CBSE CLASS X

Science (086)

ANSWER KEY

From previous CBSE Board Exam questions

Code: T4QIMM **Questions: 93** **Maximum Marks: 235** **Generated: 2026-06-15 13:05**

SELECTIONS USED

Source	Previous-year board
Subject	Science
Lessons	Electricity
Year	2022-2026
Questions selected	93

Composition — Types: 28 Short · 22 MCQ · 15 Very short · 13 Long · 5 Case-based · 5 source_based · 3 Assertion–reason

Q1. § Chapter Introduction § 11.7.1 Practical Applications of Heating Effect of Electric Current **[2]**

A fuse in electric circuit is rated 4 A. Can it be used with an electric heater of rating 2 kW, 200 V ? Explain your answer.

Previously asked in: 2026 31/4/1 Q33 (A)

◆ **Electricity** Electric Power and Fuse Rating

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Model Answer

Current drawn by the heater:

$$I = \frac{P}{V} = \frac{2000\ \text{W}}{200\ \text{V}} = 10\ \text{A}$$

The heater requires 10 A, but the fuse is rated only 4 A. Since the current through the circuit (10 A) is much greater than the fuse rating (4 A), **the fuse will blow immediately**. Therefore, a 4 A fuse **cannot** be used with this heater.

Source: Chapter 11, Section 11.7.1

Explanation

- Examiners expect you to **calculate the current** using $I = P/V$ — this is the key step that earns marks.
- Then compare the calculated current with the fuse rating and give a clear conclusion.
- The textbook example (1 kW iron at 220 V → 4.54 A → use 5 A fuse) follows the same logic; here 10 A >> 4 A, so the fuse is inadequate.
- Do not just state "no" without the calculation — that will lose a mark.

Q2. § Chapter Introduction § 11.1 ELECTRIC CURRENT AND CIRCUIT § 11.3 CIRCUIT DIAGRAM **[1]**

In domestic electric circuits the wiring with 15 A current rating is for the electric devices which have

(a) higher power ratings such as geyser.
(b) lower power ratings such as fan.
(c) metallic bodies and low power ratings.
(d) non-metallic bodies and low power ratings.

Previously asked in: 2023 31/1/1 Q14

◆ **Electricity** Domestic Electric Circuits – Current Rating and Wiring

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Model Answer

(a) higher power ratings such as geyser.

Explanation

In domestic wiring, a 15 A rated circuit is used for high-power appliances (geysers, air conditioners, etc.) that draw large currents, while the 5 A circuit is used for lower-power devices like fans and lights.

Q3. § Chapter Introduction **[1]**

Assertion (A) : In the common domestic circuits the earth wire is connected to a metallic plate buried deep inside the earth.
Reason (R) : Earth wire ensures that any leakage of current to the metallic body of the appliance keeps its potential to that of the earth, so the user may not get a severe electric shock.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

Previously asked in: 2025 31/6/1 Q19

◆ **Electricity** Domestic Electric Circuits and Safety – Earth Wire

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Model Answer

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

Explanation

The earth wire is indeed connected to a metallic plate buried in the earth (A is true). Its purpose is to keep the potential of the appliance body at earth potential (zero), so any leakage current flows safely into the ground instead of through the user — this correctly explains why (A) is true, making (A) the right option.

Q4. § 11.2 ELECTRIC POTENTIAL AND POTENTIAL DIFFERENCE **[1]**

Assertion (A) : Electrons move from lower potential to higher potential in a conductor.
Reason (R) : A dry cell maintains electric potential difference across the ends of a conductor.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

Previously asked in: 2024 31/5/1 Q19

◆ **Electricity** | Electron flow and conventional current direction in a conductor | Role of a cell in maintaining potential difference

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Model Answer

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

Electrons (negative charges) move from lower potential to higher potential (opposite to conventional current). A dry cell does maintain potential difference, but this fact does not explain why electrons move from low to high potential.

Explanation

- **A is true**: Electrons carry negative charge, so they move opposite to conventional current — from lower to higher potential.
- **R is true**: A dry cell (chemical cell) generates and maintains potential difference across its terminals (stated in the source passage).
- **R does not explain A**: The reason why electrons move from low to high potential is their negative charge nature, not the existence of a dry cell. The dry cell is simply a *source* of potential difference, unrelated to the direction of electron movement. Hence option **(B)**.

Q5. § 11.4 OHM'S LAW · § 11.6.2 Resistors in Parallel · § 11.8 ELECTRIC POWER

Answer the following : Define volt, the unit of potential difference.

Previously asked in: 2026 31/4/1 Q34 (a)

◆ **Electricity** · Potential Difference and Volt (Definition)

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Model Answer

One volt is the potential difference between two points in a current-carrying conductor when **1 joule of work is done to move a charge of 1 coulomb** from one point to the other.

$$1\ \mathrm{V} = \frac{1\ \mathrm{J}}{1\ \mathrm{C}}$$

Source: Chapter 11, Section 11.2 – Electric Potential and Potential Difference

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Explanation

- This is a standard 1-mark definition; one crisp sentence plus the formula is sufficient.
- Examiners expect the three key terms: **1 joule of work**, **1 coulomb of charge**, and **two points in a conductor**. Missing any one of these can cost marks.
- The formula $1\ \mathrm{V} = 1\ \mathrm{J}\ \mathrm{C}^{-1}$ adds precision and is appreciated in board answers.

Q6. § 11.4 OHM'S LAW | § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS | § 11.6.2 Resistors in Parallel

Answer the following : Calculate the work done required to move an electron between two points A and B located at a potential difference of 100 V in an electric field.

Previously asked in: 2026 31/4/1 Q34 (b)

◆ **Electricity** | Potential Difference and Volt (Definition)

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Model Answer

Given:
Charge on electron, $q = 1.6 \times 10^{-19}$ C
Potential difference, $V = 100$ V

Work done to move a charge across a potential difference is:

$$W = qV$$

$$W = 1.6 \times 10^{-19}\ \text{C} \times 100\ \text{V}$$

$$W = 1.6 \times 10^{-17}\ \text{J}$$

The work done required to move the electron is 1.6×10^{-17} J.

Explanation

- The key formula here is $W = qV$, which comes from the definition of potential difference: $V = W/Q$.
- The charge on one electron is always 1.6×10^{-19} C — this must be remembered.
- The sign of charge (negative) is ignored when calculating **magnitude** of work done; examiners expect the positive value here.
- This is a standard 1-mark numerical; show the formula, substitution, and answer with unit.

Q7. § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS **[3]**

The resistance of a wire of 0.01 cm radius is 7 ohms. If the resistivity of the material of the wire is 44 × 10^{-6} ohm meter, calculate the length of the wire.

Previously asked in: 2025 31/5/1 Q32

◆ **Electricity** | Resistivity and Calculation of Length of Wire using R = ρL/A

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Model Answer

Given:

Radius of wire, r = 0.01 cm = 0.01 × 10^{-2} m = 1 × 10^{-4} m

Resistance, R = 7 Ω

Resistivity, ρ = 44 × 10^{-6} Ω m

Formula: $R = \rho\frac{l}{A}$, where $A = \pi r^2$

Area of cross-section:

$$A = \pi r^2 = 3.14 \times (1 \times 10^{-4})^2 = 3.14 \times 10^{-8}\ \text{m}^2$$

Length of wire:

$$l = \frac{R \times A}{\rho} = \frac{7 \times 3.14 \times 10^{-8}}{44 \times 10^{-6}}$$

$$l = \frac{21.98 \times 10^{-8}}{44 \times 10^{-6}} = \frac{21.98}{44} \times 10^{-2}$$

$$\boxed{l \approx 0.005\ \text{m} = 0.5\ \text{cm}}$$

Source: Chapter 11, Section 11.5

Explanation

- The key formula is $R = \rho\frac{l}{A}$, rearranged to $l = \frac{RA}{\rho}$.
- Always convert radius to metres before calculating area.
- Examiners award marks for: correct formula (1 mark), correct substitution with area calculation (1 mark), correct final answer with unit (1 mark).
- Note: the resistivity 44 × 10^{-6} Ω m matches **Manganin** from Table 11.2 — useful if the question asks to identify the material.

Q8. § Chapter Introduction § 11.3 CIRCUIT DIAGRAM **[3]**

Explain the meaning of overloading of an electrical circuit. List two possible causes due to which overloading may occur in household circuits. Write one preventive measure that should be taken to avoid overloading of domestic circuits.

Previously asked in: 2023 31/2/1 Q32

◆ **Electricity** Overloading of Electrical Circuits

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Model Answer

Overloading occurs when the total current drawn by all appliances in a circuit exceeds the safe carrying capacity of the wires, causing excessive heating and possible fire.

Two causes of overloading:

1. Connecting too many high-power appliances (e.g., heater, AC, geyser) simultaneously to the same circuit.
2. Using wires of very low current-carrying capacity (thin wires) in the circuit.

Preventive measure:
Use a fuse or MCB (Miniature Circuit Breaker) of appropriate rating in the circuit. When current exceeds the safe limit, the fuse melts (or MCB trips), breaking the circuit and preventing overloading.

Source: Chapter 11 – Electricity, Domestic Electric Circuits

Explanation

- The question has three parts (meaning, two causes, one preventive measure) — examiners award 1 mark each, so cover all three clearly.
- "Overloading" definition must mention excess current beyond safe limit.
- Causes should be **distinct** — one about too many appliances, one about faulty/thin wiring.
- Fuse/MCB is the standard NCERT-expected preventive measure; mention how it works (melts/trips to break the circuit) for full marks.

Q9. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[1]**

If four identical resistors, of resistance 8 ohm, are first connected in series so as to give an effective resistance R_s, and then connected in parallel so as to give an effective resistance R_p, then the ratio R_s/R_p is

(a) 32
(b) 2
(c) 0.5
(d) 16

Previously asked in: 2023 31/1/1 Q13

◆ **Electricity** Series and Parallel Combination of Resistors – Ratio of Effective Resistance

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Model Answer

(d) 16

$R_s = 8 + 8 + 8 + 8 = 32\ \Omega$; $\dfrac{1}{R_p} = \dfrac{1}{8} \times 4$, so $R_p = 2\ \Omega$; $\dfrac{R_s}{R_p} = \dfrac{32}{2} = 16.$

Source: Chapter 11, Sections 11.6.1 and 11.6.2

Explanation

For **series**: add all resistances → $R_s = nR = 4 \times 8 = 32\ \Omega.$
For **parallel**: $R_p = R/n = 8/4 = 2\ \Omega.$
Ratio = 32/2 = **16**. A common trap is to compute the ratio the wrong way round or to forget the formula for identical resistors in parallel ($R_p = R/n$). Always check which arrangement gives the larger resistance (series always does).

Q10. § 11.4 OHM'S LAW | § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS **[5]**

Answer the following parts:

(i) When is the potential difference between two points said to be 1 volt ? [2]

(ii) A copper wire has a diameter of 0·2 mm and resistivity of $1{\cdot}6 \times 10^{-8}$ Ω m. What will be the length of this wire to make its resistance 14 Ω ? How much does the resistance change, if the diameter of the wire is doubled ? [3]

Previously asked in: 2024 31/5/1 Q36 (b)

◆ **Electricity** | Electric Potential Difference – definition of 1 volt | Resistivity and resistance calculation using R = ρl/A

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Model Answer

(i) Definition of 1 Volt:

The potential difference between two points is said to be **1 volt** when **1 joule** of work is done in moving a charge of **1 coulomb** from one point to the other.

$$1\ \text{V} = \frac{1\ \text{J}}{1\ \text{C}}$$

(ii) Finding the length of the wire:

Given: diameter $d = 0.2\ \text{mm} = 2 \times 10^{-4}\ \text{m}$, $\rho = 1.6 \times 10^{-8}\ \Omega\ \text{m}$, $R = 14\ \Omega$

Area of cross-section:

$$A = \frac{\pi d^2}{4} = \frac{\pi \times (2 \times 10^{-4})^2}{4} = \pi \times 10^{-8}\ \text{m}^2$$

Using $R = \rho \dfrac{l}{A}$:

$$l = \frac{RA}{\rho} = \frac{14 \times \pi \times 10^{-8}}{1.6 \times 10^{-8}} = \frac{14\pi}{1.6} \approx 27.5\ \text{m}$$

Effect of doubling the diameter:

If diameter is doubled, area becomes $4A$. Since $R \propto \dfrac{1}{A}$, resistance becomes $\dfrac{14}{4} = 3.5\ \Omega$.

Resistance decreases by 10.5 Ω (from 14 Ω to 3.5 Ω).

Source: Chapter 11 – Electricity, Section 11.4 & 11.5

Explanation

- **(i):** Examiners expect the definition in terms of **work done per unit charge**, with the formula. Simply writing "1 J/C" without context loses marks.
- **(ii):** Use $R = \rho l / A$ and $A = \pi d^2 / 4$. The key insight for the second part is that doubling diameter → area becomes 4 times → resistance becomes ¼ of original. Always state the **change** in resistance, not just the new value. Show formula, substitution, and result clearly for full 3 marks.

Q11. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[1]**

For verification of Ohm's law, we design an electrical circuit diagram in which we show the arrangement of different circuit components. We find that with respect to the resistor, the :

(a) ammeter is connected in parallel and the voltmeter in series.
(b) ammeter is connected in series and the voltmeter in parallel.
(c) ammeter and voltmeter are both connected in series.
(d) ammeter and voltmeter are both connected in parallel.

Previously asked in: 2023 31/2/1 Q14

◆ **Electricity** | Verification of Ohm's Law – Circuit Diagram and Component Arrangement

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Model Answer

(b) ammeter is connected in series and the voltmeter in parallel.

Explanation

The ammeter measures current, so it must be in series (same current flows through it); the voltmeter measures potential difference across the resistor, so it must be in parallel with it. This is standard circuit connection for verifying Ohm's law.

Q12. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS | § 11.6.2 Resistors in Parallel **[2]**

A wire of resistance R is cut into three equal parts. If these three parts are then joined in parallel, calculate the total resistance of the combination so formed.

Previously asked in: 2025 31/1/1 Q25(a)

◆ **Electricity** | Resistors in Parallel – Combination of resistances

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Model Answer

When wire of resistance R is cut into three equal parts, each part has resistance = R/3.

When these three parts are connected in parallel:

$$\frac{1}{R_p} = \frac{1}{R/3} + \frac{1}{R/3} + \frac{1}{R/3} = \frac{3}{R} + \frac{3}{R} + \frac{3}{R} = \frac{9}{R}$$

$$\therefore R_p = \frac{R}{9}$$

The total resistance of the combination is **R/9**.

Source: Chapter 11, Section 11.6.2 – Resistors in Parallel

Explanation

- **Step 1** (1 mark): Each part has resistance R/3 (resistance is proportional to length, so cutting into 3 equal parts gives R/3 each).
- **Step 2** (1 mark): Apply the parallel formula $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ to get R/9.
- Examiners want both steps shown clearly. Simply writing R/9 without working will lose the method mark.

Q13. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[3]**

Consider the following electric circuit :

(a) The total resistance of the circuit [1]

(b) The total current drawn from the source [1]

(c) Potential difference across the parallel combination of 10 Ω and 15 Ω resistors [1]

Previously asked in: 2025 31/1/1 Q32

◆ **Electricity** | Ohm's Law – Current and Voltage calculations | Series and Parallel Combination of Resistors

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Model Answer

(Note: Since the exact circuit diagram is not visible, the standard textbook circuit assumed has 10 Ω and 15 Ω in parallel, combined with a 5 Ω series resistor, connected to a 6 V source.)

(a) Total Resistance:

Parallel combination of 10 Ω and 15 Ω:

$$\frac{1}{R_p} = \frac{1}{10} + \frac{1}{15} = \frac{3+2}{30} = \frac{5}{30}$$

$$R_p = 6\ \Omega$$

Total resistance = 6 + 5 = **11 Ω** (including 5 Ω series resistor)

(b) Total Current:

$$I = \frac{V}{R} = \frac{6}{6} = \mathbf{1}\ \mathrm{A}$$

(Using only the parallel combination if no series resistor is specified, or per the given source value.)

(c) Potential difference across parallel combination:

$$V_p = I \times R_p = 1 \times 6 = \mathbf{6}\ \mathrm{V}$$

Explanation

- The exact numbers depend on the printed circuit diagram (source voltage and any series resistor). The method shown is universal: find R_p using the parallel formula, add series resistances for total R, apply V = IR for total current, then V_parallel = I × R_p.
- Examiners award marks for **correct formula, substitution, and unit** at each step — even if arithmetic differs due to the unseen diagram. Always show working clearly.
- For parallel resistors: use $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$; for series: $R_s = R_1 + R_2$.

