SPH3U UNIVERSITY PHYSICS

ELECTRICITY & MAGNETISM

- Electrical Power (P.504-507)

Electrical Power

You may have noticed that electrical devices are labelled with a power rating. For example, a compact fluorescent light bulb (i.e. CFLs) may be labelled 15 W, while a hair dryer might be labelled 1200 W. What is an electrical power rating, and what does it mean?

Electrical Power

Electrical power (P) *is the rate at which electrical energy is produced or consumed. Power is measured in watts (W). The higher the power rating value, or "wattage," the more electrical energy the device produces or consumes.*

NOTE!

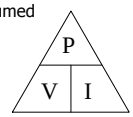
The equation P = VI is an expression for determining the electric power dissipated by a current, I, through a potential difference, V.

Electrical Power

ELECTRIC POWER (P)

- rate at which electrical energy is produced or consumed

$$P = VI$$



P=VI V=P/I I=P/V

where P is the electric power (W)
V is the potential difference (V)
I is the current (A)

NOTE!

Another common unit for power is the kilowatt (kW) ☞ *1 kW = 1000 W*

Electrical Power

PRACTICE

1. What is the maximum power (in W and kW) that can be used in a circuit with a potential difference of 120 V and a maximum current of 20 A?

   P = 2400 W = 2.4 kW

Electrical Power

PRACTICE

2. What is the current drawn by a 100 W light bulb operating at a potential difference of 120 V?

   I = 0.83 A

Electrical Power

NOTE!

If the load has a resistance, R, then two different expressions can be derived by applying Ohm's law. From Ohm's Law, V=IR and I=V/R, we can write:

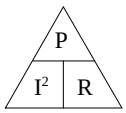
since	$P = VI$	*and*	$P = VI$
then	$P = (IR)I$		$P = V(V/R)$
or	$\mathbf{P = I^2R}$		$\mathbf{P = V^2/R}$

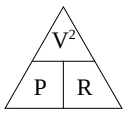
Electrical Power

ELECTRIC POWER (P)

$$P = I^2R \qquad P = \frac{V^2}{R}$$

where P is the electric power (W)
I is the current (A)
V is the potential difference (V)
R is the resistance (Ω)





Electrical Power

PRACTICE

3. What is the resistance of a 600 W kettle that draws a current of 5.0 A?

R = 24 Ω

Electrical Power

PRACTICE

4. What power is dissipated by an electric frying pan that has a resistance of 12 Ω and operates at a potential difference of 120 V?

   P = 1200 W

Electrical Power – DYK?

*Employees at the power plant monitor power needs and generate power "on demand." When more power is needed, the employees increase power generation up to the maximum capability. If no more can be generated, then the electricity has to be purchased from somewhere else, such as the United States. As a last resort, the employees may shut down the power to a neighbourhood for a short time. Short temporary interruptions to the electricity supply are called "**brownouts**."*

Electrical Power – DYK?

NOTE!

Power is generated on demand because there is no practical method of storing the electrical energy. Batteries are impractical because of the large number that would be needed.

Electrical Power – DYK?

ELECTRICAL POWER

- generated on demand
- no practical method of storing the energy
- if demand > supply then:
  - ① buy more (from US)
  - ② interrupt power supply ☞ brownout

✔ Check Your Learning

WIKI (ELECTRICITY & MAGNETISM)

✎.... 3U4 - QUIZ#1 (Electricity - Part 1)