Introduction

This is a learning as well as an exam preparation video.

At the end of the video are practice assignments for you to attempt.

Please go to www.eastpoint.intemass.com/ or click on the link at the bottom of this video to do the assignments for this topic.

MEGAForte

Innovate. Educate.

Chapter 3: Electricity

Chapter 3: Electricity

Electric Current

- Electric current is expressed as the amount of charge flowing through a particular area in unit time.
- Quantitatively, electric current is defined as the rate of flow of electric charge.

$$\text{Current, I} = \frac{\text{Charge flowing (Q)}}{\text{Time taken (t)}}$$

Chapter 3: Electricity

Electric Current

- The S.I. unit of current is ampere (A), where 1 ampere = 1 coulomb/second.
- 1 mA = 10−3 A, 1 μ A = 10−6 A
- Quantitatively, electric current is defined as the rate of flow of electric charge.
- The conventional direction of electric current is the one in which positive charges move orderly.
- An instrument called ammeter measures electric current in a circuit. It is always connected in series in a circuit through which the current is to be measured.

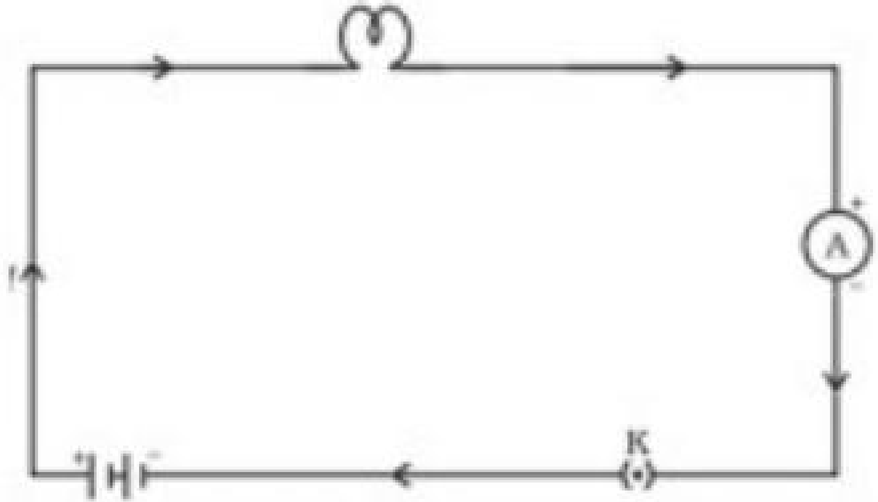
Chapter 3: Electricity

Electric circuit and circuit diagram

The electric circuits are closed loop or path which forms a network of electrical components, where electrons are able to flow. This path is made using electrical wires and is powered by a source, like a battery. The start of the point from where the electrons start flowing is called the source whereas the point where electrons leave the electrical circuit is called the return. Representation of an electric circuit through symbols is called a circuit diagram.

Chapter 3: Electricity

Electric circuit and circuit diagram



A schematic diagram of an electric circuit comprising – cell, electric bulb, ammeter and plug key

Chapter 3: Electricity

Electric circuit and circuit diagram

Example: A current of 1A is drawn by a filament of an electric bulb for 20 minutes. Find the amount of electric charge that flows through the circuit.

Ans:

The given data is,

$I = 1A$ and

$t = 20$ minutes

$t = 20 \times 60$

$t = 1200$ seconds

Therefore,

Chapter 3: Electricity

Electric circuit and circuit diagram

Example: A current of 1A is drawn by a filament of an electric bulb for 20 minutes. Find the amount of electric charge that flows through the circuit.

Ans:

$$I = \frac{Q}{t}$$

The given data is,

I = 1A and

t = 20 minutes

t = 20 × 60

t = 1200 seconds

Therefore,

Electric charge is q = It q = 1 × 1200

q = 1200 C

Chapter 3: Electricity

Coulomb's Law

According to Coulomb's law, the force of attraction or repulsion between two charged bodies is directly proportional to the product of their charges and inversely proportional to the square of the distance between them. It acts along the line joining the two charges considered to be point charges.

$$F \propto \frac{q_1 q_2}{d^2}$$

Chapter 3: Electricity

Electric Potential

Electric potential is the work done per unit charge in bringing the charge from infinity to that point against electrostatic force. In a conductor, electrons flow only when there is a difference in electric pressure at its ends. This is also called potential difference