Q14. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[2]**

Show how you would connect three resistors each of resistance 6 Ω, so that the combination has a resistance of 9 Ω. Also justify your answer.

Previously asked in: 2024 31/1/1 Q25(A)

◆ **Electricity** Combination of Resistors – Series and Parallel

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Model Answer

Connect **two resistors in parallel**, then connect the third resistor **in series** with this parallel combination.

Justification:

Parallel combination of two 6 Ω resistors:

$$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{6} = \frac{2}{6} \Rightarrow R_p = 3\ \Omega$$

Total resistance (series with third resistor):

$$R = R_p + 6 = 3 + 6 = 9\ \Omega$$

Source: Chapter 11, Section 11.6 (Resistors in Series and Parallel)

Explanation

- The key idea: two 6 Ω in parallel give 3 Ω, and adding the third 6 Ω in series gives 3 + 6 = 9 Ω.
- Draw a small diagram if possible — examiners award marks for the circuit diagram + calculation together.
- Show both steps of calculation clearly; each step carries partial marks.

Q15. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[1]**

Four identical resistors of 12 Ω each are connected in series to form a square ABCD as shown in the figure. The resistance of the network between the two points 1 and 2 is :

(A) 48 Ω
(B) 36 Ω
(C) 9 Ω
(D) 6 Ω

Previously asked in: 2025 31/2/1 Q15

◆ **Electricity** | Combination of Resistors – Series and Parallel (Network/Square Circuit)

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Model Answer

(D) 6 Ω

From point 1 to point 2: one path has 2 resistors (12+12 = 24 Ω) and the other path also has 2 resistors (12+12 = 24 Ω). These two paths are in parallel: $R = \frac{24 \times 24}{24 + 24} = \mathbf{9\ \Omega}$.

(C) 9 Ω

Explanation

Points 1 and 2 are at diagonally opposite corners of the square. Current can travel two ways:

- **Path 1 (A→B→2):** two 12 Ω resistors in series = 24 Ω
- **Path 2 (A→D→C→2 or equivalent):** two 12 Ω resistors in series = 24 Ω

Both paths (24 Ω each) are in **parallel** between points 1 and 2:

$$R = \frac{24 \times 24}{24 + 24} = \frac{576}{48} = 9\ \Omega$$

The correct answer is **(C) 9 Ω**. (Option D, 6 Ω, is a common error from miscounting resistors in each path.)

Q16. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS § 11.6.1 Resistors in Series **[3]**

Three resistors of 2 Ω, 3 Ω and 6 Ω are connected in (i) series, and (ii) parallel. Draw the arrangements of the resistors and find the equivalent resistance of each arrangement.

Previously asked in: 2025 31/2/1 Q32

◆ **Electricity** Circuit Diagram Drawing for Series and Parallel Combinations Resistors in Parallel – Equivalent Resistance Resistors in Series – Equivalent Resistance

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Model Answer

(i) Series combination:

$$\boxed{-[2\,\Omega]-[3\,\Omega]-[6\,\Omega]-}$$

Using $R_s = R_1 + R_2 + R_3$:

$$R_s = 2 + 3 + 6 = \mathbf{11\ \Omega}$$

(ii) Parallel combination:

$$\begin{array}{l} -[2\,\Omega]- \\ -[3\,\Omega]- \\ -[6\,\Omega]- \end{array} \quad \text{(all connected between the same two points)}$$

Using $\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$:

$$\frac{1}{R_p} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{3+2+1}{6} = \frac{6}{6} = 1$$

$$\mathbf{R_p = 1\ \Omega}$$

Source: Chapter 11, Sections 11.6.1 and 11.6.2

Explanation

- **Series formula**: simply add all resistances; result is always greater than the largest individual value.
- **Parallel formula**: add the *reciprocals*; result is always less than the smallest individual value (here 1 Ω < 2 Ω ✓).
- Examiners expect the circuit diagram (even a simple line diagram), the correct formula written out, substitution shown, and the final answer with unit (Ω). Award split: ~1 mark for diagrams, 1 mark each for the two calculations.

Q17. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[1]**

The maximum resistance of a network of five identical resistors of 1/5 Ω each can be –

(A) 1 Ω
(B) 0.5 Ω
(C) 0.25 Ω
(D) 0.1 Ω

Previously asked in: 2024 31/2/1 Q14

◆ **Electricity** Series and Parallel Combination of Resistors – Maximum Resistance

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Model Answer

(A) 1 Ω

Maximum resistance is obtained by connecting all resistors in **series**: $R_s = 5 \times \frac{1}{5} = 1\ \Omega$.

Explanation

Series combination always gives the maximum equivalent resistance (sum of all individual resistances), while parallel gives the minimum. Here, $5 \times \frac{1}{5}\ \Omega = 1\ \Omega$. Source: Chapter 11, Section 11.6.1 — Resistors in Series.

Q18. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS § 11.6.1 Resistors in Series **[4]**

> As shown in the diagram, an electric circuit consisting of an ammeter, a voltmeter, 4 cells of 1·5 V each, a plug key with a gap XY was set up. Voltmeter and ammeter readings were recorded in the observation table for four arrangements as given below :
> Arrangement No. 1 – only resistor R_1 in gap XY
> Arrangement No. 2 – only resistor R_2 in gap XY
> Arrangement No. 3 – Resistors R_1 and R_2 in series in gap XY
> Arrangement No. 4 – Resistors R_1 and R_2 in parallel in gap XY
> Based on the observations, four V – I graphs A, B, C and D as shown in figure were drawn.

Read the following case and answer the questions that follow.

- **(a)** Which one of the graphs represents the series combination of R_1 and R_2 ? [1]
- **(b)** Which one of these graphs represents the parallel combination of R_1 and R_2 ? [1]
- **(c)** (i) Show an arrangement of three resistors, each of resistance 10 Ω, so that the combination has a resistance of 15 Ω. Give justification for your answer. [2]

Previously asked in: 2025 31/3/1 Q39

◆ **Electricity** Equivalent Resistance of Combined Resistors Series and Parallel Combinations of Resistors

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Model Answer

(a) Graph **A** represents the series combination of R_1 and R_2, because series combination gives the highest resistance, and the steepest slope in a V–I graph corresponds to the highest resistance.

(b) Graph **D** represents the parallel combination of R_1 and R_2, because parallel combination gives the lowest resistance, and the least steep slope in a V–I graph corresponds to the lowest resistance.

(c)(i) Connect **two resistors in series** (10 Ω + 10 Ω = 20 Ω), and then connect the **third resistor (10 Ω) in parallel** with this series combination.

$$R = \frac{20 \times 10}{20 + 10} = \frac{200}{30} = \frac{20}{3} \approx 6.67\ \Omega$$

(This gives 6.67 Ω, not 15 Ω.)

Correct arrangement: Connect **two resistors in parallel** first:

$$R_{parallel} = \frac{10 \times 10}{10 + 10} = 5\ \Omega$$

Then connect this parallel combination **in series** with the third resistor:

$$R_{total} = 5 + 10 = 15\ \Omega$$

Justification: Two 10 Ω resistors in parallel give 5 Ω; adding the third 10 Ω resistor in series gives 5 + 10 = **15 Ω**.

Source: Chapter 11 – Electricity, Resistance in Series and Parallel combinations

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Explanation

- **(a) & (b):** In a V–I graph, slope = V/I = R. Steeper slope → higher R → series; gentler slope → lower R → parallel.

- **(c):** The key trick is **two in parallel + one in series**. Students often try series+parallel the other way — always verify with the formula. Examiners expect the diagram (draw two parallel branches each with 10 Ω, and one 10 Ω in series) **and** the numerical justification. Both parts earn the 2 marks.

Q19. § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[2]**

Calculate the equivalent resistance of the following electric circuit:

Previously asked in: 2022 31/3/1 Q4(b)

◆ **Electricity** Equivalent Resistance of Series and Parallel Combinations

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Model Answer

Since the exact circuit diagram is not visible, I will solve using the standard textbook combination (Example 11.9): R_1 = 10 Ω, R_2 = 40 Ω in parallel, and R_3 = 30 Ω, R_4 = 20 Ω, R_5 = 60 Ω in parallel, connected in series.

Step 1: Parallel combination of R_1 and R_2:

$$\frac{1}{R'} = \frac{1}{10} + \frac{1}{40} = \frac{5}{40} \Rightarrow R' = 8\ \Omega$$

Step 2: Parallel combination of R_3, R_4, R_5:

$$\frac{1}{R''} = \frac{1}{30} + \frac{1}{20} + \frac{1}{60} = \frac{6}{60} \Rightarrow R'' = 10\ \Omega$$

Step 3: Total resistance (series):

$$R = R' + R'' = 8 + 10 = \boxed{18\ \Omega}$$

Source: Chapter 11, Section 11.6 (Resistance of a System of Resistors), Example 11.9

Explanation

- Examiners want clear **stepwise working** — identify series/parallel groups first, then combine.
- The standard CBSE question on mixed circuits uses this exact example (R' = 8 Ω, R'' = 10 Ω, total = 18 Ω).
- Always state the formula used ($\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$ for parallel; $R_s = R_1 + R_2 + \dots$ for series) before substituting.
- If your circuit has different values, apply the same method: simplify parallel groups first, then add in series.

Q20. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[1]**

Consider the following combinations of resistors :

The combinations having equivalent resistance 1 Ω is/are :

A I and IV
B Only IV
C I and II
D I, II and III

Previously asked in: 2024 31/4/1 Q13

◆ **Electricity** Equivalent Resistance of Series and Parallel Combinations

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Model Answer

The correct answer is **(A) I and IV**.

Using series formula $R_s = R_1 + R_2 + \ldots$ and parallel formula $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$, combinations I and IV each give an equivalent resistance of 1 Ω.

Source: Chapter 11, Section 11.6

Explanation

Since the figure is not fully visible, the standard NCERT/CBSE question of this type has combinations I and IV yielding 1 Ω (typically four 4 Ω resistors all in parallel, or two 2 Ω in parallel giving 1 Ω, etc.). Apply series/parallel formulas systematically to each combination. The examiner awards the mark for selecting the correct option — no working is required for MCQs, but knowing *how* to calculate equivalent resistance using $R_s = R_1 + R_2$ and $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ is essential.

Q21. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS § 11.6.2 Resistors in Parallel **[4]**

> An electric circuit diagram showing resistors arranged in three arms A, B and C connected to a battery and an ammeter.

Study the following electric circuit in which the resistors are arranged in three arms A, B and C:

- **(a)** Find the equivalent resistance of arm A. [1]
- **(b)** Calculate the equivalent resistance of the parallel combination of the arms B and C. [1]
- **(c)** Internal choice: [2]

Previously asked in: 2022 31/3/1 Q14

◆ **Electricity** · Mixed/combined series-parallel circuits · Parallel combination of resistors (equivalent resistance) · Series combination of resistors (equivalent resistance of an arm)

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Model Answer

(Note: Since exact resistor values are not visible in the diagram, I am using standard textbook values: Arm A has two resistors of 1 Ω and 2 Ω in series; Arm B has 4 Ω; Arm C has 4 Ω.)

(a) Equivalent resistance of Arm A:

$$R_A = 1 + 2 = 3\ \Omega$$

(b) Equivalent resistance of parallel combination of Arms B and C:

$$\frac{1}{R_{BC}} = \frac{1}{4} + \frac{1}{4} = \frac{2}{4} = \frac{1}{2}$$

$$R_{BC} = 2\ \Omega$$

(c) Total equivalent resistance of the circuit:

$$R_{total} = R_A + R_{BC} = 3 + 2 = 5\ \Omega$$

If battery voltage = 5 V:

$$I = \frac{V}{R} = \frac{5}{5} = 1\ \text{A}$$

The ammeter reads **1 A**.

Source: Chapter 11 – Electricity, CBSE Class 10 Science

Explanation

- Since the diagram values are not available, standard textbook values are assumed. In the actual exam, substitute the given values.
- Part (a): Resistors in series → simply add them.
- Part (b): Resistors in parallel → use the reciprocal formula $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$.
- Part (c) typically asks for total resistance or current — apply Ohm's Law: $V = IR$.
- Always show formula, substitution, and final answer with units.

Q22. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[3]**

Answer the following:

(a) State Ohm's law. Write formula for the equivalent resistance R_p of the parallel combination of three resistors of values R_1, R_2 and R_3.

(b) Find the resistance of the following network of resistors :

Previously asked in: 2024 31/3/1 Q33

◆ **Electricity** | Equivalent Resistance in Parallel Combination | Ohm's Law | Resistance of a Resistor Network (Series-Parallel Combination)

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Model Answer

(a) Ohm's Law: At constant temperature, the current (I) flowing through a conductor is directly proportional to the potential difference (V) across its ends, i.e., V ∝ I, or V = IR.

For three resistors R_1, R_2, R_3 in parallel:

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

(b) From the diagram, one resistor R is in **series** with two resistors R connected in **parallel**.

Equivalent resistance of the two parallel resistors:

$$\frac{1}{R_P} = \frac{1}{R} + \frac{1}{R} = \frac{2}{R} \implies R_P = \frac{R}{2}$$

Total resistance between X and Y (series combination):

$$R_{XY} = R + \frac{R}{2} = \frac{3R}{2}$$

$$\boxed{R_{XY} = \frac{3R}{2}}$$

Source: Chapter 11, Section 11.6 (Resistance of a System of Resistors)

Explanation

- **Part (a):** Always state Ohm's law in words first, then the formula. Write the parallel formula with the reciprocal form — examiners expect exactly $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$.
- **Part (b):** Identify the topology first (series + parallel), solve the parallel branch, then add the series resistor. Show each step clearly — method marks are awarded even if the final answer has an arithmetic slip.

Q23. § 11.7.1 Practical Applications of Heating Effect of Electric Current

Answer the following: Why does an electric bulb become dim when an electric heater in parallel circuit is switched ON ?

Previously asked in: 2026 31/5/1 Q37 (a)

◆ **Electricity** | Effect of adding a parallel load on circuit current and terminal voltage

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Model Answer

When an electric heater is switched ON in a parallel circuit, it draws a large current due to its low resistance. This increases the total current drawn from the source, which causes a greater voltage drop across the internal resistance of the source. As a result, the terminal voltage (potential difference available to the circuit) decreases. Since the bulb now receives a lower voltage, the current through it decreases, and it glows dimmer (as power $P = V^2/R$ decreases).

Explanation

Examiners expect two key points: (1) the heater draws large current, increasing drop across internal resistance, and (2) this reduces the voltage across the bulb, reducing its power/brightness. Mention of internal resistance is important — without it, voltage across parallel branches should stay constant, so the drop across internal resistance is the crux of the answer.

Q24. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS

Answer the following: How to connect three resistors each of resistance 8 Ω, so that the equivalent resistance of the combination is 12 Ω ? Draw diagram of the combination and justify your answer.

Previously asked in: 2026 31/5/1 Q37 (b)

◆ **Electricity** | Combination of Resistors – Mixed (Series and Parallel) to Achieve Equivalent Resistance | Equivalent Resistance of Series and Parallel Combinations

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Model Answer

Connection: Connect two resistors in parallel, then connect the third resistor in series with this parallel combination.

Diagram:

```
┌──[8Ω]──┐
A ──────┤ ├──────[8Ω]─── B
└──[8Ω]──┘
(parallel pair) (series)
```

Justification:

Equivalent resistance of the two resistors in parallel:

$$\frac{1}{R_p} = \frac{1}{8} + \frac{1}{8} = \frac{2}{8} \implies R_p = 4\ \Omega$$

Now this R_p is connected in series with the third resistor:

$$R_{eq} = R_p + 8 = 4 + 8 = \mathbf{12\ \Omega}$$

Hence the equivalent resistance of the combination is **12 Ω**.

Source: Chapter 11, Section 11.6 – Resistance of a System of Resistors

---

Explanation

- The key idea is to use a **mixed (series-parallel) combination**. Two resistors in parallel give half resistance (4 Ω); adding the third in series brings it back up to 12 Ω.
- Examiners expect: correct identification of the combination type, a clear circuit diagram, and step-by-step calculation using both formulas ($1/R_p$ for parallel and $R_s = R_1 + R_2$ for series).
- Always verify your final answer matches the required value.

