

UNIT

2

Electric charge and electric current



TEXT BOOK EXERCISES

I. Choose the correct answer

- In current electricity, a positive charge refers to,
 - presence of electron
 - presence of proton
 - absence of electron
 - absence of proton

Ans: c) absence of electron

- Rubbing of comb with hair
 - creates electric charge
 - transfers electric charge
 - either (a) or (b)
 - neither (a) nor (b)

Ans: b) transfers electric charge

- Electric field lines _____ from positive charge and _____ in negative charge.
 - start; start
 - start; end
 - start; end
 - end; end

Ans: c) start: end

- Potential near a charge is the measure of its _____ to bring a positive charge at that point.
 - force
 - ability
 - tendency
 - work

Ans: d) work

- In an electrolyte the current is due to the flow of,
 - electrons
 - positive ions
 - both (a) and (b)
 - neither (a) nor (b)

Ans: c) both (a) and (b)

- Heating effect of current is called,
 - Joule heating
 - Coulomb heating
 - voltage heating
 - Ampere heating

Ans: a) Joule heating

- The following is not a safety device.
 - fuse
 - trip switch
 - ground connection
 - wire

Ans: d) wire

- Electroplating is an example for
 - heating effect
 - chemical effect
 - flowing effect
 - magnetic effect

Ans: b) chemical effect

- Resistance of a wire depends on,
 - temperature
 - geometry
 - nature of material
 - all the above

Ans: d) all the above

10. In India the frequency of alternating current is,

- a) 220 Hz b) 50 Hz
c) 5 Hz d) 100 Hz

Ans: b) 50 Hz

II. Match the following

- | | |
|-------------------------|------------------------|
| 1. Electric Charge | (a) ohm |
| 2. Potential difference | (b) ampere |
| 3. Electric field | (c) coulomb |
| 4. Resistance | (d) newton per coulomb |
| 5. Electric current | (e) volt |

Ans:

- | | |
|-------------------------|------------------------|
| 1. Electric Charge | (a) coulomb |
| 2. Potential difference | (b) volt |
| 3. Electric field | (c) newton per coulomb |
| 4. Resistance | (d) ohm |
| 5. Electric current | (e) ampere |

III. True or False

1. Electrically neutral means it is either zero or equal positive and negative charges.

Ans: True

2. Ammeter is connected in parallel in any electric circuit.

Ans: False

3. The anode in electrolyte is negative.

Ans: False

4. Current can produce magnetic field.

Ans: True

5. Electric fuse works on Joule heating principle.

Ans: True

IV. Fill in the blanks

1. Electrons move from _____ potential to _____ potential.

Ans: high, low

2. The direction opposite to the movement of electron is called _____ current.

Ans: conventional

3. The e.m.f of a cell is analogous to _____ of a pipe line.

Ans: pump

4. The domestic electricity in India is an ac with a frequency of _____ Hz.

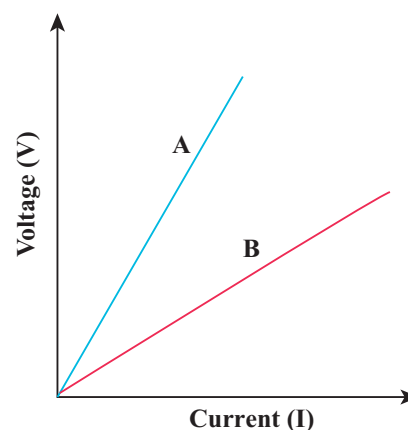
Ans: 50

5. Trip switch is a _____ safety device.

Ans: electro mechanical

V. Conceptual questions

1. A bird sitting on a high power electric line is still safe. How?
- a) Electricity flows along the path of least (low) resistance. Birds have high resistance.
- b) Birds are not good conductors of electricity. Their cell and tissue don't offer electrons an easier route.
- As a result the electricity by passes the bird.
2. Two resistors 12Ω and 6Ω are first connected in series and then in parallel. The current-voltage graph for the two connections will be represented by which lines in the graph?



