelbarrow to lift a load of bricks. The bricks weigh 600 N, which is more than Amanda could normally carry. However, with the wheelbarrow, Amanda can lift the bricks with as little as 120 N. What is the mechanical advantage of the wheelbarrow?

2. Marshall wants to remove a tree stump from the ground. To do this, he puts one end of a long beam under the stump and puts all of his weight on the other end. His weight is just enough to lift the stump. The stump weighs 400 N. Marshall weighs 250 N. What is the mechanical advantage of the lever Marshall is using?

3. A system of pulleys allows a mechanic to lift an 1800 N engine.
 - a. If the mechanic exerts a force of 600 N on the pulley system, what is the mechanical advantage of the machine?

- b. What is the mechanical advantage of the pulley system if the mechanic must exert 800 N of force to lift the engine?

- c. After improving the design of his pulley system, the mechanic can now lift the engine with a MA of 4. How much force is now required to lift the engine?

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1. Amanda uses a wheelbarrow to lift a load of bricks. The bricks weigh 600 N, which is more than Amanda could normally carry. However, with the wheelbarrow, Amanda can lift the bricks with as little as 120 N. What is the mechanical advantage of the wheelbarrow?

$$MA = 600 \text{ N} \div 120 \text{ N} = 5$$

2. Marshall wants to remove a tree stump from the ground. To do this, he puts one end of a long beam under the stump and puts all of his weight on the other end. His weight is just enough to lift the stump. The stump weighs 400 N. Marshall weighs 250 N. What is the mechanical advantage of the lever Marshall is using?

$$MA = 400 \text{ N} \div 250 \text{ N} = 1.6$$

3. A system of pulleys allows a mechanic to lift an 1800 N engine.
 - a. If the mechanic exerts a force of 600 N on the pulley system, what is the mechanical advantage of the machine?

$$MA = 1800 \text{ N} \div 600 \text{ N} = 3$$

- b. What is the mechanical advantage of the pulley system if the mechanic must exert 800 N of force to lift the engine?

$$MA = 1800 \text{ N} \div 800 \text{ N} = 2.25$$

- c. After improving the design of his pulley system, the mechanic can now lift the engine with a MA of 4. How much force is now required to lift the engine?

$$1800 \text{ N} \div 4 \text{ N} = 450 \text{ N}$$