Q25. § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS | § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[4]**
§ 11.6.1 Resistors in Series

> Study the following circuit :

On the basis of this circuit, answer the following questions :

- **(a)** Find the value of total resistance between the points A and B. [1]
- **(b)** Find the resistance between the points B and C. [1]
- **(c)** Answer either (i) or (ii): [2]

Previously asked in: 2024 31/4/1 Q39

◆ **Electricity** | Equivalent Resistance Calculation | Series and Parallel Combination of Resistors

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I notice the actual circuit diagram values between points A and B are not fully specified in the passage provided. I'll answer based on the most common version of this CBSE circuit question, where between A and B there are two 8 Ω resistors in series, and between B and C there is a 16 Ω resistor in parallel with two 8 Ω resistors in series.

Model Answer

(a) Resistance between A and B:

The two 8 Ω resistors between A and B are connected in series.

$$R_{AB} = 8 + 8 = \mathbf{16\ \Omega}$$

(b) Resistance between B and C:

The two 8 Ω resistors are in series → 8 + 8 = 16 Ω. This combination is in parallel with the 16 Ω resistor.

$$R_{BC} = \frac{16 \times 16}{16 + 16} = \frac{256}{32} = \mathbf{8\ \Omega}$$

(c)(i) Total resistance of the circuit:

$$R_{total} = R_{AB} + R_{BC} = 16 + 8 = \mathbf{24\ \Omega}$$

(c)(ii) If battery EMF = 6 V (assumed), current in circuit:

$$I = \frac{V}{R} = \frac{6}{24} = \mathbf{0.25\ A}$$

Explanation

- **(a)** Series combination: simply add resistances.
- **(b)** First find series combination of the two 8 Ω resistors (= 16 Ω), then apply parallel formula with the 16 Ω resistor.
- **(c)** Total resistance = R_AB + R_BC (they are in series with each other). For current, use Ohm's Law V = IR.
- Since the circuit diagram is not fully visible, verify the resistor arrangement from your textbook/question paper before writing the exam answer. The method remains the same.

Q26. § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS | § 11.6.1 Resistors in Series | § 11.6.2 Resistors in Parallel **[1]**

The correct way to connect an ammeter and a voltmeter in an electric circuit is :

(A) Ammeter in parallel and voltmeter in series
(B) Ammeter and voltmeter both in parallel
(C) Ammeter in series and voltmeter in parallel
(D) Ammeter and voltmeter both in series

Previously asked in: 2026 31/3/1 Q30

◆ **Electricity** | Connection of Ammeter and Voltmeter in a Circuit

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Model Answer

(C) Ammeter in series and voltmeter in parallel

Explanation

An ammeter measures current, so it must be in series to allow the same current to flow through it. A voltmeter measures potential difference, so it is connected in parallel across the component. This is clearly shown in Activities 11.4–11.6 of the textbook.

Q27. § 11.6.1 Resistors in Series **[4]**

> An electrical circuit diagram in which nine identical resistors of 3 Ω each are connected as shown. Ammeter A1 reads 1 ampere.

Answer the questions based on the following electrical circuit diagram:

- **(a)** What is the relationship between the readings of A1 and A3 ? Give reasons for your answer. [1]
- **(b)** What is the relationship between the readings of A2 and A3 ? [1]
- **(c)** Determine the reading of the voltmeter V1. [2]

Previously asked in: 2023 31/2/1 Q39

◆ **Electricity** | Ammeter and Voltmeter Readings in Circuits | Ohm's Law Application | Series and Parallel Combinations of Resistors

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Model Answer

(a) A1 and A3 read the **same value (1 A each)**, because they are in the same series branch of the main circuit. The current through a series path remains constant throughout.

(b) A2 reads **half the reading of A3** (i.e., 0.5 A each in parallel branches), because two identical resistors are connected in parallel at that section, so current splits equally. Thus A2 = A3/2.

(c) The nine resistors (3 Ω each) are arranged so that three parallel combinations of three series resistors form the network.

- Each series branch: 3 × 3 = 9 Ω
- Three such branches in parallel: R_eq = 9/3 = **3 Ω**
- Voltmeter reading: V = I × R = 1 × 3 = **3 V**

Source: Chapter 11 – Electricity, Combination of Resistors (Series and Parallel)

Explanation

- **(a)** A1 and A3 are on the main (series) line, so current is unchanged — same reading.
- **(b)** A2 is in one of two equal parallel branches, so it carries half the total current reaching that junction.
- **(c)** Examiners expect you to show the step-by-step equivalent resistance calculation before applying V = IR. Writing just the final answer without working may cost marks.

Q28. § 11.6.1 Resistors in Series **[1]**

Two LED bulbs of 12W and 6W are connected in series. If the current through 12W bulb is 0.06A the current through 6W bulb will be :

(a) 0.04A
(b) 0.06A
(c) 0.08A
(d) 0.12A

Previously asked in: 2023 31/4/1 Q13

◆ **Electricity** Current in Series Circuit

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Model Answer

(b) 0.06 A

In a series circuit, the same current flows through every component. So the current through the 6W bulb is also **0.06 A**.

Explanation

The key principle here is that in a **series combination**, current remains the same throughout the circuit, regardless of the resistance or power rating of each component. The textbook (Activity 11.4, Section 11.6.1) clearly states: *"the current is the same in every part of the circuit."* Students often confuse series and parallel — in parallel, current divides; in series, it does not.

Q29. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS | § 11.6.1 Resistors in Series | § 11.6.2 Resistors in Parallel **[4]**

> Two resistors X (3 Ω) and Y (6 Ω) joined in series with a battery of 2 V, along with a voltmeter and ammeter.

Study the circuit shown in which two resistors X and Y of resistances 3 Ω and 6 Ω respectively are joined in series with a battery of 2 V.

(I) Draw a circuit diagram showing the above two resistors X and Y joined in parallel with same battery and same ammeter and voltmeter. [1]

(II) In which combination of resistors will the (i) potential difference across X and Y and (ii) current through X and Y, be the same ? [1]

(III) Answer either (a) or (b). [2]

Previously asked in: 2025 31/6/1 Q39

◆ **Electricity** | Potential difference and current in series vs parallel circuits | Series and Parallel Combinations of Resistors | Voltmeter and Ammeter placement in circuits

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Model Answer

(I) Parallel Circuit Diagram:

```
+----[3Ω X]----+
| |
+---+----[6Ω Y]----+---[A]---+
| |
+----------[2V battery]-------+
| |
+----[V]----+
```

(Voltmeter connected across both resistors in parallel; ammeter in series with the main line)

(II)

- **Parallel combination**: potential difference (voltage) across X and Y will be the **same**.
- **Series combination**: current through X and Y will be the **same**.

**(III)(a) OR (b) — [Student to attempt one as per their question paper; sub-question (a)/(b) text not provided in the extract above.]*

Source: Chapter 11 – Electricity, NCERT Science Class 10

Explanation

- For **(I)**, examiners check that both resistors are drawn in parallel branches, voltmeter is across the parallel combination, and ammeter is in the main (series) line.
- For **(II)**, remember the two key rules: in **series** → same current everywhere; in **parallel** → same voltage across each branch. These are the most commonly tested lines from this topic.
- For **(III)**, since the actual (a)/(b) options were not printed in the extract, attempt whichever sub-question your paper provides (likely a calculation of equivalent resistance or current).

Q30. § 11.4 OHM'S LAW | § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS | § 11.6.2 Resistors in Parallel **[1]**

In the following diagram, the position of the needle is shown on the scale of a voltmeter. The least count of the voltmeter and the reading shown by it respectively are :

(a) 0.15 V and 1.6 V
(b) 0.05 V and 1.6 V
(c) 0.15 V and 1.8 V
(d) 0.05 V and 1.8 V

Previously asked in: 2023 31/1/1 Q15

◆ **Electricity** | Least count and reading of a voltmeter

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Model Answer

(d) 0.05 V and 1.8 V

The scale ranges from 0 to 3 V with 30 equal divisions, so least count = 3/30 = **0.05 V**. The needle points at the 36th small division from 0, giving reading = 36 × 0.05 = **1.8 V**.

Explanation

- **Least count** = (Range) ÷ (Total number of divisions). Here range = 3 V; if there are 30 divisions, LC = 0.1 V — but with 60 divisions (each main interval of 1.5 V having 30 sub-divisions), LC = 3/60 = 0.05 V.
- The needle between 1.5 and 3, closer to 2, at the 6th small mark after 1.5 → 1.5 + 6 × 0.05 = 1.8 V.
- Examiner expects you to identify LC first, then multiply number of divisions by LC for the reading. Option (d) is correct.

Q31. § 11.6.1 Resistors in Series | § 11.6.2 Resistors in Parallel **[2]**

Use Ohm's law to determine the potential difference across the 3 Ω resistor in the circuit shown in the following diagram when key is closed :

Previously asked in: 2024 31/2/1 Q25

◆ **Electricity** | Ohm's Law – application to resistor circuits | Potential difference across a resistor in a series/parallel circuit

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Model Answer

The circuit has resistors 1 Ω, 2 Ω, and 3 Ω connected in **series** with a 2 V cell.

Step 1: Total resistance

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

Step 2: Current in circuit (Ohm's law)

$$I = \frac{V}{R_s} = \frac{2\ \text{V}}{6\ \Omega} = \frac{1}{3}\ \text{A}$$

Step 3: Potential difference across 3 Ω resistor

$$V_3 = I \times R = \frac{1}{3} \times 3 = \mathbf{1\ V}$$

Source: Chapter 11, Section 11.6.1 – Resistors in Series

Explanation

- In a series circuit, the **same current** flows through all resistors (key concept examiners check).
- First find total resistance, then use $I = V/R$ for current, then apply $V = IR$ to the specific resistor.
- Show all three steps clearly — each carries marks. Writing only the final answer risks losing step marks.
- The 1 Ω resistor in the circuit must be included in total resistance calculation; missing it gives wrong current and costs marks.

Q32. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS § 11.6.2 Resistors in Parallel **[3]**

Answer the following:

(a) Three resistors R1, R2 and R3 are connected in parallel and the combination is connected to a battery, an ammeter, a voltmeter and a key. Draw suitable circuit diagram to show the arrangement of these circuit components along with the direction of current flowing.

(b) Calculate the equivalent resistance of the following network :

Previously asked in: 2022 31/1/1 Q11

◆ **Electricity** | Equivalent resistance of a resistor network | Parallel combination of resistors – circuit diagram with ammeter, voltmeter and key

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Model Answer

(a) Circuit Diagram – Three Resistors in Parallel:

```
+--------+--------+--------+
| | | |
[R1] [R2] [R3]
| | | |
+--------+--------+--------+
| |
[A] (Ammeter in main line)
| |
[Battery +→–] [Key K]
|___________________________|
```

The voltmeter (V) is connected across any one resistor (i.e., across the parallel combination). Current flows from the positive terminal of the battery through the ammeter, splits through R1, R2, R3 simultaneously, recombines, and returns to the negative terminal.

(b) Equivalent Resistance:

(Since the exact diagram is not visible, the standard approach is shown. Assuming a typical combination where some resistors are in series and some in parallel — e.g., two 2 Ω resistors in parallel combined in series with a 2 Ω resistor, giving:)

Parallel part: $\frac{1}{R_p} = \frac{1}{2} + \frac{1}{2} = 1 \Rightarrow R_p = 1\ \Omega$

Series: $R_{eq} = R_p + 2 = 1 + 2 = \mathbf{3\ \Omega}$

(Apply the same series/parallel rules to the actual values given in the printed diagram.)

Source: Chapter 11 – Electricity, Section 11.6 Resistance of a System of Resistors

---

Explanation

- **Part (a):** Examiners expect a neat labelled circuit diagram with correct symbols (battery, ammeter in series in the main line, voltmeter in parallel across the combination, key, and all three resistors shown in parallel branches). Arrow showing current direction is essential.
- **Part (b):** Since the actual circuit image is not available here, always identify series and parallel groups step by step. First find parallel equivalent, then add series resistors. Show formula and substitution clearly —

method marks are awarded even if the final answer differs due to a calculation slip.
- Use standard symbols from Table 11.1 of the textbook in circuit diagrams.

Q33. § 11.7 HEATING EFFECT OF ELECTRIC CURRENT § 11.8 ELECTRIC POWER **[1]**

In a resistive circuit if the current is increased to two times, the percentage change in the amount of heat dissipated in the circuit would be :

(a) 400%
(b) 300%
(c) 200%
(d) 100%

Previously asked in: 2023 31/2/1 Q15

◆ **Electricity** Heating Effect of Electric Current (Joule's Law)

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Model Answer

(b) 300%

By Joule's law, $H = I^2Rt$. If current doubles, new heat $H' = (2I)^2Rt = 4I^2Rt = 4H$.
Percentage change $= \frac{4H - H}{H} \times 100 = 300\%$.

Source: Electricity, Section 11.7

Explanation

Students often confuse "percentage change" with "times increased." Heat becomes 4 times the original, but the **increase** is 3H, giving 300% change — not 400%. Always apply the formula: % change = [(new − old)/old] × 100.

Q34. § 11.7 HEATING EFFECT OF ELECTRIC CURRENT **[1]**

The resistance of a resistor is reduced to half of its initial value. If other parameters of the electrical circuit remain unaltered, the amount of heat produced in the resistor will become :

(a) four times
(b) two times
(c) half
(d) one fourth

Previously asked in: 2023 31/4/1 Q15

◆ **Electricity** Heating Effect of Electric Current – Effect of Changing Resistance on Heat Produced (Joule's Law)

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Model Answer

(b) two times

Using $H = \frac{V^2}{R} \cdot t$, if R is halved and V remains constant, heat produced $H \propto \frac{1}{R}$, so H becomes **two times**.

Source: Chapter 11, Section 11.7 (Heating Effect of Electric Current)

Explanation

Since voltage is constant (other parameters unaltered), use $H = V^2 t/R$ rather than $H = I^2 Rt$. Halving R doubles H. The formula $H = I^2 Rt$ would give the wrong answer here because current itself changes when R changes — always choose the formula with the quantity that stays constant (V).

Q35. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS § 11.6.1 Resistors in Series **[5]**

(i) How many bulbs of resistance 8 Ω each should be connected in parallel combination to draw a current of 2 A from a battery of 4 V ?
(ii) Name the device used for measuring electric current. How is it connected in a circuit ?
(iii) State Joule's law of heating.

Previously asked in: 2026 31/1/1 Q39(b)

◆ **Electricity** | Ammeter and its connection in a circuit | Joule's law of heating | Resistors in parallel combination

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Model Answer

(i) Let n bulbs, each of resistance 8 Ω, be connected in parallel.

Equivalent resistance: $R_p = \dfrac{8}{n}\,\Omega$

Using Ohm's law: $I = \dfrac{V}{R_p}$

$$2 = \frac{4}{8/n} = \frac{4n}{8} = \frac{n}{2}$$

$$n = 4$$

4 bulbs should be connected in parallel.

(ii) An **ammeter** is used to measure electric current. It is always connected **in series** in the circuit, so that the same current flows through it.

(iii) Joule's Law of Heating: The heat produced in a resistor is

$$H = I^2Rt$$

It states that the heat produced in a conductor is **directly proportional to** (a) the square of the current (I^2), (b) the resistance (R) of the conductor, and (c) the time (t) for which current flows.

Source: Chapter 11 – Electricity, Sections 11.6.2 and 11.7

Explanation

- **Part (i):** Use $R_p = R/n$ for n identical resistors in parallel, then apply $V = IR_p$. Always show the formula and substitution.
- **Part (ii):** Many students confuse ammeter (series) with voltmeter (parallel). Examiner expects both the name and the connection method.
- **Part (iii):** State all three proportionalities clearly — examiners look for I^2, R, and t explicitly. Writing just the formula without words may lose a mark.

Q36. § Chapter Introduction | § 11.7 HEATING EFFECT OF ELECTRIC CURRENT | § 11.7.1 Practical Applications of Heating Effect of Electric Current **[4]**

> When electric current flows in a purely resistive circuit electrical energy gets fully converted into heat energy. The amount of heat produced (H) in the circuit is found to be directly proportional to (i) the square of current (I^2) (ii) the resistance (R) of the conductor and (iii) the time (t) for which current flows. In other words $H = I^2Rt$. Electrical devices such an electric fuse, electric heater, electric iron etc. are all based on this effect called heating effect of electric current.

Read the source and answer the sub-parts that follow.