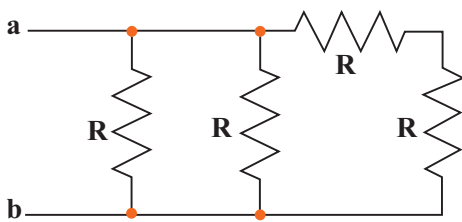
Resistance in the parallel circuit is less than the resistance in series. The slope of line **B** is less than the slope of line **A**. Hence the resistance of line **B** is less than the resistance of line **A**. Thus the line **B** represent parallel circuit and the line **A** represent series circuit.

3. Does a solar cell always maintain the potential across its terminals constant? Discuss.

The potential across the terminals of the solar cell changes according to the intensity of the sun.

It gives high potential at high temperature and low potential at low temperature.

4. What is the effective resistance across the terminals a and b of the arrangement of resistors?



Resistance in series combination = $R_s = R_1 + R_2$
 $= 2R$

Resistance in parallel combination } $1/R_p = 1/R_1 + 1/R_2$
 $1/R_p = 1/R + 1/R + 1/2R$
 $1/R_p = 2 + 2 + 1/2R$
 $= 5/2R$
 $R = 2/5 R \Omega$

5. Can electroplating be possible with alternating current?

In case of alternating current, the direction of current keeps changing. Due to this the metallic ions in the electrolyte keep shunting between electrodes, that keep changing polarity. Hence electroplating cannot be possible with alternating current.

VI. Answer the following

- On what factors does the electrostatic force between two charges depend?
 - value of charges on them,
 - distance between them and
 - nature of medium between them.

2. What are electric lines of force?

The electric lines of force are straight or curved paths along which a unit positive charge tends to move in the electric field.

3. Define electric field.

Electric field at a point is a measure of force acting on a unit positive charge placed at that point.

4. Define electric current and give its unit.

Current is the rate at which charges flow past a point on a circuit. The standard SI unit for current is ampere with the symbol A.

5. State Ohm's law.

Ohm's law states that electric potential difference across two points in an electrical circuit is directly proportional to the current passing through it. Ohm's law is written as, $V = IR$

6. On what factor does the resistance of a wire depend at a particular temperature?

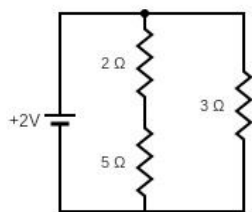
The resistance offered by a material at a particular temperature depends on the,

- geometry of the material and
- nature of the material.

7. Name any two appliances which work under the principle of heating effect of current.

Iron box, Water Heater, toaster

8. Draw a circuit with a 2Ω and 5Ω resistors in series. Connect another 3Ω resistor parallel to the above connection.



9. How are the home appliances connected in general, in series or parallel. Give reasons.

Parallel circuit

In a house there are many electrical appliances that have to run independent of each other. If one appliance is turned on or off it should not affect the other appliances. When appliances are connected in a parallel arrangement, each of them can be put 'on' and 'off' independently. This is a feature that is essential in a house wiring.

When house wiring is done in parallel the potential difference across each appliance is the same and equal to the potential difference being provided by the power company (House).

10. List the safety features while handling with electricity.

Ground connection

The metal bodies of all the electrical appliances are to be connected to the ground by means of a third wire apart from the two wires used for electrical connection.

Trip switch

It is an electromechanical device which does not allow a current beyond a particular value by automatically switching off the connection. We have trip switches of various current ratings used for specific purposes. It works on relay principle.

Fuse

A fuse is another safety mechanism which works on joule heating principle. Fuse is a wire made up of a Nickel and Chromium alloy which has a definite melting point. If current passes through the fuse beyond a particular desired value, the excess heat produced melts the fuse wire, thus the electrical connection is cut-off.