Chapter 3: Electricity

Electric Potential Different

Electric potential difference (pd) between two points in an electric circuit, carrying some current, is the amount of work done to move a unit charge from one point to another.

$$\text{Potential difference (pd)} = \frac{\text{Work done (W)}}{\text{Quanity of charge moved (Q)}}$$

The S.I. unit of pd is volt (V), where

$$1\ \text{volt} = \frac{1\ \text{joule}}{1\text{coulomb}}$$

Chapter 3: Electricity

Electric Potential Different

Example: How much work is done in moving a charge of 2 C across two points having a potential difference 12 V?

Ans:

The amount of charge Q, that flows between two points at potential difference V (= 12 V) is 2 C. Thus, the amount of work W, done in moving the charge [from Eq. (12.2)] is

$W = VQ$

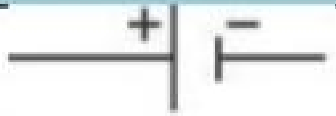
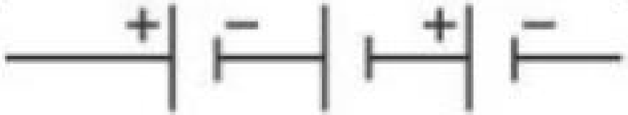
$= 12\ V \times 2\ C$

$= 24\ J.$

Chapter 3: Electricity

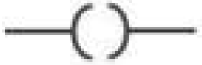
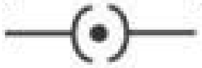
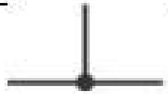
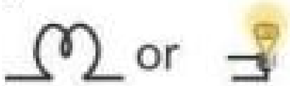
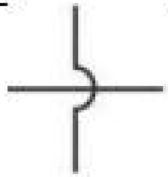
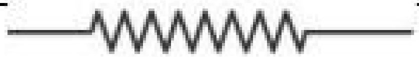
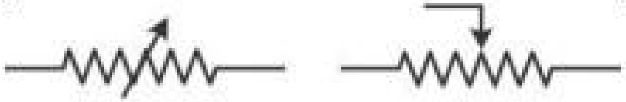
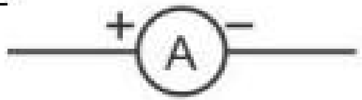
Electric Circuit

- A continuous conducting path between the terminals of a source of electricity is called an electric circuit.
- A drawing showing the way various electric devices are connected in a circuit is called a circuit diagram.
- Some commonly used circuit elements are given below:

Sr. No.	Element	Symbol
1	An electric cell	
2	A battery	

Chapter 3: Electricity

Electric Circuit

3	Plug key or switch (open)	
4	Plug key or switch (closed)	
5	A wire joint	
7	Bulb	
6	Wires crossing without joining	
8	Resistor	
9	Variable resistor or Rheostat	
10	Ammeter	
11	Voltmeter	

Chapter 3: Electricity

Ohm’s law

- According to Ohm’s law, the current (I) flowing through a conductor is directly proportional to the potential difference (V) across its ends, provided its physical conditions remain the same.

$$V \propto I$$

$$\frac{V}{I} = Constant$$

$$\frac{V}{I} = R$$

$$V = IR$$

- where R is a constant of proportionality called resistance of the conductor.