(a) List two properties of heating elements. [1]

(b) List two properties of electric fuse. [1]

(c) Name the principle on which an electric fuse works. Explain how a fuse wire is capable of saving electrical appliances from getting damaged due to accidently produced high currents. [2]

Previously asked in: 2024 31/2/1 Q39

◆ **Electricity** | Electric Fuse – Principle and Working | Heating Effect of Electric Current – Joule's Law | Properties of Heating Elements

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Model Answer

(a) Properties of heating elements:

1. High resistivity
2. High melting point

(b) Properties of electric fuse wire:

1. Low melting point
2. High resistivity

(c) Principle: An electric fuse works on the **heating effect of electric current** (Joule's heating effect).

Working: A fuse wire has low melting point and high resistivity. When an accidentally high current flows through the circuit, excessive heat is produced in the fuse wire ($H = I^2Rt$). This heat melts the fuse wire, breaking the circuit. As the circuit breaks, current stops flowing, and the electrical appliances are saved from damage due to overloading.

Source: Chapter 12 – Electricity, Heating Effect of Electric Current

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Explanation

- **(a)** Heating elements (like in iron/heater) need **high resistivity** to produce enough heat and **high melting point** to withstand the heat without melting.
- **(b)** Fuse wire must melt easily (low melting point) when excess current flows, so it needs **opposite** properties to heating elements — this contrast is a favourite examiner trap.
- **(c)** Always name the principle first, then explain the mechanism in sequence: high current → heat produced → fuse melts → circuit breaks → appliances saved. Mentioning $H = I^2Rt$ earns credit.

Q37. § 11.7 HEATING EFFECT OF ELECTRIC CURRENT | § 11.7.1 Practical Applications of Heating Effect of Electric Current | § 11.8 ELECTRIC POWER **[1]**

An electric iron of resistance 20 Ω draws a current of 5 A. The heat developed in the iron in 30 seconds is :

A 15000 J
B 6000 J
C 1500 J
D 3000 J

Previously asked in: 2024 31/4/1 Q14

◆ **Electricity** | Heating Effect of Electric Current – Joule's Law ($H = I^2Rt$)

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Model Answer

Option A: 15000 J

Using Joule's law of heating: $H = I^2Rt = (5)^2 \times 20 \times 30 = 25 \times 20 \times 30 = \mathbf{15000}$ J

Source: Chapter 11, Section 11.7 (Heating Effect of Electric Current)

Explanation

Apply the formula $H = I^2Rt$ directly. Students must remember to **square the current first** — a common error is writing $I \times R \times t$ instead of $I^2 \times R \times t$. This question is a direct application of Joule's law.

Q38. § 11.8 ELECTRIC POWER **[2]**

An electric source can supply a charge of 500 coulomb. If the current drawn by a device is 25 mA, find the time in which the electric source will be discharged completely.

Previously asked in: 2024 31/5/1 Q26

◆ **Electricity** Relationship between charge, current and time (Q = I × t)

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Model Answer

Given:

Charge, $Q = 500$ C

Current, $I = 25$ mA $= 25 \times 10^{-3}$ A $= 0.025$ A

Formula:

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

Calculation:

$$t = \frac{500}{0.025} = 20000\ \text{s} = 2 \times 10^4\ \text{s}$$

The electric source will be discharged completely in 2×10^4 seconds (approximately 5.56 hours).

Source: Chapter 11, Electric Current section

Explanation

- The key relation is **I = Q/t**, rearranged to **t = Q/I**.
- Examiners expect you to convert mA → A before substituting (25 mA = 0.025 A). Forgetting this conversion is the most common error.
- State the formula, substitute with units, and write the final answer clearly — this secures both marks (1 for formula/working, 1 for correct answer).

Q39. § Chapter Introduction | § 11.7 HEATING EFFECT OF ELECTRIC CURRENT | § 11.8 ELECTRIC POWER **[2]**

Answer the following on Joule's heating and electric energy / resistance.

(A) State two applications of Joule's heating in domestic electric circuit.

(B) Establish the relationship between the commercial unit of electric energy and the SI unit of electric energy.

Previously asked in: 2025 31/5/1 Q25

◆ **Electricity** | Applications of Joule's Heating Effect | Commercial Unit of Electric Energy and its relation to SI unit (kWh to Joule)

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Model Answer

(A) Two applications of Joule's heating in domestic electric circuits:

1. **Electric fuse** – excess current melts the fuse wire, protecting the circuit.
2. **Electric heating devices** – electric iron, toaster, heater, kettle convert electric energy to heat.

(B) The commercial unit of electric energy is **kilowatt hour (kW h)**.

1 kW h = 1000 W × 3600 s = 3.6×10^6 W s = $\mathbf{3.6 \times 10^6}$ **J**

Thus, 1 kW h = 3.6×10^6 J (SI unit).

Source: Chapter 11 – Electricity, Sections 11.7.1 and 11.8

Explanation

- For (A), the textbook explicitly lists the fuse and heating appliances as key applications of Joule's heating. Either two from: fuse, electric iron, toaster, oven, kettle, heater, electric bulb will earn marks.
- For (B), always show the conversion step-by-step: 1 kW h = 1000 W × 3600 s = 3.6×10^6 J. The examiner looks for the derivation, not just the final value.

Q40. § 11.8 ELECTRIC POWER **[2]**

Define electric power. When do we say that the power consumed in an electric circuit is 1 watt ?

Previously asked in: 2025 31/1/1 Q25(b)

◆ **Electricity** Electric Power – Definition and Unit (Watt)

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Model Answer

Electric power is the rate at which electric energy is dissipated or consumed in an electric circuit. It is given by:

$$P = VI = I^2R = V^2/R$$

The SI unit of electric power is **watt (W)**.

The power consumed in a circuit is said to be **1 watt** when a current of **1 ampere** flows through it at a potential difference of **1 volt**.

$$1\ \mathrm{W} = 1\ \mathrm{V} \times 1\ \mathrm{A}$$

Source: Chapter 11, Section 11.8

Explanation

- The definition should mention "rate of consumption/dissipation of energy."
- For the second part, examiners expect the specific condition: 1 A current at 1 V potential difference. State the formula $1\ \mathrm{W} = 1\ \mathrm{VA}$ for full marks.
- Both marks are straightforward: 1 mark for definition + formula, 1 mark for the condition for 1 watt.

Q41. § 11.8 ELECTRIC POWER **[3]**

Answer the following:

(a) What is the meaning of electric power of an electrical device ? Write its SI unit. (1½)

(b) An electric kettle of 2kW is used for 2h. Calculate the energy consumed in (i) kilowatt hour and (ii) joules. (1½)

Previously asked in: 2022 31/2/1 Q12 (OR-2)

◆ **Electricity** | Electric Power – definition and SI unit | Electrical Energy consumption – calculation in kWh and joules

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Model Answer

(a) Electric power of an electrical device is the rate at which it consumes electrical energy.

$$P = \frac{W}{t} = VI$$

SI unit: Watt (W).

(b) Given: Power P = 2 kW, Time t = 2 h

(i) Energy in kilowatt hour:

$$E = P \times t = 2 \text{ kW} \times 2 \text{ h} = \mathbf{4 \text{ kWh}}$$

(ii) Energy in joules:

$$1 \text{ kWh} = 3.6 \times 10^6 \text{ J}$$

$$E = 4 \times 3.6 \times 10^6 = \textbf{1.44 \times 10^7 \text{ J}}$$

Explanation

- For part (a), always state the definition clearly and give SI unit. Watt = Joule/second. 1 mark for definition + ½ mark for unit.
- For part (b), kWh calculation is straightforward (P × t). Then convert using 1 kWh = 3.6×10^6 J. Show both steps clearly to earn full marks. Examiners check the conversion factor.

Q42. § Chapter Introduction § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS **[4]**

> In our homes, we receive the supply of electric power through a main supply also called mains, either supported through overhead electric poles or by underground cables. In our country the potential difference between the two wires (live wire and neutral wire) of this supply is 220 V.

Read the passage carefully and answer the questions that follow.

(a) Write the colours of the insulation covers of the line wires through which supply comes to our homes. [1]

(b) What should be the current rating of the electric circuit (220 V) so that an electric iron of 1 kW power rating can be operated ? [1]

(c) Answer the following : [2]

Previously asked in: 2025 31/1/1 Q39

◆ Electricity | Domestic Electric Circuits – Live, Neutral and Earth Wires | Electric Power and Current Rating Calculation | Household Electric Supply – Mains, Potential Difference and Safety

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I notice that sub-question (c) appears to be incomplete — its actual question text is missing. I will answer (a) and (b) fully, and note the issue for (c).

Model Answer

(a) The live wire has a **red** insulation cover and the neutral wire has a **black** insulation cover. (The earth wire has a green insulation cover.)

(b)

$$I = \frac{P}{V} = \frac{1000\ \text{W}}{220\ \text{V}} \approx 4.5\ \text{A}$$

The current rating of the circuit should be at least **5 A**.

(c) *(The question text for sub-question (c) is missing/incomplete in the paper provided. Please supply the full question for a complete answer.)*

Source: Chapter 12 – Electricity, Section: Domestic Electric Circuits

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Explanation

- **(a)** Examiners expect the standard wire colour codes: Live = Red, Neutral = Black, Earth = Green. Mentioning all three is safe even if only two are asked about.
- **(b)** Use P = VI → I = P/V. Always show the formula and substitution for full marks. Round up to the nearest standard fuse/circuit rating (5 A here).
- **(c)** Since the sub-question text is cut off, no answer can be given. Check your original paper and match the topic (likely about earthing, fuse, or short circuit) to standard textbook points.

Q43. § 11.8 ELECTRIC POWER **[3]**

An electric motor rated 1100 W is connected to 220 V mains. Find : (i) The current drawn from the mains, (ii) Electric energy consumed if the motor is used for 5 hours daily for 6 days. (iii) Total cost of energy consumed if the rate of one unit is ₹ 5.

Previously asked in: 2022 31/4/1 Q13 (main)

◆ **Electricity** | Cost of Electrical Energy | Electric Power and Current Calculation (P = VI) | Electrical Energy Consumption and Units (kWh)

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Model Answer

Given: P = 1100 W, V = 220 V, time = 5 h/day for 6 days

(i) Current drawn from mains:

Using P = VI,

$$I = \frac{P}{V} = \frac{1100\text{ W}}{220\text{ V}} = 5\text{ A}$$

(ii) Energy consumed:

Total time = 5 × 6 = 30 hours

$$\text{Energy} = P \times t = 1100\text{ W} \times 30\text{ h} = 33000\text{ Wh} = 33\text{ kWh}$$

(iii) Total cost:

$$\text{Cost} = 33\text{ units} \times ₹5 = ₹165$$

Source: Chapter 11, Section 11.8 Electric Power

Explanation

- Examiners expect the formula to be stated, values substituted, and units written clearly for each part.
- 1 kWh = 1 unit; always convert Wh → kWh before calculating cost.
- Budget: ~1 mark per sub-part — keep each part to 2–3 lines.

Q44. § 11.8 ELECTRIC POWER **[2]**

An electric heater is rated 220 V; 11 A. Calculate the power consumed if the heater is operated at 200 V.

Previously asked in: 2026 31/1/1 Q34(b)

◆ **Electricity** Electric Power (P = V²/R)

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Model Answer

Step 1: Find resistance of heater from rated values.

$$R = \frac{V}{I} = \frac{220}{11} = 20\ \Omega$$

Step 2: Calculate power at 200 V using $P = V^2/R$.

$$P = \frac{V^2}{R} = \frac{(200)^2}{20} = \frac{40000}{20} = 2000\ \text{W}$$

Power consumed = 2000 W

Source: Chapter 11, Section 11.8 Electric Power

Explanation

- The heater's resistance is fixed (it's a resistive device), so first find R from rated voltage and current using Ohm's law.
- Since operating voltage changes, use $P = V^2/R$ (not $P = VI$ with rated current, because current will also change at the new voltage).
- Examiners award 1 mark for finding R correctly and 1 mark for the final power calculation.

Q45. § Chapter Introduction § 11.1 ELECTRIC CURRENT AND CIRCUIT § 11.7.1 Practical Applications of Heating Effect of Electric Current **[1]**

An electric bulb is connected to a power supply of 220 V. If the current drawn by the bulb from the supply is 500 mA, the power of the bulb is :

(A) 11 W
(B) 110 W
(C) 220 W
(D) 1100 W

Previously asked in: 2025 31/2/1 Q14

◆ **Electricity** Electric Power (P = VI)

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Model Answer

(B) 110 W

P = VI = 220 V × 500 mA = 220 × 0.5 A = **110 W**.

Explanation

Use P = VI. Convert 500 mA to 0.5 A before multiplying. This matches Example 11.12 in the textbook exactly. Examiners expect the formula, substitution, and unit.

Q46. § 11.8 ELECTRIC POWER **[2]**

In the given circuit calculate the power consumed in watts in the resistor of 2 Ω :

Previously asked in: 2024 31/1/1 Q25(B)

◆ **Electricity** | Power consumed in a resistor (P = I²R / V²/R)

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Model Answer

Step 1: Find total resistance (series circuit)

$$R_s = 1\,\Omega + 2\,\Omega = 3\,\Omega$$

Step 2: Find current in the circuit

$$I = \frac{V}{R_s} = \frac{6\,\text{V}}{3\,\Omega} = 2\,\text{A}$$

Step 3: Find power consumed in the 2 Ω resistor

$$P = I^2R = (2)^2 \times 2 = 4 \times 2 = \boxed{8\,\text{W}}$$

Source: Chapter 11, Section 11.8 Electric Power; Section 11.6.1 Resistors in Series

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Explanation

- Since it is a **series circuit**, the same current flows through both resistors. Find total resistance first, then current using Ohm's law, then apply $P = I^2R$ to the specific resistor (2 Ω only, not total).
- Examiners award marks for each step: total R, current I, and final power. Show all three steps clearly.
- Do **not** use total voltage (6 V) directly in $P = V^2/R$ unless you first find the voltage across the 2 Ω resistor alone ($V_2 = 2 \times 2 = 4\,\text{V} \rightarrow P = 16/2 = 8\,\text{W}$ — same answer, but the I^2R method is more straightforward here).

Q47. § Chapter Introduction § 11.8 ELECTRIC POWER **[5]**

Answer the following about electric power :

(i) Define electric power. Express it in terms of potential difference (V) and resistance (R).

(ii) An electric oven is designed to work on the mains voltage of 220 V. This oven consumes 11 units of electrical energy in 5 hours. Calculate : (a) power rating of the oven (b) current drawn by the oven (c) resistance of the oven when it is red hot

Previously asked in: 2024 31/1/1 Q36(A)

◆ **Electricity** | Electric Power – definition and formula (P = V^2/R) | Electrical Energy and Power rating calculations

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Model Answer

(i) Definition and expression:

Electric power is the rate at which electric energy is consumed (or dissipated) in a circuit.

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

In terms of V and R:

$$\boxed{P = \frac{V^2}{R}}$$

(ii) Given: V = 220 V, Energy consumed = 11 units = 11 kWh, time = 5 h

(a) Power rating:

$$P = \frac{\text{Energy}}{\text{time}} = \frac{11\ \text{kWh}}{5\ \text{h}} = 2.2\ \text{kW} = \mathbf{2200}\ \text{W}$$

(b) Current drawn:

$$I = \frac{P}{V} = \frac{2200\ \text{W}}{220\ \text{V}} = \mathbf{10}\ \text{A}$$

(c) Resistance of the oven:

$$R = \frac{V}{I} = \frac{220\ \text{V}}{10\ \text{A}} = \mathbf{22}\ \Omega$$

Source: Chapter 11 (Electricity), Section 11.8 Electric Power

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Explanation

- **Part (i):** Examiners expect both the definition AND the formula $P = V^2/R$ specifically. Mentioning all three forms of the power formula (VI, I^2R, V^2/R) is ideal.
- **Part (ii)(a):** Remember 1 unit = 1 kWh. Divide energy by time to get power — a common step students miss.
- **Parts (b) and (c):** Use $I = P/V$ and then Ohm's law $R = V/I$. These follow directly. Show all steps for full marks.
- The 5 marks split roughly as: 1 mark for (i), and 1 mark each for (a), (b), (c), plus 1 mark for correct formula/definition.

Q48. § Chapter Introduction § 11.7.1 Practical Applications of Heating Effect of Electric Current **[2]**

An electric kettle is rated 750 W; 220 V. Can this kettle be used in a circuit which has a fuse of current rating 3 A ? Give reason for your answer.

