

Power

What is power?

The word "power" is often used to describe someone in authority like a king or a dictator. It's also used to describe someone or something that is very strong like a baseball player that hits home runs. In physics, power is used to describe the rate at which energy is used. In other words, it is a measurement of how fast you are using energy.

The equation that describes power is:

$$\text{Power} = \text{Work} \div \text{Time}$$

or

$$P = W/t$$

An Example

Whether you run up a flight of stairs in 5 seconds or take a slow walk up the same flight in 40 seconds, you are doing the same amount of work. However, you are doing it at a different rate. When you run up the stairs you are working much faster. While running up the stairs you have a higher power than when you walk up the stairs.

If the work it takes you to climb the stairs is 1000 joules, then we can calculate the power in both cases P_1 (running) and P_2 (walking):

$$\text{Power} = W/t$$

$$P_1 = 1000 \text{ J} \div 5 \text{ s}$$

$$P_1 = 200 \text{ W}$$

$$P_2 = 1000 \text{ J} \div 40 \text{ s}$$

$$P_2 = 25 \text{ W}$$

You can see that the power was much higher while running the stairs than while walking.

How to Measure Power

The standard unit for measuring power is the Watt. From the equation above we can see that power is $\text{Work} \div \text{Time}$. The unit for work is the joule (J), so a Watt is the same as a joule/second or J/s.

Another common unit for power that is used for automobile engines and machines is horsepower. One horsepower is about equivalent to 745.7 Watts.

Power and Force

Power can also be calculated from the force and velocity of an object using the following equation:

$$\text{power} = \text{force} * \text{velocity}$$

Electrical Power

When figuring out the [electrical](#) power, we use the current and the voltage. Current is measured in amperes (A) and voltage is measured in volts (V). Note: Current is represented in equations with an "I."

$$\text{Power} = \text{Current} * \text{Voltage}$$
$$P = I * V$$

Example problem:

What is the power of an electrical circuit generating 3 amperes at 10 volts?

$$P = I * V$$

$$P = 3A * 10V$$

$$P = 30 \text{ Watts}$$

Interesting Facts about Power

- Explosions may not always release a lot of energy, but because they release energy over a very short period time, they can still be very powerful.
- The "power" bill we get in the mail is usually billed in kilowatt hours. This is power over time which is actually a measurement of energy used and not power.
- The power exerted by the Space Shuttle rockets at lift-off is around 12 billion watts.
- One horsepower is equal to the power it takes to lift 550 pounds up one foot in one second.