



**Machine Equations:**

1. Write the word and symbol equations for calculating work:
2. Write the word and symbol general equations for calculating mechanical advantage (MA) of a machine:
3. Write the word and symbol equations for calculating the efficiency (Eff) of a machine:
4. Write the word and symbol equations for the ideal mechanical advantage (IMA) specific to inclined planes:
5. Write the word and symbol equations for the ideal mechanical advantage (IMA) specific to levers:
6. Write the word and symbol equations for the ideal mechanical advantage (IMA) specific to a wheel and axle:
7. Explain how to find the ideal mechanical advantage (IME) specific to a pulley system.

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**Machine Problems:** Be sure to make a list of variables, write the equation, show substitutions with units and unit cancellations, and then solve any problems that use an equation.

8. How much work is done when a student lifts a 22 N stack of books 2.7 meters to place them on a shelf?
9. How much work is done if the student carries the same stack of books 15 meters across a level floor?

10. What is the ideal mechanical advantage of a ramp 1.2 meters high and 6.0 meters long?
11. If a person is using a hand truck (no friction) to move a 550 newton crate up the ramp in question 10, how much force will they exert in the direction of the ramp?
12. A man uses a rake to clean the leaves out of his lawn. If his right hand is at one end of a 2.0 meter rake and his left hand is 0.80 meters from his right hand, calculate the ideal mechanical advantage of the rake.
13. A screwdriver has a handle with a radius of 1.1 cm. The blade of the screwdriver is 0.40 cm wide. Calculate the ideal mechanical advantage of the screwdriver.
14. If you expend 22 000 J of energy to do a job and the machine you are using expends 18 500 J of energy, what is the efficiency of the machine?
15. Find the ideal mechanical advantage of the pulley system shown.