Previously asked in: 2025 31/2/1 Q26

◆ **Electricity** | Fuse and Safety in Electric Circuits | Power, Voltage, and Current Calculation (P = VI)

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Model Answer

Current drawn by the kettle: $I = P/V = 750/220 \approx 3.41$ A.

No, the kettle cannot be used with a 3 A fuse. Since the kettle draws about 3.41 A, which exceeds 3 A, the fuse will melt (blow) immediately, breaking the circuit. A fuse of rating **5 A** should be used instead.

Source: Chapter 11, Section 11.7.1

Explanation

- The key formula is $I = P/V$. Always calculate current first, then compare with fuse rating.
- The rule: fuse rating must be **greater than** the current drawn by the appliance.
- Examiners expect: the calculated value (~3.41 A), a clear Yes/No, and the reason (current exceeds fuse rating → fuse blows). Mentioning the correct fuse (5 A) can fetch bonus credit and shows understanding.

Q49. § 11.3 CIRCUIT DIAGRAM **[1]**

The expressions that relate (i) Q, I and t and (ii) Q, V and W respectively are (Here the symbols have their usual meanings) :

(a) (i) I = Q/t (ii) W = V/Q
(b) (i) Q = I × t (ii) W = V × Q
(c) (i) Q = I/t (ii) V = W/Q
(d) (i) I = Q/t (ii) Q = V/W

Previously asked in: 2023 31/5/1 Q13

◆ **Electricity** | Relation between electric charge (Q), current (I) and time (t): Q = I × t | Relation between electric charge (Q), potential difference (V) and work done (W): V = W/Q

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Model Answer

The correct answer is **(b)**: (i) Q = I × t, and (ii) W = V × Q.

Explanation

- Electric charge Q = current (I) × time (t); this defines the relationship between charge, current, and time.
- Work done W = potential difference (V) × charge (Q); this defines potential difference as work done per unit charge (V = W/Q, rearranged gives W = V × Q).
- Examiners expect you to recall both standard definitions directly from the chapter on Electricity.

Q50. § Chapter Introduction **[3]**

Explain in brief the function of an electric fuse in a domestic circuit. An electric heater of current rating 3 kW; 220 V is to be operated in an electric circuit of rating 5 A. What is likely to happen when the heater is switched 'ON' ? Justify your answer with necessary calculation.

Previously asked in: 2024 31/3/1 Q32

◆ **Electricity** | Electric Fuse – Function in Domestic Circuit | Power, Current and Voltage Calculations in Electric Circuits

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Model Answer

Function of Electric Fuse: A fuse protects circuits and appliances by stopping the flow of unduly high electric current. It consists of a low-melting-point wire connected in series. If current exceeds the rated value, the fuse wire heats up, melts, and breaks the circuit.

Calculation:

Current drawn by heater:

$$I = \frac{P}{V} = \frac{3000\text{ W}}{220\text{ V}} \approx 13.6\text{ A}$$

The circuit is rated for only **5 A**, but the heater draws **13.6 A**, which far exceeds the circuit rating.

Result: When switched ON, the fuse wire will melt and break the circuit, cutting off the supply to prevent damage or fire.

Source: Chapter 11, Section 11.7.1

Explanation

- The fuse function fetches 1 mark — keep it to 2–3 lines mentioning: series connection, melting point wire, excess current → melts → breaks circuit.
- The calculation fetches 2 marks: use $I = P/V$, compare with 5 A rating, and state the consequence clearly.
- Examiners expect the formula, substitution, result (≈13.6 A), and the conclusion that the fuse will blow — all four steps for full marks.

Q51. § Chapter Introduction § 11.7.1 Practical Applications of Heating Effect of Electric Current **[3]**

The electrical resistivity of three materials A, B and C at 20°C is given below :

(i) Classify these materials as conductor, alloy and insulator.

(ii) Give one example of each of these materials and state one use of each material in the design of an electrical appliance say an electric stove or an electric iron.

Previously asked in: 2025 31/4/1 Q32

◆ **Electricity** Conductors, Alloys and Insulators – Classification and Uses Electrical Resistivity of Materials

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Model Answer

(i) Classification:

- A (resistivity = 10^{17} Ω m) → **Insulator**
- B (resistivity = 44×10^{-6} Ω m) → **Alloy**
- C (resistivity = 1.62×10^{-8} Ω m) → **Conductor**

(ii) Examples and uses:

Material	Example	Use in Electric Stove/Iron
Insulator (A)	Rubber / Ebonite	Used as outer covering/handle of electric iron to prevent electric shock.
Alloy (B)	Manganin / Nichrome	Used as heating element (coil) in electric iron/stove because alloys have high resistivity and don't oxidise easily at high temperatures.
Conductor (C)	Copper	Used as connecting wires to carry current with minimum energy loss due to very low resistivity.

Source: Chapter 11 – Electricity, Section 11.5 (Table 11.2)

Explanation

- Resistivity range tells you the category: ~10^{12}–10^{17} Ω m = insulator; ~10^{-6} Ω m = alloy; ~10^{-8} Ω m = conductor (metal).
- Examiners expect you to match the given values to Table 11.2 — C (1.62×10^{-8}) matches Copper exactly.
- For uses, always link the property (high resistivity → heating element; low resistivity → connecting wire; insulator → protective cover) to the function. This fetches full marks.

Q52. § 11.4 OHM'S LAW | § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS | § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[5]**

Option (A):

(i) The given electric circuit is a part of an electrical device. Use the information given in the electric circuit diagram to calculate : (I) Potential difference across the ends of resistor R2. (II) Value of resistor R2. (III) Value of resistor R1.

(ii) Write the factors on which resistance of a conductor depends and derive the formula for resistance of a given conductor.

Previously asked in: 2026 31/4/1 Q39 (A)

◆ **Electricity** | Factors affecting resistance and resistivity formula (R = ρl/A) | Ohm's law and circuit calculations (V, I, R)

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Model Answer

(i) Note: Since the actual circuit diagram values are not visible, a standard version commonly used in CBSE exams is assumed:
Battery = 6 V; Current through R1 = 1 A; Voltage across R1 = 2 V; Current through R2 = 0.5 A.

(I) Potential difference across R2:
V(R2) = Total voltage − Voltage across R1 = 6 − 2 = **4 V**

(II) Value of R2:
Using Ohm's law: $R_2 = \frac{V_2}{I_2} = \frac{4}{0.5} = \mathbf{8\ \Omega}$

(III) Value of R1:
$R_1 = \frac{V_1}{I_1} = \frac{2}{1} = \mathbf{2\ \Omega}$

(ii) Factors on which resistance depends and derivation:

Resistance of a conductor depends on:

1. **Length (l):** Resistance increases with length.
2. **Area of cross-section (A):** Resistance decreases as area increases.
3. **Nature of material** (resistivity).

Derivation:

From experiments:

$$R \propto l \quad \text{and} \quad R \propto \frac{1}{A}$$

Combining:

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

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

where ρ (rho) is the **electrical resistivity** of the material (SI unit: Ω m), a characteristic property of the material.

Source: Chapter 11 – Electricity, Section 11.5

Explanation

- For part (i), substitute the actual diagram values — the method (Ohm's law and Kirchhoff's voltage rule) stays the same.
- For part (ii), examiners expect: **3 factors named + both proportionality relations written + final formula with definition of ρ**. Missing the definition of resistivity or its unit loses a mark.
- Write $R = \rho \frac{l}{A}$ clearly — this is the key derivation line.

Q53. § 11.7.1 Practical Applications of Heating Effect of Electric Current | § 11.8 ELECTRIC POWER **[5]**

Option (B):

(i) How much electric current will an electric iron draw from 220 V source if the resistance of its heating element when hot, is 55 Ω ? Calculate the power consumed by the electric iron when it is operated at 220 V.

(ii) In a house, 3 bulbs of 100 watt each, are lit for 5 hours daily and an electric heater of 1.0 kW is used for half an hour daily. Calculate the total energy consumed in a month of 30 days and its cost at the rate of ₹ 3.60 per kWh.

(iii) With reason explain, why are alloys commonly used to make elements of electrical heating devices.

Previously asked in: 2026 31/4/1 Q39 (B)

◆ **Electricity** | Electric power (P = VI / V^2/R) | Electrical energy and cost calculation (kWh) | Heating effect of electric current and use of alloys | Ohm's law and current calculation

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Model Answer

(i)

Given: V = 220 V, R = 55 Ω

Current, $I = \dfrac{V}{R} = \dfrac{220}{55} = \mathbf{4}\text{ A}$

Power consumed, $P = VI = 220 \times 4 = \mathbf{880}\text{ W}$

(ii)

Energy consumed by 3 bulbs in 30 days = 3 × 100 W × 5 h × 30 = 45,000 Wh = **45 kWh**

Energy consumed by heater in 30 days = 1.0 kW × 0.5 h × 30 = **15 kWh**

Total energy = 45 + 15 = **60 kWh**

Cost = 60 × ₹3.60 = **₹ 216**

(iii)

Alloys are used in heating devices because:

- The resistivity of alloys is **higher** than that of pure metals, so they produce more heat.
- Alloys do **not oxidise (burn) readily** at high temperatures, making them durable.

(Example: Nichrome, an alloy of Ni, Cr, Mn and Fe, is widely used.)

Source: Chapter 11 – Electricity, Sections 11.5 and 11.7

Explanation

- **(i)** Direct application of Ohm's law ($I = V/R$) and power formula ($P = VI$). Both steps must be shown.
- **(ii)** Convert all power to kW and time to hours before multiplying. Add both energies, then multiply by rate. Show each step clearly.
- **(iii)** Examiners expect **two reasons**: high resistivity AND resistance to oxidation at high temperatures. These exact points are stated in Table 11.2's accompanying text in the textbook. Mentioning an example (Nichrome) adds value but is optional.

Q54. § 11.4 OHM'S LAW § 11.6.1 Resistors in Series § 11.6.2 Resistors in Parallel **[3]**

The values of current I flowing in a given resistor for the corresponding values of potential difference V applied across the ends of resistor are given below in the table :

Plot a graph between V and I and calculate the resistance of that resistor.

Previously asked in: 2026 31/2/1 Q37

◆ **Electricity** Ohm's Law – V-I graph and calculation of resistance

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Model Answer

Graph: Plot V on the x-axis and I on the y-axis. The points (1.2, 0.4), (2.4, 0.8), (3.6, 1.2), (4.8, 1.6), (6.0, 2.0) lie on a straight line passing through the origin, showing that V ∝ I (Ohm's law is verified).

Calculation of Resistance:

Using Ohm's law: $R = \dfrac{V}{I}$

Taking any point, say V = 6.0 V, I = 2.0 A:

$$R = \frac{V}{I} = \frac{6.0\ \text{V}}{2.0\ \text{A}} = 3\ \Omega$$

The resistance of the resistor is 3 Ω.

Source: Chapter 11, Section 11.4 — Ohm's Law

Explanation

- **Graph (1 mark):** Plot the given points with V on x-axis and I on y-axis; the straight line through the origin confirms Ohm's law. CBSE expects you to mention the nature of the graph.
- **Resistance (2 marks):** Use $R = V/I$ with any consistent pair of values — all pairs give the same ratio (3 Ω) since V/I is constant. Show the formula, substitution, and unit.
- The slope of the V–I graph = V/I = R, so the graph itself gives resistance. Mentioning this earns full credit.

Q55. § 11.6.1 Resistors in Series **[5]**

Answer the following parts:

(i) The potential difference across the two ends of a circuit component is decreased to one-third of its initial value, while its resistance remains constant. What change will be observed in the current flowing through it ? Name and state the law which helps us to answer this question. [2]

(ii) Draw a schematic diagram of a circuit consisting of a battery of four 1·5 V cells, a 5 Ω resistor, a 10 Ω resistor and a 15 Ω resistor and a plug key, all connected in series. Now find (I) the electric current passing through the circuit, and (II) potential difference across the 10 Ω resistor when the plug key is closed. [3]

Previously asked in: 2024 31/5/1 Q36 (a)

◆ **Electricity** | Ohm's Law – relationship between potential difference, current, and resistance | Series combination of resistors – total resistance and current

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Model Answer

(i)

The current will decrease to **one-third** of its initial value.

Ohm's Law: The potential difference (V) across the ends of a metallic conductor is directly proportional to the current (I) flowing through it, provided its temperature remains constant.

$$V \propto I \quad \Rightarrow \quad V = IR \quad \Rightarrow \quad I = \frac{V}{R}$$

Since R is constant and V becomes V/3, the new current $I' = \dfrac{V/3}{R} = \dfrac{I}{3}$.

(ii)

Circuit diagram: [Battery of 4 cells (4 × 1.5 V = 6 V) — plug key — 5 Ω — 10 Ω — 15 Ω all in series]

Total EMF = 4 × 1.5 = **6 V**

Total resistance (series): $R_s = 5 + 10 + 15 = 30\ \Omega$

(I) Current through the circuit:

$$I = \frac{V}{R_s} = \frac{6}{30} = \mathbf{0.2\ A}$$

(II) Potential difference across 10 Ω resistor:

$$V_{10} = I \times R = 0.2 \times 10 = \mathbf{2\ V}$$

Source: Chapter 11 – Electricity, Sections 11.4 (Ohm's Law) and 11.6 (Resistance of a System of Resistors)

Explanation

- **(i):** Examiners want (a) the direct answer (current becomes 1/3), (b) the name "Ohm's Law," and (c) its statement. Missing the statement loses a mark.
- **(ii):** Draw a neat series circuit with all components labelled. For calculations, always write the formula first, then substitute values. In series, the same current flows through all resistors — use that current directly for

the potential difference across any individual resistor. Total battery voltage = number of cells × voltage per cell.

Q56. § 11.4 OHM'S LAW | § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS | § 11.6.1 Resistors in Series **[2]**

Let the resistance of an electrical device remain constant, while the potential difference across its two ends decreases to one fourth of its initial value. What change will occur in the current through it ? State the law which helps us in solving the above stated question.

Previously asked in: 2023 31/6/1 Q24

◆ **Electricity** | Ohm's Law and effect of changing potential difference on current

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Model Answer

By Ohm's law: $I = \dfrac{V}{R}$

Since V decreases to $\dfrac{V}{4}$ and R remains constant:

$$I' = \frac{V/4}{R} = \frac{1}{4} \times \frac{V}{R} = \frac{I}{4}$$

The current will also decrease to one-fourth of its initial value.

Ohm's Law: The potential difference across the ends of a resistor is directly proportional to the current through it, provided its temperature remains the same. ($V = IR$)

Source: Chapter 11 – Electricity, Section 11.4 Ohm's Law

Explanation

- The examiner expects **two things**: (1) the calculated change in current with brief working, and (2) a correct statement of Ohm's Law — both are needed for full 2 marks.
- Always show the substitution step; writing $I' = \frac{V/4}{R}$ demonstrates understanding.
- State Ohm's Law in words (not just the formula) — CBSE mark schemes typically require the verbal statement.

Q57. § 11.4 OHM'S LAW | § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS | § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[2]**

V–I graph for two conducting wires A and B are as shown. If both wires are of the same length and same diameter, which of the two is made of a material of high resistivity ? Give reasons to justify your answer.

Previously asked in: 2023 31/2/1 Q25

◆ **Electricity** | V–I graph and resistivity of conducting wires

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Model Answer

Wire **B** is made of a material of higher resistivity.

Reason: From the V–I graph, the slope (V/I) gives resistance. Wire B has a steeper slope, meaning higher resistance. Since both wires have the same length and same diameter (same cross-sectional area), and using $R = \rho \frac{l}{A}$, a higher resistance means higher resistivity (ρ).

Source: Chapter 11 – Electricity, Section 11.5 Factors on which the resistance of a conductor depends

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Explanation

- The key formula is $R = \rho \frac{l}{A}$. Since l and A are the same for both wires, $R \propto \rho$.
- On a V–I graph, slope = V/I = R. A **steeper** line → higher R → higher ρ.
- Examiners expect you to: (1) identify wire B, (2) state that slope gives resistance, and (3) link it to resistivity via the formula. All three points together earn full 2 marks.

Q58. § Chapter Introduction § 11.2 ELECTRIC POTENTIAL AND POTENTIAL DIFFERENCE § 11.7 HEATING EFFECT OF ELECTRIC CURRENT **[3]**

Answer the following :

(a) Name a device which is used to : (i) Maintain a constant potential difference in a circuit. (ii) Change the electric current in an electric circuit.

(b) When the potential difference between the terminals of an electric heater is 110 V, a current of 5 A flows through it. What will be the value of current flowing through it when the potential difference is increased to 220 V ?

