

Lesson 41: Power

The word “**power**” is most often associated with electricity in everyday use, but this is not the case in physics.

- **Power** is the rate at which work is done.
- This means that **power** measures how quickly energy is being used.
- Since it is the rate at which something is happening, time must be involved somehow.
- If you look at the basic formula for power, you’ll see that it is the same as many formulas that involve time.

$$P = \frac{W}{t} = \frac{\Delta E}{t}$$

P = power (Watts)
W = ΔE = work (Joules)
t = time (seconds)

Power is really how fast you are using up energy, so it could be measured in Joules per second.

- In honour of his search for a more efficient engine (which was better at converting energy!), the unit for **power** is called the **Watt** after [James Watt](#).
- Think of a light bulb... you always talk about how many Watts the bulb is, like a 60 W bulb.
 - That just means that the light bulb is using 60 Joules of energy every second.

Example 1: I left a 150W bulb on for 2.5 hours. **Determine** how much electricity I used.

In this case the electricity (electrical energy) is being changed into heat and light...that’s the work done!

Warning!

Electricity is NOT power.
Electricity is energy.

$$P = \frac{\Delta E}{t}$$
$$\Delta E = Pt$$
$$\Delta E = 150(9.0e3)$$
$$\Delta E = 1.4e6 J$$

You used over a million Joules of energy!!!

In many questions we need to look at situations where an motor is lifting something at a constant velocity.

- The difference between motors is that a higher power motor will be able to move the load faster.
- We can see this if we start to play with the formula a bit.

$$P = \frac{W}{t}$$

$$P = \frac{Fd}{t}$$

$$P = Fv$$

Since $v = d / t$, we can substitute it out.

- You can only use this in situations where the object is being moved at a constant velocity.

Example 2: A 200 W motor is being used to lift shingles at a constant velocity to the top of a roof. If one pack of shingles has a 28 kg mass, **determine** the velocity that the pack will be raised at.

If the shingles are being raised at a constant velocity, then the net force acting on the pack is zero (any net force would cause acceleration).

$$F_{NET} = F_a + F_g$$

$$0 = F_a + F_g$$

$$F_a = -F_g$$

$$F_a = -mg$$

$$F_a = -28(-9.81) = 274.68 \text{ N}$$

Really only has two sig digs, but we won't round off till the end of the question.

Now we can calculate the velocity...

$$P = Fv$$

$$v = \frac{P}{F}$$

$$v = \frac{200}{274.68}$$

$$v = 0.73 \text{ m/s}$$