Chapter 3: Electricity

Ohm’s law

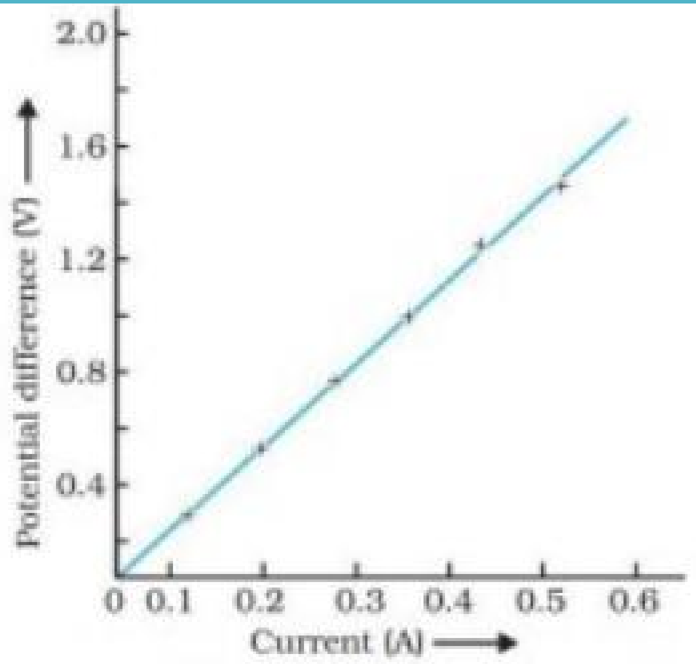
- **Resistance is the property of a conductor to resist the flow of charges through it.**
- **The S.I. unit of resistance is ohm (Ω).**

$$\text{From } R \propto \frac{V}{I} \; 1 \text{ ohm} = 1 \frac{\text{volt}}{\text{ampere}}$$

- **Potential difference across the two points of a metallic conductor is directly proportional to current passing through the circuit provided that temperature remains constant.**

Chapter 3: Electricity

Ohm's law



V–I graph for a nichrome wire. A straight line plot shows that as the current through a wire increases, the potential difference across the wire increases linearly – this is Ohm's law.

Chapter 3: Electricity

Factors Affecting Resistance

A conducting wire's resistance is determined by:

a) Nature of the material of the wire [Resistivity (Ω)]

b) Length of the wire (l)

c) Cross-sectional area of the wire (A)

Factors on which the Resistance of a Conductor depends

Resistance of a uniform metallic conductor is:

a) directly proportional to the length of conductor,

b) inversely proportional to the area of cross-section,

c) directly proportional to the temperature and

d) depend on nature of material.

Chapter 3: Electricity

Resistivity

- The resistance of a conductor is directly proportional to its length (l) and inversely
- proportional to its area of cross section (A).

$$R \propto \frac{l}{A}$$

$$R = \rho\frac{l}{A}$$

- where ρ is a constant of proportionality called specific resistance or resistivity of the material of the conductor.

Chapter 3: Electricity

Resistivity

- The S.I. unit of resistivity is ohm metre (Ω m). Resistivity does not change with change in length or area of cross-section but it changes with change in temperature.
- Range of resistivity of metals and alloys is 10-8 to 10-6 Ωm.
- Range of resistivity of insulators is 1012 to 1017 Ωm.

Chapter 3: Electricity

Resistivity

- Resistivity of alloy is generally higher than that of its constituent metals.
- Alloys do not oxidize (burn) readily at high temperature, so they are commonly used in electrical heating devices.
- Copper and aluminium are used for electrical transmission lines as they have low resistivity.

Chapter 3: Electricity

Semiconductors and Superconductors

- Semiconductors are materials with resistivity that fall between those of an insulator and a conductor.
- Materials which lose their resistivity at low temperatures are called super conductors

Chapter 3: Electricity

Combination of Resistances

Resistances in Series

- The current flowing through each resistance is the same.
- The potential difference across the ends of the series combination is distributed across the resistances.
- The equivalent resistance (R_s) of a series combination containing resistances R_1, R_2, R_3...