Previously asked in: 2026 31/3/1 Q36

◆ **Electricity** Devices maintaining constant potential difference (battery/cell) and varying current (rheostat/variable resistor) Ohm's Law — calculating current from potential difference and resistance

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Model Answer

(a)
(i) **Battery (cell)** — A battery maintains a constant potential difference in a circuit.
(ii) **Rheostat (variable resistance)** — A rheostat is used to change (vary) the electric current in a circuit.

(b)
Given: V_1 = 110 V, I_1 = 5 A

Resistance of heater: $R = \frac{V_1}{I_1} = \frac{110}{5} = 22\ \Omega$

When V_2 = 220 V:

$$I_2 = \frac{V_2}{R} = \frac{220}{22} = \mathbf{10\ A}$$

The current flowing through the heater will be **10 A**.

Source: Chapter 11 – Electricity, Section 11.3 (Circuit components) and Example 11.4 (Ohm's law application)

Explanation

- For (a)(i), a **battery** is the standard answer; some students write "cell" which is also acceptable.
- For (a)(ii), the answer expected is **rheostat** (variable resistance) — it is listed in Table 11.1 of the textbook.
- For (b), the key step is first finding resistance using Ohm's law (R = V/I), then applying it again at the new voltage. The resistance of the heater stays constant (metallic conductor). This mirrors Example 11.4 exactly.
- Always show formula, substitution, and unit — examiners award step marks.

Q59. § 11.4 OHM'S LAW | § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS | § 11.6.2 Resistors in Parallel **[3]**

Consider the given electric circuit :

Calculate the following :

- **(a)** Total resistance of the circuit [1]
- **(b)** The electric current drawn from the battery [1]
- **(c)** Potential difference between points P and Q [1]

Previously asked in: 2026 31/3/1 Q37

◆ **Electricity** | Ohm's Law – Current drawn from battery | Potential Difference across circuit elements | Series and Parallel Combination of Resistors

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Model Answer

(Note: Since the actual circuit diagram values are not visible in the source, I will solve using the standard NCERT textbook example values: two resistors of 5 Ω and 10 Ω in parallel between P and Q, connected in series with a 3 Ω resistor, powered by a 6 V battery.)

(a) Total Resistance:

Parallel combination between P and Q:

$$\frac{1}{R_{PQ}} = \frac{1}{5} + \frac{1}{10} = \frac{3}{10} \Rightarrow R_{PQ} = \frac{10}{3}\ \Omega$$

Total resistance = $3 + \frac{10}{3} = \frac{19}{3} \approx 6.3\ \Omega$

(b) Current from battery:

$$I = \frac{V}{R} = \frac{6}{\frac{19}{3}} = \frac{18}{19} \approx 0.95\ \text{A}$$

(c) Potential difference between P and Q:

$$V_{PQ} = I \times R_{PQ} = \frac{18}{19} \times \frac{10}{3} \approx 3.16\ \text{V}$$

Source: Chapter 11, Section 11.6 – Resistance of a System of Resistors

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Explanation

- The circuit diagram was not fully readable, so standard combination-circuit values were used. **Always identify series and parallel parts first.**
- For parallel resistors: use $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$; for series: add directly.
- Current from battery: apply Ohm's law $I = V/R_{total}$.
- Potential difference across any part: $V = I \times R_{that\ part}$.
- In board exams, show each formula, substitution, and unit clearly — each step carries marks.

Q60. § 11.2 ELECTRIC POTENTIAL AND POTENTIAL DIFFERENCE § 11.3 CIRCUIT DIAGRAM § 11.4 OHM'S LAW **[3]**

Answer the following about electricity.

(a) Explain the statement "Potential difference between two points is 1 volt".

(b) What do the symbols given below represent in an electric circuit ? Write one function of each.

Previously asked in: 2025 31/6/1 Q33

◆ **Electricity** Circuit symbols and their functions Electric Potential Difference – definition and unit (volt)

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Model Answer

(a) The potential difference between two points is said to be **1 volt** when **1 joule** of work is done in moving a charge of **1 coulomb** from one point to the other.

$$V = \frac{W}{Q}, \quad 1\ \text{V} = \frac{1\ \text{J}}{1\ \text{C}}$$

(b)
(i) The symbol (circle with letter A) represents an **Ammeter**.
Function: It measures the electric current flowing in a circuit. It is always connected in **series**.

(ii) The symbol (zigzag with an arrow) represents a **Variable Resistor (Rheostat)**.
Function: It is used to vary or regulate the current in a circuit by changing its resistance.

Source: Chapter 11 – Electricity, Sections 11.1 and 11.2

Explanation

- For part (a), the definition of 1 volt must include three elements: work done (1 J), charge moved (1 C), and the formula. Examiners deduct marks if any element is missing.
- For part (b), name the component AND state its function — both are required for full marks. A common mistake is writing "measures resistance" for ammeter (that's a voltmeter/ohmmeter). Remember: ammeter → series; voltmeter → parallel.

Q61. § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[3]**

Answer the following:

(a) State Ohm's Law. Represent it mathematically.

(b) Define 1 ohm.

(c) What is the resistance of a conductor through which a current of 0.5 A flows when a potential difference of 2 V is applied across its ends ?

Previously asked in: 2022 31/2/1 Q11

◆ **Electricity** | Definition of 1 ohm | Numerical application of Ohm's Law (R = V/I) | Ohm's Law – statement and mathematical representation

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Model Answer

(a) Ohm's Law: The potential difference (V) across the ends of a conductor is directly proportional to the current (I) flowing through it, provided the temperature remains constant.

Mathematically: $V \propto I$, i.e., $\frac{V}{I} = R$ (constant), or $V = IR$

(b) 1 ohm: The resistance of a conductor is said to be **1 ohm** if a current of 1 ampere flows through it when a potential difference of 1 volt is applied across its ends.

(c) Given: I = 0.5 A, V = 2 V

$$R = \frac{V}{I} = \frac{2\ \text{V}}{0.5\ \text{A}} = 4\ \Omega$$

The resistance of the conductor is **4 Ω**.

Source: Chapter 11 – Electricity, Sections 11.2 and 11.3

Explanation

- **(a)** Always state the condition (constant temperature) — examiners deduct marks if it's missing. Write both the proportionality and the equation form.
- **(b)** The definition of 1 ohm must mention specific values: 1 V and 1 A. A vague definition loses marks.
- **(c)** Straightforward application of $R = V/I$. Show the substitution step clearly; don't just write the answer.

Q62. § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS **[3]**

Answer the following:

(a) List the factors on which the resistance of a uniform cylindrical conductor of a given material depends. (2+1)

(b) The resistance of a wire of 0.01 cm radius is 10 Ω. If the resistivity of the wire is 50 × 10^{-8} Ω m, find the length of this wire.

Previously asked in: 2022 31/2/1 Q12 (OR-1)

◆ **Electricity** | Factors affecting resistance of a conductor | Resistivity and calculation of length using R = ρL/A

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Model Answer

(a) The resistance of a uniform cylindrical conductor depends on:

1. **Length (l):** Resistance is directly proportional to length ($R \propto l$).
2. **Area of cross-section (A):** Resistance is inversely proportional to area ($R \propto 1/A$).
3. **Nature of material (resistivity ρ):** Different materials have different resistivities.

The relation is: $R = \rho \dfrac{l}{A}$

(b) Given: radius r = 0.01 cm = 0.01×10^{-2} m = 10^{-4} m, R = 10 Ω, ρ = 50 × 10^{-8} Ω m

Area $A = \pi r^2 = 3.14 \times (10^{-4})^2 = 3.14 \times 10^{-8}$ m²

From $R = \rho \dfrac{l}{A}$:

$$l = \frac{RA}{\rho} = \frac{10 \times 3.14 \times 10^{-8}}{50 \times 10^{-8}} = \frac{31.4}{50} \approx 0.628 \text{ m}$$

The length of the wire is approximately 0.628 m.

Source: Chapter 11, Section 11.5

Explanation

- **(a)** is worth 2 marks — list all three factors clearly. The formula $R = \rho l/A$ ties them together and examiners expect it.
- **(b)** is worth 1 mark — show the substitution step clearly. Convert radius to metres first (common error: forgetting cm → m). The key formula is $l = RA/\rho$. Write the final answer with units.

Q63. § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS | § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[3]**
§ 11.7.1 Practical Applications of Heating Effect of Electric Current

Answer the following :

(a) Write the relationship between resistivity and resistance of a cylindrical conductor of length l and area of cross-section A. Hence derive the SI unit of resistivity. [2]

(b) Why are alloys used in electrical heating devices ? [1]

Previously asked in: 2025 31/1/1 Q33

◆ **Electricity** | Alloys in electrical heating devices | Resistivity and Resistance – relationship and SI unit derivation

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Model Answer

(a) The resistance of a cylindrical conductor is given by:

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

where l = length, A = area of cross-section, and ρ = resistivity.

Rearranging: $\rho = \frac{RA}{l}$

SI unit of ρ = $\frac{\Omega \times m^2}{m}$ = **Ω m**

(b) Alloys are used in electrical heating devices because:

- Their resistivity is higher than that of pure metals, so they produce more heat.
- They do not oxidise (burn) readily at high temperatures.

Source: Chapter 11, Section 11.5

Explanation

- For part (a), always write the formula first, then rearrange to get ρ, then substitute SI units (Ω for R, m^2 for A, m for l) to derive Ω m. Examiners expect the derivation of the unit, not just stating it.
- For part (b), two points are needed but since it is 1 mark, one complete reason (high resistivity + no oxidation) suffices. Both points together make a stronger answer.

Q64. § 11.7.1 Practical Applications of Heating Effect of Electric Current **[1]**

Which of the following is a poor conductor of electricity ?

A Pb
B Cu
C Ag
D Al

Previously asked in: 2026 31/1/1 Q21

◆ **Electricity** | Conductors, Alloys and Insulators – Classification and Uses | Electrical Resistivity of Materials

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Model Answer

Answer: A — Pb (Lead)

Lead (Pb) is a poor conductor of electricity compared to Cu (copper), Ag (silver), and Al (aluminium), which are all good conductors.

Explanation

Cu, Ag, and Al are metals widely used as electrical conductors (Ag is the best conductor, Cu and Al are used in wiring). Lead (Pb) is a metal but has significantly higher resistivity, making it a poor conductor relative to the others. The textbook mentions Al, Cu as fuse/wire materials for good conductivity; Pb is notably absent from such applications.

Q65. § 11.6.1 Resistors in Series § 11.6.2 Resistors in Parallel **[3]**

Study the following circuit and find : (i) Effective resistance of the circuit (ii) Current drawn from the battery (iii) Potential difference across the 5 Ω resistor

Previously asked in: 2022 31/4/1 Q13 (OR)

◆ **Electricity** | Current drawn from a battery using Ohm's Law | Effective/Equivalent Resistance of a Circuit (Series and Parallel Combinations) | Potential Difference across a resistor in a circuit

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Model Answer

Given: $R_1 = 5\ \Omega$, $R_2 = 10\ \Omega$, $R_3 = 4\ \Omega$, $R_4 = 6\ \Omega$, $R_5 = 10\ \Omega$, $V = 20$ V

Step 1: R_3 and R_4 are in series → $R_{34} = 4 + 6 =$ **10 Ω**

Step 2: R_2 (10 Ω) and R_{34} (10 Ω) are in parallel:

$$\frac{1}{R_{parallel}} = \frac{1}{10} + \frac{1}{10} = \frac{2}{10} \Rightarrow R_{parallel} = 5\ \Omega$$

(i) Effective resistance:
R_1 is in series with R_parallel:

$$R_{eff} = 5 + 5 = \boxed{10\ \Omega}$$

(ii) Current drawn from battery (Ohm's law):

$$I = \frac{V}{R_{eff}} = \frac{20}{10} = \boxed{2\ \text{A}}$$

(iii) Potential difference across R_1 (5 Ω):

$$V_1 = I \times R_1 = 2 \times 5 = \boxed{10\ \text{V}}$$

Source: Chapter 11, Sections 11.6.1 and 11.6.2

Explanation

- **Circuit reading:** Identify series/parallel groupings carefully. $R_3 + R_4$ are in series (same branch), their combination is parallel to R_2, and the whole parallel block is in series with R_1.
- **Examiner looks for:** correct identification of combination type, proper formula application, and 3 clearly labelled answers — one for each sub-part.
- **Common mistake:** Adding all resistors directly or misidentifying which resistors are parallel. Always reduce step by step.
- The voltmeter reads V across R_1 only (it is connected across R_1), so the answer to (iii) is simply $I \times R_1$.

Q66. § Chapter Introduction § 11.1 ELECTRIC CURRENT AND CIRCUIT **[3]**

(A) (i) Why is an alternating current (A.C.) considered to be advantageous over direct current (D.C.) for the long distance transmission of electric power ?
(ii) How is the type of current used in household supply different from the one given by a battery of dry cells ?
(iii) How does an electric fuse prevent the electric circuit and the appliances from a possible damage due to short circuiting or overloading.

Previously asked in: 2023 31/4/1 Q32 (A)

◆ **Electricity** AC household supply vs DC from dry cell battery
Alternating Current (AC) vs Direct Current (DC) – advantages of AC for long distance transmission
Electric fuse – working principle and role in preventing damage due to short circuit and overloading

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Model Answer

(i) A.C. voltage can be stepped up using a transformer, which reduces current and hence power loss ($P = I^2R$) during long-distance transmission. D.C. cannot be stepped up/down easily, making it less suitable for long-distance transmission.

(ii) Household supply uses **alternating current (A.C.)** — the direction of current reverses periodically (50 Hz in India). A battery of dry cells provides **direct current (D.C.)** — current flows in one fixed direction only.

(iii) A fuse wire has high resistance and a low melting point. During short-circuiting or overloading, excessive current flows, which heats and melts the fuse wire, breaking the circuit. This prevents damage to wiring and appliances.

Explanation

- Part (i) focuses on the transformer advantage of A.C. — the key phrase is "step up voltage → reduce current → reduce I^2R loss."
- Part (ii) requires the two key terms: A.C. (alternating) for household, D.C. (direct/unidirectional) for battery.
- Part (iii) must mention: high resistance + low melting point of fuse → melts on excess current → breaks circuit. These are the examiner's expected points.

Q67. § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[2]**

The resistance of a wire of 0.01 cm radius and 1.0 cm length is 7 Ω. Calculate its resistivity.

Previously asked in: 2026 31/1/1 Q34(a)

◆ **Electricity** Resistivity and factors affecting resistance

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Model Answer

Given: radius $r = 0.01 \text{ cm} = 1 \times 10^{-4}$ m, length $l = 1.0 \text{ cm} = 1 \times 10^{-2}$ m, $R = 7\,\Omega$

Area of cross-section: $A = \pi r^2 = 3.14 \times (10^{-4})^2 = 3.14 \times 10^{-8}$ m²

Using $R = \rho \dfrac{l}{A}$:

$$\rho = \frac{R \times A}{l} = \frac{7 \times 3.14 \times 10^{-8}}{1 \times 10^{-2}}$$

$$\rho = 21.98 \times 10^{-6} \approx 2.2 \times 10^{-5}\ \Omega\,\text{m}$$

Source: Chapter 11, Section 11.5

Explanation

- The key formula is $\rho = RA/l$ (rearranged from $R = \rho l/A$).
- Always convert all units to SI (metres) before substituting.
- Examiners award 1 mark for correct substitution and 1 mark for the final answer with correct unit (Ω m). Don't forget to write the unit.

Q68. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS | § 11.6.1 Resistors in Series | § 11.6.2 Resistors in Parallel **[5]**

Answer the following:

(i) How is electric current related to the potential difference across the terminals of a conductor ? Draw a labelled circuit diagram to verify this relationship.

(ii) Why should an ammeter have low resistance ?

(iii) Two V - I graphs A and B for series and parallel combinations of two resistors are as shown. Giving reason state which graph shows (a) series, (b) parallel combination of the resistors.

Previously asked in: 2023 31/4/1 Q36

◆ **Electricity** | Ammeter – low resistance and its significance | Circuit diagram to verify Ohm's Law | Ohm's Law – relationship between electric current and potential difference | V-I graphs for series and parallel combinations of resistors

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Model Answer

(i) Electric current through a conductor is directly proportional to the potential difference across its terminals, provided temperature remains constant. This is **Ohm's Law**: $V = IR$.

Circuit diagram to verify Ohm's Law:

```
+–[Battery]–[Rheostat]–[Key]–+
| |
+–[A (Ammeter, series)]–[R]–+
[V (Voltmeter, parallel across R)]
```

(Ammeter connected in series; voltmeter connected in parallel across the resistor R.)

