

Power

Race cars need powerful engines. Why? In order to move fast. It takes work to move a car around a track. The car's engine needs to exert a force to overcome friction and move it around the track the distance from start to finish. That's work! ($W = F \times d$). Of course, if the engine only exerted enough force to be equal and opposite to friction, that would not accomplish any work because the net force would be zero. Remember Newton's Second Law ($F = ma$). The mass of the race car is constant. Increasing the force on the race car with a big, powerful engine increases the acceleration, making the car go faster. The work done getting the car around the race track with a powerful engine takes less time. Power is the rate at which work is done. Power is expressed in watts. ($1 \text{ watt} = 1 \text{ J/s}$)



A more powerful brain also works faster.

Sample Problems
How much power is needed to accomplish 250 J of work in 12.5 s?

$$P = \frac{W}{t}; P = \frac{250 \text{ J}}{12.5 \text{ s}} = 20 \text{ watts}$$

How much energy does a 60 watt bulb use in 1 minute (60 s)?

$$P = \frac{W}{t}; 60 \text{ watts} = \frac{W}{60 \text{ s}}; W = (60 \text{ watts})(60 \text{ s}) = 3600 \text{ J}$$

How high can a 500 N box be lifted in 25 s with 400 watts of power?

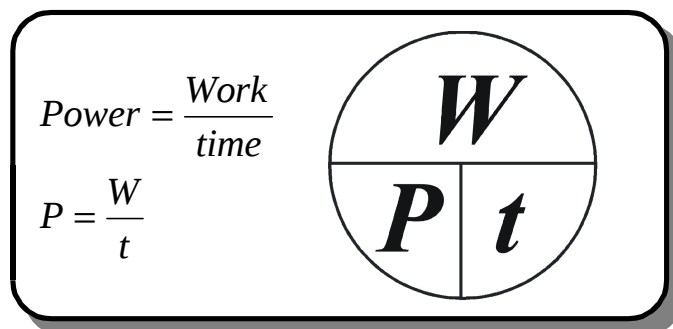
Step 1: Calculate work done

$$P = \frac{W}{t}; 400 \text{ watts} = \frac{W}{25 \text{ s}}; W = 10,000 \text{ J}$$

Step 2: Calculate the distance

$$W = F \times d; 10,000 \text{ J} = (500 \text{ N})(d)$$

$$d = \frac{10,000 \text{ J}}{500 \text{ N}}; d = 20 \text{ m}$$



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

1. A 15 watt compact fluorescent (CFL) bulb is as bright as a standard 60 watt bulb. How much energy is saved every minute by using the CFL bulb?
2. How long does it take to do 15,000 J of work with 250 watts of power?
3. What is the weight of a box that can be lifted 15 m in 25 s with 200 watts of power?
4. How high can a 750 N box be lifted in 15 s with 500 watts of power?