

UNIQUE STUDY POINT

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| Class: X | Subject: Science | Session: 2025-26 |
| Chapter: 11 - Electricity | Time: 1½ Hours | Max. Marks: 40 |

General Instructions:

1. All questions are compulsory.
2. This question paper contains 20 questions divided into five sections A, B, C, D and E.
3. Section A contains 10 MCQs of 1 mark each.
4. Section B contains 4 questions of 2 marks each.
5. Section C contains 3 questions of 3 marks each.
6. Section D contains 1 question of 5 marks.
7. Section E contains 2 Case Study Based questions of 4 marks each.

SECTION A - Multiple Choice Questions (1 mark each)

Q1. The SI unit of potential difference is:

- (a) Ampere
- (b) Coulomb
- (c) Volt
- (d) Ohm

Q2. The conventional direction of electric current is from:

- (a) Negative to positive terminal
- (b) Positive to negative terminal
- (c) Lower potential to higher potential
- (d) None of these

Q3. A voltmeter is always connected:

- (a) In series with the circuit
- (b) In parallel with the circuit
- (c) Either in series or parallel
- (d) None of these

Q4. 1 kilowatt hour is equal to:

- (a) 3.6×10^5 J
- (b) 3.6×10^6 J
- (c) 3.6×10^7 J
- (d) 3.6×10^8 J

Q5. When resistors are connected in parallel, the equivalent resistance is:

- (a) Greater than the largest resistance
- (b) Equal to the sum of all resistances
- (c) Less than the smallest resistance
- (d) Equal to the average resistance

Q6. The resistance of a wire is $10\ \Omega$. If its length is doubled, the new resistance will be:

- (a) $5\ \Omega$
- (b) $10\ \Omega$
- (c) $20\ \Omega$
- (d) $40\ \Omega$

Q7. Which of the following has the highest resistivity?

- (a) Copper
- (b) Silver
- (c) Nichrome
- (d) Aluminum

Q8. The power of an electric appliance is $100\ \text{W}$. How much energy does it consume in 1 hour?

- (a) $0.1\ \text{kWh}$
- (b) $1\ \text{kWh}$
- (c) $10\ \text{kWh}$
- (d) $100\ \text{kWh}$

Q9. The charge on one electron is:

- (a) $1.6 \times 10^{-19}\ \text{C}$
- (b) $1.6 \times 10^{-18}\ \text{C}$
- (c) $1.6 \times 10^{-17}\ \text{C}$
- (d) $1.6 \times 10^{-20}\ \text{C}$

Q10. A fuse wire is made of:

- (a) High melting point and high resistivity
- (b) Low melting point and low resistivity
- (c) Low melting point and high resistivity
- (d) High melting point and low resistivity

SECTION B - Short Answer Questions (2 marks each)

Q11. Define potential difference. What is the SI unit of potential difference?

Q12. Draw symbols for: (a) Electric cell (b) Battery (c) Ammeter (d) Voltmeter

Q13. Why are alloys commonly used in electrical heating devices like electric iron and toaster?

Q14. Calculate the number of electrons constituting 1 coulomb of charge. (Given: charge on one electron = $1.6 \times 10^{-19}\ \text{C}$)

SECTION C - Short Answer Questions (3 marks each)

Q15. Three resistors of $2\ \Omega$, $3\ \Omega$ and $6\ \Omega$ are connected in parallel. Calculate the equivalent resistance of the combination.

Q16. A wire of length $2\ \text{m}$ and area of cross-section $1.5 \times 10^{-6}\ \text{m}^2$ has a resistance of $4\ \Omega$. Calculate the resistivity of the material.

Q17. Explain why series arrangement is not used for domestic circuits. Give three reasons.

SECTION D - Long Answer Question (5 marks)

Q18. (a) Derive the expression for equivalent resistance when three resistors are connected in parallel.

(b) Three resistors of $10\ \Omega$, $15\ \Omega$ and $30\ \Omega$ are connected in parallel to a $12\ \text{V}$ battery. Calculate:

- (i) The equivalent resistance
- (ii) The total current in the circuit
- (iii) The current through each resistor

SECTION E - Case Study Based Questions (4 marks each)

Q19. Case Study 1:

In a physics laboratory, students were given different wires made of the same material but with different lengths and areas of cross-section. They measured the resistance of each wire and recorded the following data:

| Wire | Length (m) | Area (mm ²) | Resistance (Ω) |
|------|------------|-------------------------|----------------|
| A | 1 | 1 | 10 |
| B | 2 | 1 | 20 |
| C | 1 | 2 | 5 |

Based on this data, answer the following:

- (a) How does the resistance vary with length of the wire? (1 mark)
- (b) How does the resistance vary with area of cross-section? (1 mark)
- (c) Write the relationship between resistance, length and area of cross-section. (2 marks)

Q20. Case Study 2:

An electric circuit consists of a 6 V battery connected to three resistors of 1 Ω, 2 Ω and 3 Ω in series. An ammeter is connected in the circuit to measure the current.

Based on this information, answer the following:

- (a) Draw the circuit diagram. (1 mark)
- (b) Calculate the total resistance of the circuit. (1 mark)
- (c) Calculate the current flowing through the circuit. (1 mark)
- (d) Is the current same through all the resistors? Justify your answer. (1 mark)

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SECTION A - Answers to MCQs

Ans 1. (c) Volt

Ans 2. (b) Positive to negative terminal

Ans 3. (b) In parallel with the circuit

Ans 4. (b) 3.6×10^6 J

Ans 5. (c) Less than the smallest resistance

Ans 6. (c) 20Ω

Ans 7. (c) Nichrome

Ans 8. (a) 0.1 kWh

Ans 9. (a) 1.6×10^{-19} C

Ans 10. (c) Low melting point and high resistivity

SECTION B - Answers to Short Answer Questions

Ans 11.