(ii) An ammeter is connected in series in a circuit to measure current. If its resistance were high, it would reduce the current in the circuit, giving an incorrect reading. Hence, an ammeter must have **very low (ideally zero) resistance** so it does not alter the current being measured.

(iii)

- The slope of V-I graph = $\frac{V}{I}$ = **Resistance**.
- **Graph A** (steeper slope → higher resistance) → **Series combination**, because $R_s = R_1 + R_2$ is greater than individual resistances.
- **Graph B** (shallower slope → lower resistance) → **Parallel combination**, because $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$, so R_p is less than any individual resistance.

Source: Chapter 11 – Electricity, Section 11.3 (Circuit Diagram), Ohm's Law, Section 11.6 (Resistance of a System of Resistors)

Explanation

- **(i)** Examiners expect the statement of Ohm's Law, its formula, and a neat labelled diagram with ammeter in series and voltmeter in parallel. Don't skip labels.
- **(ii)** The key logic is: ammeter is in series → high resistance would disturb the circuit current → must be low resistance. One line is enough.
- **(iii)** Always link slope of V-I graph to resistance. Series resistance > individual resistance (steeper slope); parallel resistance < individual resistance (shallower slope). State the reason clearly — that's where marks lie.

Q69. § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS | § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[5]**

(i) Due to change in length and area of cross-section of a conductor, resistance of conductor changes while resistivity does not change. Why ?
(ii) Conductors of electric toasters and electric iron are made of an alloy rather than a pure metal. Why ?
(iii) Define the S.I. unit of electric current.

Previously asked in: 2026 31/1/1 Q39(a)

◆ **Electricity** | Resistance and Resistivity (factors affecting resistance) | SI unit of electric current (Ampere)

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Model Answer

(i) Resistance of a conductor is given by $R = \rho \frac{l}{A}$. When length or area of cross-section changes, the ratio l/A changes, so R changes. However, resistivity (ρ) depends only on the **nature (material) of the conductor**, not on its dimensions. Hence, resistivity remains unchanged even when shape or size changes.

(ii) The resistivity of an alloy is generally **higher** than that of its constituent pure metals. Also, alloys **do not oxidise (burn) readily at high temperatures**. Therefore, they can withstand the high temperatures produced in heating devices like toasters and electric irons without melting or oxidising, making them more suitable than pure metals.

(iii) SI unit of electric current is ampere (A).
One ampere is defined as the flow of **one coulomb of charge per second** through a cross-section of a conductor.

$$1\ \text{A} = \frac{1\ \text{C}}{1\ \text{s}}$$

Source: Chapter 11 – Electricity, Sections 11.5 and 11.7.1

Explanation

- For part (i), the key is distinguishing resistance (geometric + material property) from resistivity (material property only). Always quote the formula $R = \rho\, l/A$ to justify your reasoning.
- For part (ii), two reasons are expected: high resistivity (produces more heat efficiently) and non-oxidising nature at high temperatures. Both points carry marks.
- For part (iii), simply naming the unit alone may not fetch full marks. Always add the definition (1 C/s) when 1 mark is allocated to a "define" question.

Q70. § 11.7.1 Practical Applications of Heating Effect of Electric Current **[1]**

Assertion (A) : Nichrome is an alloy which is commonly used in electrical heating devices such as electric irons, toasters, etc.
Reason (R) : The resistivity of nichrome is high and its resistance decreases with increase in temperature.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

Previously asked in: 2025 31/2/1 Q19

◆ **Electricity** Resistivity and its dependence on temperature – Nichrome as heating element

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Model Answer

(C) Assertion (A) is true, but Reason (R) is false.

Assertion is correct — nichrome's high resistivity and high melting point make it suitable for heating devices. However, the Reason is false: the resistance of nichrome (and alloys in general) **increases** with increase in temperature, not decreases.

Source: Chapter 11, Section 11.5

Explanation

- The Assertion is directly supported by the textbook: alloys like nichrome have high resistivity and do not oxidise at high temperatures, so they are used in electric irons, toasters, etc.
- The Reason contains one correct part (high resistivity) but one **wrong** part: for metallic conductors and alloys, resistance increases with temperature. The textbook states "Both the resistance and resistivity of a material vary with temperature" — for metals/alloys this variation is an increase.
- Since the Reason is partially false (the key claim about resistance decreasing is wrong), option **(C)** is correct.

Q71. § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS **[5]**

Answer the following about electrical resistivity :

(i) Write the relation between resistance R and electrical resistivity ρ of the material of a conductor in the shape of cylinder of length l and area of cross-section A. Hence derive the SI unit of electrical resistivity.

(ii) The resistance of a metal wire of length 3 m is 60 Ω. If the area of cross-section of the wire is 4×10^{-7} m^2, calculate the electrical resistivity of the wire.

(iii) State how would electrical resistivity be affected if the wire (of part 'ii') is stretched so that its length is doubled. Justify your answer.

Previously asked in: 2024 31/1/1 Q36(B)

◆ **Electricity** | Effect of stretching a wire on electrical resistivity | Electrical Resistivity – formula, SI unit derivation | Numerical calculation of electrical resistivity using ρ = RA/l

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Model Answer

(i) The relation between resistance and resistivity is:

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

Rearranging: $\rho = \dfrac{RA}{l}$

SI unit of $\rho = \dfrac{\Omega \times m^2}{m} = \mathbf{\Omega\, m}$

(ii) Given: $l = 3$ m, $R = 60\ \Omega$, $A = 4 \times 10^{-7}$ m²

$$\rho = \frac{RA}{l} = \frac{60 \times 4 \times 10^{-7}}{3} = \frac{240 \times 10^{-7}}{3}$$

$$\boxed{\rho = 8 \times 10^{-6}\ \Omega\ \mathrm{m}}$$

(iii) Electrical resistivity **will not change**.

Resistivity is a characteristic property of the material, not of the shape or size of the conductor. Stretching doubles the length but also halves the area of cross-section, so the resistance changes (increases 4 times), but resistivity remains the same.

Source: Chapter 11, Section 11.5

Explanation

- **(i)** Examiners want the formula, the rearrangement for ρ, and the unit derivation step-by-step.
- **(ii)** Substitute correctly into $\rho = RA/l$. Show working clearly for full marks.
- **(iii)** The key distinction is: *resistance* depends on dimensions; *resistivity* depends only on the material. Always justify by stating resistivity is a material property. This is a common trap question.

Q72. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS § 11.6.2 Resistors in Parallel **[1]**

Study the I-V graph for three resistors of resistances R_1, R_2 and R_3 and select the correct statement from the following :

(A) $R_1 = R_2 = R_3$
(B) $R_1 > R_2 > R_3$
(C) $R_3 > R_2 > R_1$
(D) $R_2 > R_3 > R_1$

Previously asked in: 2024 31/2/1 Q15

◆ **Electricity** I-V graph and comparison of resistances

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Model Answer

(C) $R_3 > R_2 > R_1$

In an I-V graph, slope = I/V = 1/R. A steeper slope means lower resistance. Since R_1 has the steepest slope, it has the least resistance, giving $R_3 > R_2 > R_1$.

Explanation

The key concept: in an I-V graph, slope = 1/R (from Ohm's law, I = V/R). A steeper line → higher current for same voltage → lower resistance. R_1 is steepest, so R_1 is smallest; R_3 is least steep, so R_3 is largest. Students often confuse steeper slope with higher resistance — remember it is the **inverse**.

Q73. § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS **[1]**

A wire of length 'l' is gradually stretched so that its length increases to 3l. If its original resistance is R, then its new resistance will be :

(A) 3R
(B) 6R
(C) 9R
(D) 27R

Previously asked in: 2025 31/3/1 Q13

◆ **Electricity** Resistance and its dependence on length and cross-sectional area (stretching of wire)

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Model Answer

(C) 9R

When length becomes 3l, volume is conserved, so area becomes A/3. New resistance = ρ(3l)/(A/3) = 9(ρl/A) = **9R**.

Source: Electricity, Section 11.5

Explanation

Key concept: Volume of wire is conserved during stretching (V = A·l = constant).

- New length = 3l → New area = A/3
- Since R = ρl/A, new R' = ρ(3l)/(A/3) = 9·ρl/A = 9R
- Resistance scales as the **square** of the length multiplier when volume is conserved. Examiners expect you to state the conservation of volume step clearly.

Q74. § 11.8 ELECTRIC POWER **[5]**

Answer the following :

(a) State Ohm's law.

(b) Name and define the physical quantity determined by the slope of V–I curve given in the diagram. Use this graph to find the value of this physical quantity in SI units.

(c) Establish the relationship between 1 kWh and 1 joule.

Previously asked in: 2023 31/5/1 Q36

◆ **Electricity** | Ohm's Law | Relationship between kWh and Joule (Electrical Energy) | Resistance from V–I graph (slope of V–I curve)

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Model Answer

(a) Ohm's Law:

At constant temperature, the potential difference (V) across the ends of a conductor is directly proportional to the current (I) flowing through it.

$$V \propto I \quad \Rightarrow \quad \frac{V}{I} = R \text{ (constant)}$$

(b) The physical quantity determined by the slope of the V–I graph is **Resistance (R)**.

Resistance is defined as the ratio of potential difference across a conductor to the current flowing through it.

$$R = \frac{V}{I} = \text{slope of V–I graph}$$

From the graph (using marked data points, e.g., V = 6 V, I = 2 A):

$$R = \frac{6}{2} = 3\ \Omega$$

SI unit of resistance is **ohm (Ω)**.

(c) Relationship between 1 kWh and 1 Joule:

$$1 \text{ kWh} = 1 \text{ kW} \times 1 \text{ h}$$

$$= 1000 \text{ W} \times 3600 \text{ s}$$

$$= 3.6 \times 10^6 \text{ W·s}$$

$$\boxed{1 \text{ kWh} = 3.6 \times 10^6 \text{ J}}$$

Source: Chapter 11 – Electricity, Sections 11.2, 11.5, 11.7

Explanation

- **(a)** Always state "at constant temperature" — examiners deduct marks if this condition is missing.
- **(b)** The slope of V–I (not I–V) gives resistance directly. Read two clear points from the graph to calculate slope. State the SI unit.

- **(c)** The key steps are: convert kW → W (×1000) and hour → seconds (×3600), then multiply. The final value 3.6×10^6 J must be stated clearly. This derivation is frequently asked for 2 marks.

Q75. § 11.4 OHM'S LAW § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[1]**

In case of four wires of same material, the resistance will be minimum if the diameter and length of the wire respectively are

A D/2 and L/4
B D/4 and 4L
C 2D and L
D 4D and 2L

Previously asked in: 2024 31/3/1 Q14

◆ **Electricity** Factors affecting resistance – length and cross-sectional area (diameter)

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Model Answer

Option D: 4D and 2L

Using $R = \rho\dfrac{l}{A} = \rho\dfrac{l}{\pi d^2/4}$, resistance is minimum when length is minimum and diameter is maximum.

Option D (diameter = 4D, length = 2L) gives the largest diameter and a relatively short length, hence minimum resistance.

Explanation

- $R \propto l$ and $R \propto \dfrac{1}{d^2}$ (since $A = \pi d^2/4$).
- To minimise R: maximise diameter, minimise length.
- Compare all options: Option D has the largest diameter (4D), making d^2 largest, which dominates over the longer length (2L). This gives the smallest resistance among all four choices.
- Source: Chapter 11, Section 11.5 (Factors on which resistance depends).

Q76. § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[2]**

Two wires A and B of same material, having same lengths and diameters 0·2 mm and 0·3 mm respectively, are connected one by one in a circuit. Which one of these two wires will offer more resistance to the flow of current in the circuit ? Justify your answer.

Previously asked in: 2024 31/4/1 Q26

◆ **Electricity** Resistance and its dependence on cross-sectional area (diameter) of a conductor

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Model Answer

Wire A will offer more resistance.

Justification: Resistance is given by $R = \rho \frac{l}{A}$. Since both wires have the same material and length, resistance depends inversely on area of cross-section. Wire A has a smaller diameter (0.2 mm) and hence a smaller area, so it offers more resistance.

$$R \propto \frac{1}{A} \propto \frac{1}{d^2}$$

$$\frac{R_A}{R_B} = \frac{d_B^2}{d_A^2} = \frac{(0.3)^2}{(0.2)^2} = \frac{9}{4} = 2.25$$

So wire A has 2.25 times more resistance than wire B.

Source: Chapter 11, Section 11.5 – Factors on which the resistance of a conductor depends

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Explanation

- The key formula is $R = \rho \frac{l}{A}$, where $A = \frac{\pi d^2}{4}$.
- Examiners expect you to: (1) state the correct wire, (2) cite the formula, (3) show the inverse relationship with diameter, and (4) optionally calculate the ratio for full marks.
- Don't forget: same material = same ρ; same length = l cancels. Only d differs.

Q77. § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS **[4]**

> Three students Shweta, Ayesha and Samridhi were performing an experiment to understand the factors on which the resistance of a conductor depends. Each one of them completed electric circuit with the help of a cell, an ammeter, a plug key and wire.
>
> Shweta put nichrome wire of length 'l' in the circuit and after plugging the key, noted current in the ammeter.
> Ayesha put nichrome wire of same thickness but twice the length i.e. '2l' in the circuit and after plugging the key, noted current in the ammeter.
> Samridhi took copper wire of length 'l' and same thickness in the circuit and after plugging the key, noted current in the ammeter.

Answer the following questions based on the passage:

(a) If the ammeter reading is X ampere with nichrome wire of length 'l', then what will be the ammeter reading if the length of nichrome wire is doubled with same area of cross-section ? [1]

(b) What happens to the ammeter reading if the area of cross-section of nichrome wire is doubled, keeping the length of wire 'l' the same ? [1]

(c) Define 'resistivity'. Write its SI unit. Compare the resistivity of an alloy with its constituents metals. [2]

Previously asked in: 2026 31/5/1 Q38

◆ **Electricity** | Factors affecting resistance of a conductor (length and area of cross-section) | Resistivity — definition, SI unit, and comparison with constituent metals

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Model Answer

(a) When length is doubled, resistance doubles ($R \propto l$). By Ohm's law, current halves.
∴ Ammeter reading = **X/2 ampere**

(b) When area of cross-section is doubled, resistance halves ($R \propto 1/A$). Therefore, current doubles.
∴ Ammeter reading **increases** (becomes **2X ampere**).

(c) **Resistivity** is defined as the resistance of a conductor of unit length and unit area of cross-section.

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

SI unit: Ohm-metre (Ω·m)

Comparison: The resistivity of an alloy is generally **higher** than that of its constituent metals. For example, nichrome (an alloy) has much higher resistivity than nickel or chromium alone.

Source: Chapter 11 – Electricity, Resistance of a System of Resistors / Resistivity

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Explanation

- For (a) and (b), use $R \propto l$ and $R \propto 1/A$ directly, then apply V = IR (V constant from cell).
- For resistivity, examiners expect: definition, formula, SI unit, and the key comparison point (alloy > constituent metals). All four elements together fetch full 2 marks.
- Write "Ω·m" correctly — a common mistake is writing Ω/m.

Q78. § 11.7 HEATING EFFECT OF ELECTRIC CURRENT **[4]**

> Swati, a class 10 student, observes that when she passes close to the refrigerator in her kitchen, she feels the heat, although the things kept inside the refrigerator are cool.

Read the following passage and answer the questions that follow :

(a) Describe the cause of heating in the above-mentioned case. [1]

(b) A current I flows through a resistor of resistance R when the potential difference across it is V. Applying Ohm's law, write the formula for amount of heat produced by the resistor in time t. [1]

(c) Answer (i) or (ii): [2]

Previously asked in: 2026 31/2/1 Q38

◆ **Electricity** | Heating Effect of Electric Current | Joule's Law of Heating – Formula Derivation using Ohm's Law

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I notice sub-question (c) is incomplete — it mentions "Answer (i) or (ii)" but neither option is provided. I'll answer (a) and (b) fully, and note the gap for (c).

Model Answer

(a) The heat felt near the refrigerator is due to the **heating effect of electric current**. The compressor motor and condenser coils carry electric current; as current flows through the resistance of these components, electrical energy is converted into heat energy, which is released into the surroundings.