VII. Exercises

- Rubbing a comb on hair makes the comb get -0.4C . (a) Find which material has lost electron and which one gained it. (b) Find how many electrons are transferred in this process.
 - Hair lost the electrons, Comb gain the electron
 - The number of electrons transferred is 4
- Calculate the amount of charge that would flow in 2 hours through an element of an electric bulb drawing a current of 2.5A .

$$t = 2 \text{ hrs}$$

$$= 2 \times 60 \times 60 = 7200 \text{ sec}$$

$$I = 2.5\text{A}$$

$$I = q/t$$

$$q = It = 2.5 \times 7200 = 18000\text{C}$$
- The values of current I flowing through a resistor for various potential differences V across the resistor are given below. What is the value of resistor?

I (ampere)	0.5	1.0	2.0	3.0	4.0
V (volt)	1.6	3.4	6.7	10.2	13.2

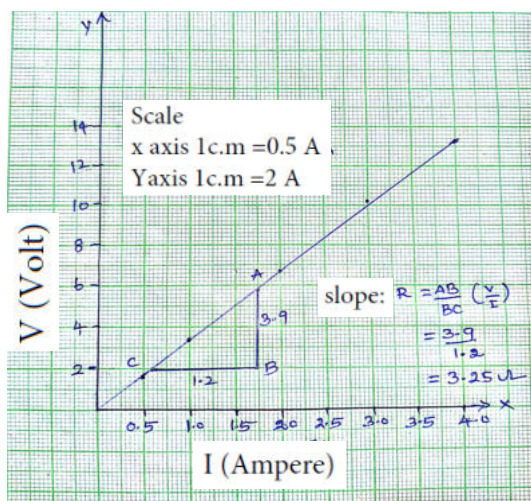
[Hint: plot V-I a graph and take slope]

S.No	I(Ampere)	V(Volt)	$R = V/I\Omega$
1	0.5	1.6	3.2
2	1.0	3.4	3.4
3	2.0	6.7	3.35
4	3.0	10.2	3.4
5	4.0	13.2	3.3

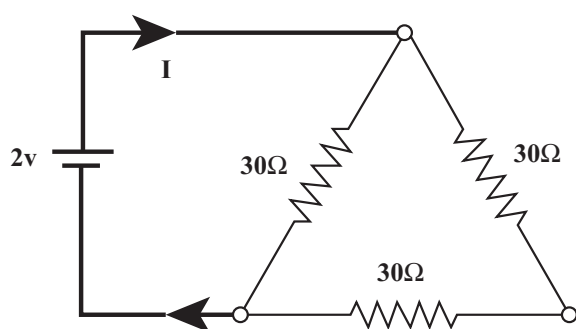
Average Resistance ($R = R_1 + R_2 + \dots + R_5$)

$$= (3.2 + 3.4 + 3.35 + 3.4 + 3.3) / 5$$

$$= 3.33\Omega$$



4. Find the value of current in the circuit.



Resistance in series $R_s = R_1 + R_2$
 $= 30 + 30 = 60\Omega$

Resistance in parallel $1/R_p = 1/R_s + 1/R_2$

$$1/R = 1/60 + 1/30$$

$$1/R = 1 + 2/60$$

$$= 3/60$$

$$= 1/20 \text{ R}$$

$$R_p = 20 \Omega$$

$$V = IR$$

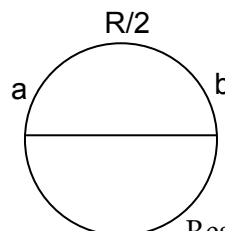
$$I = V/R$$

$$= 2/20$$

$$= 1/10$$

$$I = 0.1 \text{ A}$$

5. A wire of resistance 10Ω is bent in the form of a circle. Find the effective resistance between the points A and B which lies on the diameter.



Total Resistance $R = 10 \Omega$

above AB $R/2 = 5 \Omega$

below AB $R/2 = 5 \Omega$

Resistance in parallel: $1/R = 1/R_1 + 1/R_2$

$$= 1/5 + 1/5 = 2/5$$

$$R = 2.5 \Omega$$

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