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# Electric current and electrical power

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**CONCEPT REVIEW 21**

Complete this concept review handout and keep it as a record of what you have learned..

## Definitions

- Dynamic electricity describes *all the phenomena related to electrical charges in motion.*
- Electric current is *the orderly flow of negative charges carried by electrons.*
- Ohm's law states *that, for a given resistance, the potential difference in an electrical circuit is directly proportional to the current intensity.*
- Electrical power is *the amount of work an electrical device can perform per second.*

Unit of measurement: *watt* Symbol: *W*

$1\ W = \frac{1\ J}{1\ s}$

## Characteristics of electric current

| Characteristic (symbol) | Definition | Unit of measurement (symbol) | Equation |
|---|---|---|---|
| Current intensity (*I*) | *The number of charges that flow past a given point in an electrical circuit every second.* | *Ampere (A)* | $1\ A = \frac{1\ C}{1\ s}$ |
| *Potential difference (U)* | *The amount of energy transferred between two points in an electrical circuit.* | *Volt (V)* | $1\ V = \frac{1\ J}{1\ C}$ |
| *Electrical Electrical (R)* | *The ability of a material to hinder the flow of electric current.* | *Ohm (Ω)* | $1\ \Omega = \frac{1\ V}{1\ A}$ |

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CHAPTER 5

## Mathematical formulas and units of measurement

Formula for determining the current intensity in a circuit:

$$I = \frac{q}{\Delta t}$$

where I is the current intensity (in A).
q is the charge (in C).
Δt is time interval (in s).

Formula for determining the potential difference between two points in a circuit:

$$U = \frac{E}{q}$$

where U is the potential difference (in V).
E is the energy transferred (in J).
q is the charge (in C).

Formula for d'Ohm's law:

$$U = RI$$

where U is the potential difference (in V).
R is the resistance (in Ω).
I is the current intensity (in A).

Formula expressing electrical power as a function of work:

$$P_e = \frac{W}{\Delta t}$$

where $P_e$ is the electrical power (in W).
W is the work (in J).
Δt is time interval (in s).

Formula expressing electrical power as a function of potential difference and current intensity:

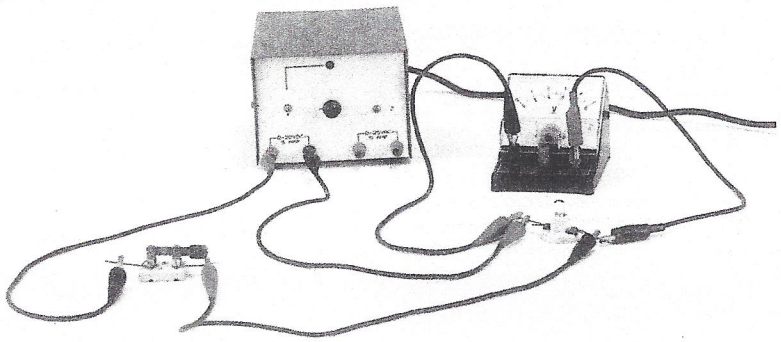
$$P_e = UI$$

where $P_e$ is the electrical power (in W).
U is the potential difference (in V).
I is the current intensity (in A).

Formula expressing the relationship between electrical power and electrical energy:

$$E = P_e \Delta t$$

where E is the electrical energy used (in J or kWh).
$P_e$ is the electrical power (in W or kW).
Δt is time interval (in s or h).



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# INTEGRATION QUESTIONS

## Electric current and electrical power

1. A machine needs a charge of 1800 C to run for 3 minutes. What is the current intensity required to make it run?

$3\ min = 180\ s$

$$I = \frac{q}{\Delta t} = \frac{1800\ C}{180\ s} = 10\ A$$

*The current intensity required to make the machine run for 3 minutes is 10 A.*

2. An electric stove requires a potential difference of 220 V. What charge is necessary for it to provide 450 000 J of energy?

$$q = \frac{E}{U} = \frac{450000\ J}{220\ V} = 2045\ C$$

*For the stove to provide 450 000 J of energy with a potential difference of 220 V, a charge of 2045 C is needed.*

3. A tool runs on a current of 20 A and a potential difference of 120 V.

a) What is the tool's electrical resistance?

$$R = \frac{U}{I} = \frac{120\ V}{20\ A} = 6\ \Omega$$

*The tool's electrical resistance is 6 Ω.*

b) What is the tool's electrical power?

$P_e = UI = 120\ V \times 20\ A = 2400\ W$

*The tool's electrical power is 2400 W.*

4. A radio receiver needs a current of 6 A to work. What charge is needed to make it work for 10 minutes?

$10\ min = 600\ s$

$q = I \times \Delta t = 6\ A \times 600\ s = 3600\ C$

*A charge of 3600 C is needed to make the radio receiver work for 10 minutes.*

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What amount of energy can a 350 C charge provide in a 120 V circuit?

$E = U \times q = 120\ V \times 350\ C = 42\,000\ J$

A 350 C charge with a potential difference of 120 V can provide 42 000 J of energy.

A toaster has an electrical power of 970 W. If it is used for two and a half minutes, what amount of energy does that represent?

$2{,}5\ min = 150\ s$

$E = P_e \times \Delta t = 970\ W \times 150\ s = 145\,500\ J$

The toaster uses 145 500 J of energy in two and a half minutes.

An electricity bill shows that 1320 kWh was consumed over a 70-day period. Calculate the electrical power used in this period.

$70\ j = 1680\ h$

$P_e = \frac{E}{\Delta t} = \frac{1320\ kWh}{1680\ h} = 0{,}79\ kW = 790\ W$

The electrical power used in 70 days was 790 W.

What amount of electrical energy will a 900 W coffee maker have consumed after six minutes of use?

$6\ min = 360\ s$

$E = P_e \Delta t = 900\ W \times 360\ s = 324\,000\ J$

The coffee maker will have consumed 324 000 J after six minutes of use.

An element in a circuit requires a potential difference of 120 V and offers a resistance of $\Omega$.

What is the intensity of the current flowing through the element?

$I = \frac{U}{R} = \frac{120\ V}{12\ \Omega} = 10\ A$

The current intensity is 10 A.

What is the element's electrical power?

$P = UI = 120\ V \times 10\ A = 1200\ W$

The element's electrical power is 1200 W.



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