Potential difference between two points in an electric circuit is the work done to move a unit charge from one point to the other.

Formula: $V = W/Q$

where V = potential difference, W = work done, Q = charge

The SI unit of potential difference is Volt (V).

1 Volt = 1 Joule/1 Coulomb

Ans 12.

The symbols would be drawn as per the standard conventions:

- (a) Electric cell: A long line (positive) and short line (negative)
- (b) Battery: Multiple cells connected in series
- (c) Ammeter: Circle with letter 'A' inside
- (d) Voltmeter: Circle with letter 'V' inside

Ans 13.

Alloys are commonly used in electrical heating devices because:

1. They have higher resistivity than pure metals, which produces more heat
2. They do not oxidize (burn) readily at high temperatures, ensuring longer life and durability

Ans 14.

Charge on one electron = 1.6×10^{-19} C

Total charge = 1 coulomb

Number of electrons = Total charge / Charge on one electron
 = $1 / (1.6 \times 10^{-19})$

$$= 6.25 \times 10^{18} \text{ electrons}$$

Therefore, approximately 6.25×10^{18} electrons constitute 1 coulomb of charge.

SECTION C - Answers to Short Answer Questions

Ans 15.

Given: $R_1 = 2 \Omega$, $R_2 = 3 \Omega$, $R_3 = 6 \Omega$ (connected in parallel)

For parallel combination:

$$1/R_p = 1/R_1 + 1/R_2 + 1/R_3$$

$$1/R_p = 1/2 + 1/3 + 1/6$$

$$1/R_p = 3/6 + 2/6 + 1/6$$

$$1/R_p = 6/6 = 1$$

Therefore, $R_p = 1 \Omega$

The equivalent resistance is 1Ω .

Ans 16.

Given: $l = 2 \text{ m}$, $A = 1.5 \times 10^{-6} \text{ m}^2$, $R = 4 \Omega$

Using the formula: $R = \rho(l/A)$

$$4 = \rho \times (2/1.5 \times 10^{-6})$$

$$\rho = 4 \times 1.5 \times 10^{-6} / 2$$

$$\rho = 3 \times 10^{-6} \Omega \text{ m}$$

The resistivity of the material is $3 \times 10^{-6} \Omega \text{ m}$.

Ans 17.

Series arrangement is not used for domestic circuits because:

1. **Same current:** All appliances would get the same current, but different appliances need different currents to operate properly
2. **Voltage division:** The voltage gets divided among all appliances, so each appliance gets less than the required voltage
3. **Complete circuit break:** If one appliance fails or is switched off, the entire circuit breaks and all other appliances stop working

SECTION D - Answer to Long Answer Question

Ans 18.

(a) **Derivation for parallel combination:**

When three resistors R_1 , R_2 and R_3 are connected in parallel:

- The potential difference across each resistor is the same ($= V$)

- The total current $I = I_1 + I_2 + I_3$

By Ohm's law:

$$I_1 = V/R_1, I_2 = V/R_2, I_3 = V/R_3$$

If R_p is the equivalent resistance:

$$I = V/R_p$$

Therefore: $V/R_p = V/R_1 + V/R_2 + V/R_3$

$$V/R_p = V(1/R_1 + 1/R_2 + 1/R_3)$$

$$\mathbf{1/R_p = 1/R_1 + 1/R_2 + 1/R_3}$$

(b) Given: $R_1 = 10 \Omega$, $R_2 = 15 \Omega$, $R_3 = 30 \Omega$, $V = 12 \text{ V}$

(i) Equivalent resistance:

$$1/R_p = 1/10 + 1/15 + 1/30$$

$$1/R_p = 3/30 + 2/30 + 1/30 = 6/30$$

$$R_p = 30/6 = 5 \Omega$$

(ii) Total current:

$$I = V/R_p = 12/5 = 2.4 \text{ A}$$

(iii) Current through each resistor:

$$I_1 = V/R_1 = 12/10 = 1.2 \text{ A}$$

$$I_2 = V/R_2 = 12/15 = 0.8 \text{ A}$$

$$I_3 = V/R_3 = 12/30 = 0.4 \text{ A}$$

SECTION E - Answers to Case Study Based Questions

Ans 19.

(a) From wires A and B: When length is doubled (1 m to 2 m), resistance also doubles (10 Ω to 20 Ω).

Therefore, **resistance is directly proportional to length** ($R \propto l$).

(b) From wires A and C: When area is doubled (1 mm^2 to 2 mm^2), resistance becomes half (10 Ω to 5 Ω).

Therefore, **resistance is inversely proportional to area of cross-section** ($R \propto 1/A$).

(c) Combining both relationships:

$$R \propto l \text{ and } R \propto 1/A$$

Therefore, $R \propto l/A$

$$\text{Or } R = \rho(l/A)$$

where ρ is the resistivity of the material (constant for a given material at a given temperature).

Ans 20.

(a) Circuit diagram would show: A 6 V battery connected to three resistors (1 Ω , 2 Ω , 3 Ω) in series with an ammeter, all forming a closed loop.

(b) Total resistance in series:

$$R = R_1 + R_2 + R_3$$

$$R = 1 + 2 + 3 = 6 \Omega$$

(c) Current flowing through the circuit:

$$I = V/R = 6/6 = 1 \text{ A}$$

(d) Yes, the current is the same through all resistors in a series circuit.

Justification: In a series circuit, there is only one path for current to flow. Therefore, the same current flows through each component in the circuit.