

Efficiency

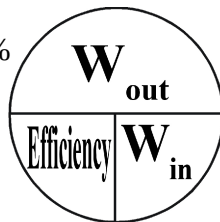
Did you ever touch the hood of a car after a long ride? It gets pretty hot. The heat comes from the engine. It's the same heat that is used to warm the interior of a car on a cold, wintery day. Heat is energy. The heat that the engine of a car gives off comes from burning fuel. Cars don't burn fuel, however, in order to get hot. They burn fuel in order to move. Some of the heat radiating from a hot engine comes from burning fuel and some comes from friction in the engine. Less than 25 percent of the energy from burning fuel is turned into useful mechanical work in a typical car engine. Even though we use some of the excess heat in the winter, it is basically wasted energy. In other words, an automobile engine is not very efficient.

According to the law of conservation of energy, you can never get more out of a machine than you put into it. But you can certainly waste energy overcoming friction. Friction reduces the work output, making it less than the work input. The efficiency is the ratio of the work output to the work input.



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

$$\text{eff} = \frac{W_{\text{out}}}{W_{\text{in}}} \times 100\%$$



(NOTE: Express efficiency as a decimal to calculate W_{out} or W_{in} .)

Sample Problem

A machine has an efficiency of 65 percent. How much work was done to accomplish 143 J of work?

$$\text{eff} = \frac{W_{\text{out}}}{W_{\text{in}}}; 0.65 = \frac{143J}{W_{\text{in}}}; W_{\text{in}} = \frac{143J}{0.65} = 220J$$

Answer the questions below based on the reading above and on your knowledge of physics.

1. How efficient is a machine with a work output of 85 J and a work input of 255 J?
2. A machine has an efficiency of 25 percent. How much work was done to accomplish 150 J of work?
3. How much useful work was done if a machine with 75 percent efficiency required an input of 800 J?