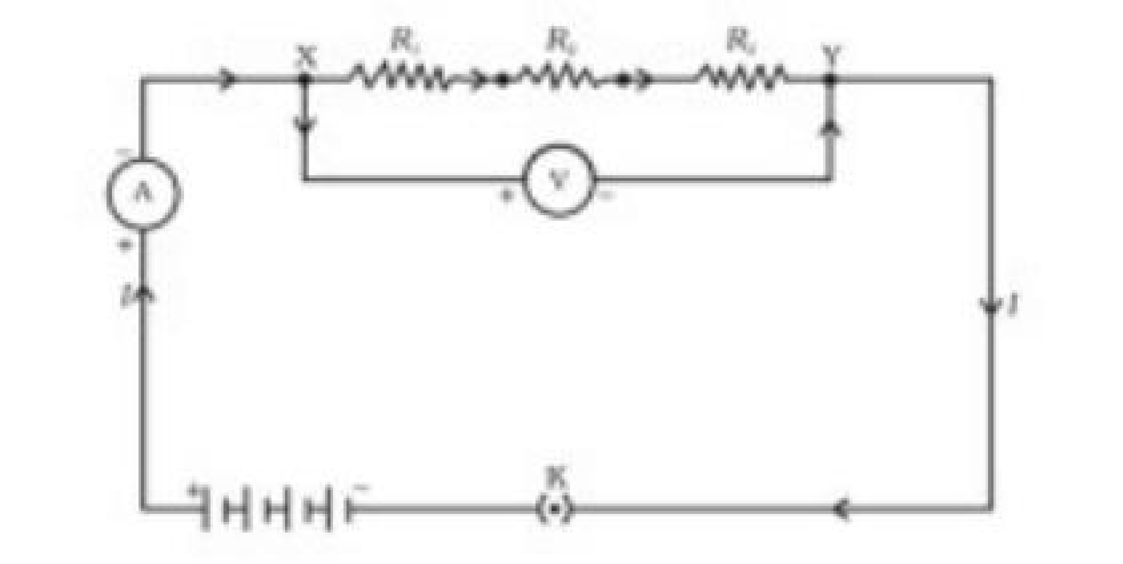
  is $R_s + R_1 + R_2 + R_3 + \ldots$

Chapter 3: Electricity

Combination of Resistances

Resistances in Series

- The equivalent resistance is greater than the greatest resistance in the combination.



Chapter 3: Electricity

Combination of Resistances

Resistances in Parallel

- The potential difference across each resistance is the same and is equal to the potential difference across the combination.
- The main current divides itself, and a different current flows through each resistance.
- The equivalent resistance (Rp) of a parallel combination containing resistances R1, R2, R3... is given by $$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} \ldots$$

Chapter 3: Electricity

Advantages of Parallel Combination over Series Combination

- In series circuit, when one component fails, the circuit is broken and none of the component works.
- Different appliances have different requirement of current. This cannot be satisfied in series as current remains same.
- The total resistance in a parallel circuit is decreased.

Chapter 3: Electricity

Heating Effect of Electric Current

- The effect of electric current due to which heat is produced in a conductor, when current passes through it, is called the heating effect of electric current.
- The total work (W) done by the current in an electric circuit is called electric energy and is given as

$$W = VIt = I^2Rt$$

$$W = \frac{V^2t}{R}$$

- This energy is exhibited as heat. Thus, we have H = VIt = I2Rt.

Chapter 3: Electricity

Heating Effect of Electric Current

- This is called Joule’s Law of Heating, which states that the heat produced in a resistor is directly proportional to the:

o Square of the current in the resistor, H ∝ I2

o Resistance of the resistor H ∝ R

o Time for which current flows through the conductor, H ∝ t. So, H = I2Rt

Chapter 3: Electricity

Heating Effect of Electric Current

- Heating effect is desirable in devices like electric heater, electric iron, electric bulb, electric fuse, etc.
- Heating effect is undesirable in devices like computers, computer monitors (CRT), TV, refrigerators etc.
- In electric bulb, most of the power consumed by the filament appears a heat and a small part of it is radiated in form of light.

Chapter 3: Electricity

Heating Effect of Electric Current

Filament of electric bulb is made up of tungsten because:

- it does not oxidise readily at high temperature.
- it has high melting point (3380º C).

The bulbs are filled with chemically inactive gases like nitrogen and argon to prolong the life of filament.

Chapter 3: Electricity

Heating Effect of Electric Current

Practical Applications of the Heating Effects of Electric Current

Electrical appliances like laundry iron, toaster, oven, kettle and heater are some devices based on Joule's Law of Heating.

The concept of electric heating is also used to produce light, as in an electric bulb.

Another application of Joule's Law of Heating is the fuse used in electric circuits.

Chapter 3: Electricity

Electric Fuse

It is a safety device that protects our electrical appliances in case of short circuit or overloading.

Fuse is made up of pure tin or alloy of copper and tin.

Fuse is always connected in series with live wire.

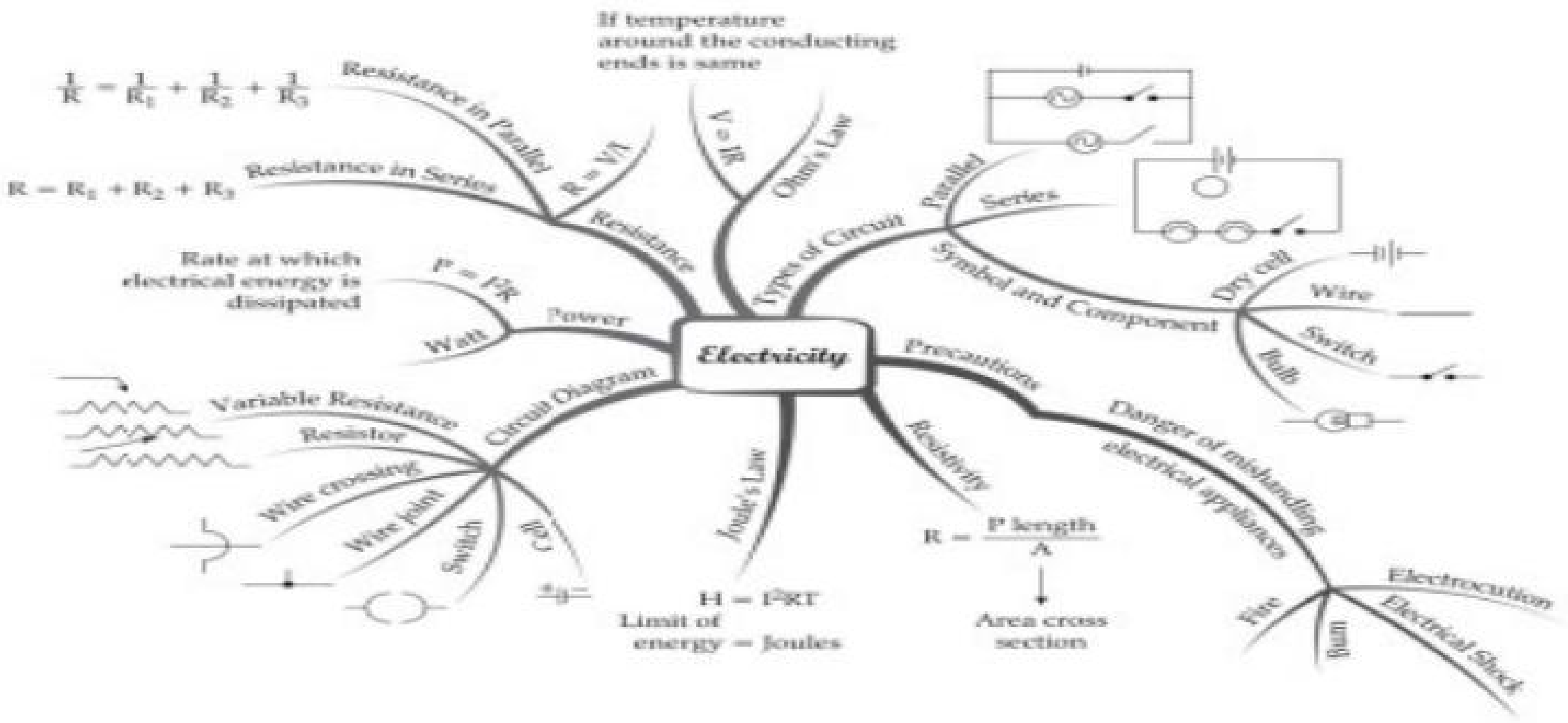
Fuse has low melting point.

Current capacity of fuse is slightly higher than that of the appliance.s

Chapter 3: Electricity

MIND MAP : LEARNING MADE SIMPLE

Chapter-12



Practice Assignments, Exam Prep Assignments for The CBSE Business Studies

1. You may now proceed to try out the exam preparation assignments.

2. **ALL** assignments will be marked and feedback will be given.

3. Should you need to speak to one of our tutors send your email to administration@intemass.com

4. Please proceed to the link www.eastpoint.intemass.com at the bottom of this video to commence with your practice.

MEGA FORTE

INTEGRATED EXAMINATION & ASSIGNMENT SYSTEM

GLOBAL LMS

Please click **subscribe** to our video if you find the content useful.

ALL THE BEST WITH YOUR ASSIGNMENTS