(b) By Ohm's law, $V = IR$.
Heat produced is given by Joule's law of heating:

$$H = VIt = I^2Rt = \frac{V^2}{R}t$$

(c) *(Sub-question (c) appears incomplete — options (i) and (ii) were not provided. Please supply them for a complete answer.)*

Source: Chapter — Effects of Electric Current (Electricity), NCERT Class 10 Science

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Explanation

- **(a)** Examiners expect you to name the phenomenon ("heating effect of electric current") and briefly explain that electrical energy converts to heat in the resistive parts of the refrigerator circuit.
- **(b)** You must show the derivation starting from $V = IR$ and arrive at all three equivalent forms of $H = I^2Rt$. Writing all three forms earns full credit.
- **(c)** Sub-question (c) is missing from the prompt. In the actual exam, it likely asks you to compare series vs. parallel heating, or calculate heat/power — answer whichever option (i)/(ii) is printed in your paper.

Q79. § Chapter Introduction § 11.7.1 Practical Applications of Heating Effect of Electric Current § 11.8 ELECTRIC POWER **[5]**

Answer the following:

(a) An electric iron consumes energy at a rate of 880 W when heating is at the maximum rate and 330 W when the heating is at the minimum. If the source voltage is 220 V, calculate the current and resistance in each case.

(b) What is heating effect of electric current ?

(c) Find an expression for the amount of heat produced when a current passes through a resistor for some time.

Previously asked in: 2023 31/1/1 Q36

◆ **Electricity** | Heating Effect of Electric Current (Joule's Heating) | Joule's Law of Heating – derivation of H = I²Rt | Power, Current and Resistance calculations (P = VI, I = P/V, R = V/I)

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Model Answer

(a) Given: V = 220 V

At maximum rate (P = 880 W):

$$I = \frac{P}{V} = \frac{880}{220} = 4\ \text{A}$$

$$R = \frac{V}{I} = \frac{220}{4} = 55\ \Omega$$

At minimum rate (P = 330 W):

$$I = \frac{P}{V} = \frac{330}{220} = 1.5\ \text{A}$$

$$R = \frac{V}{I} = \frac{220}{1.5} = 146.67\ \Omega$$

(b) When electric current flows through a conductor, the moving electrons collide with atoms, and electrical energy is converted into heat energy. This is called the **heating effect of electric current** (Joule's heating effect).

(c) Consider a resistor of resistance R. Current I flows through it for time t. The charge that flows is Q = It.

Work done (electrical energy supplied):

$$W = VQ = V \cdot It$$

By Ohm's law, V = IR, so:

$$H = I^2 Rt$$

This is **Joule's Law of Heating** — heat produced is directly proportional to I^2, R, and t.

Source: Chapter 11 – Electricity, Section 11.7

Explanation

- **(a)** Use P = VI to find current, then R = V/I. Both formulae come directly from the power–Ohm's law relations.
- **(b)** One clear definition line is enough for a 1-mark answer. Mention conversion of electrical energy → heat.
- **(c)** Derive $H = I^2Rt$ step-by-step: start from W = VQ, substitute Q = It and V = IR. Examiners want the derivation steps, not just the formula.

Q80. § 11.5 FACTORS ON WHICH THE RESISTANCE OF A CONDUCTOR DEPENDS **[5]**

Answer the following:

(i) What is meant by resistance of a conductor ? Define its SI unit.

(ii) List two factors on which the resistance of a rectangular conductor depends.

(iii) How will the resistance of a wire be affected if its (1) length is doubled, and (2) radius is also doubled ? Give justification for your answer.

Previously asked in: 2023 31/6/1 Q36(a)

◆ **Electricity** | Effect of doubling length and radius on resistance (R = ρl/A) | Factors affecting resistance of a conductor (length, cross-sectional area, material) | Resistance of a conductor and its SI unit (Ohm)

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Model Answer

(i) Resistance of a Conductor & Its SI Unit

The resistance of a conductor is its property of opposing the flow of electric current through it. It is defined by Ohm's law as:

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

SI unit: The SI unit of resistance is **ohm (Ω)**. One ohm is the resistance of a conductor when a potential difference of 1 volt drives a current of 1 ampere through it.

(ii) Two Factors on Which Resistance Depends

1. **Length (l):** Resistance is directly proportional to the length of the conductor ($R \propto l$).
2. **Area of cross-section (A):** Resistance is inversely proportional to the area of cross-section ($R \propto \frac{1}{A}$).

(iii) Effect on Resistance When Length and Radius Are Both Doubled

Using $R = \rho \dfrac{l}{A}$, where $A = \pi r^2$:

1. **Length doubled** ($l \to 2l$): $R \propto l$, so resistance **doubles**.
2. **Radius doubled** ($r \to 2r$): $A = \pi(2r)^2 = 4\pi r^2$, so area becomes 4 times. Since $R \propto \frac{1}{A}$, resistance becomes **one-fourth**.

Net effect: $R_{\text{new}} = \rho \dfrac{2l}{4A} = \dfrac{1}{2} R$

The resistance becomes **half** the original value.

Source: Chapter 11, Section 11.5 – Factors on which resistance depends

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Explanation

- **(i)** Always define resistance AND state the SI unit with the condition (1V, 1A → 1Ω). Examiners expect both.
- **(ii)** The textbook lists length and area of cross-section as the two main factors (nature of material is the third). Pick any two; length and area are safest.
- **(iii)** The key formula is $R = \rho \frac{l}{A}$. Remember that doubling the radius quadruples the area ($A = \pi r^2$). Combine both changes to get the final answer of R/2. Show the calculation step for full marks.

Q81. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS | § 11.6.1 Resistors in Series | § 11.7.1 Practical Applications of Heating Effect of Electric Current **[5]**

In an electric circuit three bulbs of 100 W each are connected in series to a source. In another circuit set of three bulbs of the same wattage are connected in parallel to the same source.

(i) Will the bulb in the two circuits glow with the same brightness ? Justify your answer.

(ii) Now, let one bulb in both the circuits get fused. Will the rest of the bulbs continue to glow in each circuit ? Give reason for your answer.

Previously asked in: 2023 31/6/1 Q36(b)

◆ **Electricity** | Effect of fusing of one bulb on rest of the circuit in series and parallel connections | Series and Parallel Circuits – comparison of brightness and power dissipation

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Model Answer

(i) Brightness in series vs parallel:

No, the bulbs will **not** glow with the same brightness.

- In the **series circuit**, the total resistance is 3R (where R is resistance of one bulb). The current through each bulb is small (I = V/3R), so each bulb glows **dimmer** than normal.
- In the **parallel circuit**, full source voltage V appears across each bulb. Each bulb draws its rated current independently, so all three glow at **full rated brightness**.

Thus, bulbs in the parallel circuit glow much brighter than those in the series circuit.

(ii) Effect of one bulb fusing:

- **Series circuit:** If one bulb fuses, the circuit is **broken** (open). No current flows anywhere, so the **remaining two bulbs go out completely**.
- **Parallel circuit:** If one bulb fuses, only that branch breaks. The other two branches remain complete, each still receiving full voltage. So the **remaining two bulbs continue to glow** normally, unaffected.

Source: Chapter 11, Section 11.6.1 and 11.6.2

Explanation

- Examiners award marks for: (i) correctly stating "no", explaining series has higher resistance → less current → dim; parallel has full voltage → full brightness. (ii) Series → circuit breaks → all off; Parallel → other branches unaffected → continue glowing.
- The textbook explicitly states: "Another major disadvantage of a series circuit is that when one component fails the circuit is broken and none of the components works." Quote or paraphrase this for full marks.
- Power $P = V^2/R$ (parallel, full V) vs $P = I^2R$ with reduced I (series) — you can mention this to strengthen part (i) if space allows.

Q82. § Chapter Introduction § 11.7 HEATING EFFECT OF ELECTRIC CURRENT **[3]**

Answer the following:

(a) A student wants to use an electric heater, an electric bulb and an electric fan simultaneously. How should these gadgets be connected with the mains ? Justify your answer giving three reasons.

(b) What is an electric fuse ? How is it connected in a circuit ?

Previously asked in: 2022 31/4/1 Q12

◆ **Electricity** | Electric fuse – definition and circuit connection | Parallel combination of electrical appliances

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Model Answer

(a) These gadgets should be connected in **parallel** with the mains. Three reasons:

1. Each appliance gets the same voltage (220 V) as required for proper functioning.
2. If one appliance is switched off, others continue to work independently.
3. The total resistance decreases in parallel, allowing each device to draw the required current without affecting others.

(b) An electric fuse is a safety device made of a thin wire of low melting point alloy (e.g., tin-lead) that melts and breaks the circuit when excess current flows, preventing damage to appliances.
It is always connected **in series** with the live wire of the circuit.

Explanation

- For part (a), the three reasons — same voltage, independent operation, and individual switching — are standard CBSE expected points. Any three valid reasons score full marks.
- For part (b), examiners look for: definition mentioning low melting point, its protective function, and that it is connected in **series**. Missing "series" is a common mistake and will cost marks.
- The question is 3 marks total, so keep answers brief and to the point.

Q83. § Chapter Introduction § 11.7.1 Practical Applications of Heating Effect of Electric Current **[1]**

An electric kettle consumes 1 kW of electric power when operated at 220 V. The minimum rating of the fuse wire to be used for it is

(a) 1 A
(b) 2 A
(c) 4 A
(d) 5 A

Previously asked in: 2023 31/5/1 Q15

◆ **Electricity** Electric Power and Fuse Rating (P = VI)

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Model Answer

(d) 5 A

Current drawn = P/V = 1000/220 = 4.54 A. Since fuse rating must be just above the operating current, a **5 A** fuse must be used.

Source: Chapter 11, Section 11.7.1

Explanation

The textbook explicitly gives this identical example (electric iron, 1 kW at 220 V → 4.54 A → use 5 A fuse). A fuse must be rated *above* the normal operating current but at the nearest standard value to give proper protection. Standard domestic fuse ratings are 1 A, 2 A, 3 A, 5 A, 10 A — so 5 A is correct.

Q84. § Chapter Introduction | § 11.7.1 Practical Applications of Heating Effect of Electric Current | § 11.8 ELECTRIC POWER **[2]**

An electric kettle is rated 230 V; 1000 W. Calculate the resistance of its heating element when in operation.

Previously asked in: 2025 31/3/1 Q26

◆ **Electricity** | Electrical Power and Resistance Calculation ($P = V^2/R$)

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Model Answer

Given: V = 230 V, P = 1000 W

Using the formula $P = \frac{V^2}{R}$, we get:

$$R = \frac{V^2}{P} = \frac{(230)^2}{1000} = \frac{52900}{1000} = 52.9\ \Omega$$

The resistance of the heating element is **52.9 Ω**.

Source: Electric Power, Section 11.8, Chapter 11 – Electricity

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Explanation

- Examiners expect you to **state the formula** used, **substitute values**, and **arrive at the answer with units**.
- The key formula here is $P = V^2/R$, rearranged to $R = V^2/P$. This comes directly from Section 11.8.
- Do **not** use $P = VI$ first to find current — it is an extra step and wastes time; the direct formula is cleaner and preferred.
- Always include the unit **Ω** in your final answer for full marks.

Q85. § 11.8 ELECTRIC POWER **[3]**

Answer the following:

(i) Define Electric Power and write its SI unit. [1]

(ii) Two bulbs rated 100 W; 220 V and 60 W; 220 V are connected in parallel to an electric mains of 220 V. Find the current drawn by the bulbs from the mains. [2]

Previously asked in: 2022 31/1/1 Q12 (a)

◆ **Electricity** | Electric Power – definition and SI unit | Parallel combination of bulbs – current drawn from mains

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Model Answer

(i) Electric power is the rate at which electrical energy is consumed (or dissipated) in a circuit.

$$P = \frac{W}{t} = VI$$

SI unit: Watt (W)

(ii) Given: V = 220 V, P1 = 100 W, P2 = 60 W

Current drawn by 100 W bulb:

$$I_1 = \frac{P_1}{V} = \frac{100}{220}\ \text{A}$$

Current drawn by 60 W bulb:

$$I_2 = \frac{P_2}{V} = \frac{60}{220}\ \text{A}$$

Total current from mains:

$$I = I_1 + I_2 = \frac{100}{220} + \frac{60}{220} = \frac{160}{220} \approx 0.727\ \text{A}$$

The current drawn from the mains is approximately 0.73 A.

Source: Chapter 11 – Electricity, Exercise Q.15

Explanation

- For (i), always state the formula along with the definition; examiners expect both for 1 mark.
- For (ii), the key idea is that in a **parallel** circuit each bulb gets the full 220 V. Use $I = P/V$ for each bulb, then add the currents. This directly matches Exercise Q.15 in the textbook.
- Do not find resistance first unless asked — the $I = P/V$ route is faster and cleaner.

Q86. § 11.7 HEATING EFFECT OF ELECTRIC CURRENT § 11.8 ELECTRIC POWER **[3]**

Answer the following:

(i) State Joule's law of heating. Express it mathematically for the situation in which an appliance of resistance R is connected to a source of voltage V and the current I flows through the appliance for a time t.

(ii) A 5 Ω resistor is connected across a battery of 6 volts. Calculate the energy that dissipates as heat in 10 s.

Previously asked in: 2022 31/1/1 Q12 (b)

◆ **Electricity** | Heat Dissipated in a Resistor – Numerical | Joule's law of heating

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Model Answer

(i) Joule's Law of Heating:

The heat produced in a resistor is directly proportional to the square of the current (I^2), the resistance (R), and the time (t) for which the current flows.

Mathematically:

$$H = I^2 Rt$$

Since $I = V/R$, substituting:

$$H = \frac{V^2}{R} \cdot t \quad \text{or} \quad H = VIt$$

(ii) Given: R = 5 Ω, V = 6 V, t = 10 s

Current: $I = \frac{V}{R} = \frac{6}{5} = 1.2\ \text{A}$

Energy dissipated as heat:

$$H = I^2 Rt = (1.2)^2 \times 5 \times 10 = 1.44 \times 50 = 72\ \text{J}$$

Explanation

- For part (i), state the law in words first, then write $H = I^2Rt$. Examiners also accept the alternate forms $H = V^2t/R$ or H = VIt since the question asks to express it for voltage V, current I, resistance R, and time t.
- For part (ii), find current using Ohm's law first, then apply $H = I^2Rt$. You can also directly use $H = V^2t/R$ = (36×10)/5 = 72 J — either method gets full marks.
- Always include units (joules) in the final answer.

Q87. § 11.8 ELECTRIC POWER **[2]**

An electric heater rated 1100 W operates at 220 V. Calculate (i) its resistance, and (ii) the current drawn by it.

Previously asked in: 2022 31/3/1 Q4(a)

◆ **Electricity** | Electric Power and Rated Wattage | Ohm's Law and Resistance Calculation

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Model Answer

Given: Power P = 1100 W, Voltage V = 220 V

(i) Resistance:

Using $P = \dfrac{V^2}{R}$,

$$R = \frac{V^2}{P} = \frac{(220)^2}{1100} = \frac{48400}{1100} = \mathbf{44\ \Omega}$$

(ii) Current:

Using $P = VI$,

$$I = \frac{P}{V} = \frac{1100}{220} = \mathbf{5}\ \mathrm{A}$$

Source: Chapter 11, Section 11.8 Electric Power

Explanation

- Examiners expect both formulae to be stated before substitution — never just write the answer.
- Two ready formulae work here: $R = V^2/P$ and $I = P/V$. Alternatively, find R first via $R = V^2/P$, then use Ohm's law $I = V/R$. Either route is acceptable.
- Each sub-part carries 1 mark: 0.5 for the correct formula/substitution and 0.5 for the correct numerical answer with unit.

Q88. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS **[1]**

A piece of wire of resistance 'R' is cut lengthwise into three identical parts. These parts are then connected in parallel. If the equivalent resistance of this combination is R′, then the value of R/R′ is :

(a) 1/9
(b) 1/3
(c) 3
(d) 9

Previously asked in: 2025 31/4/1 Q12

◆ **Electricity** Resistance of a wire cut lengthwise and connected in parallel

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Model Answer

(d) 9

Cutting wire lengthwise into 3 parts: each part has resistance R/3. In parallel: 1/R′ = 3/(R/3) = 9/R, so R′ = R/9. Therefore R/R′ = **9**.

Source: Chapter 11, Section 11.6.2

Explanation

- Cutting **lengthwise** into 3 identical parts means each part has **one-third** the original resistance (R/3), since resistance ∝ length (and cross-section stays same per part here — note: lengthwise cut keeps length same but reduces cross-section, but the question treats them as identical parts each of resistance R/3 by analogy with the textbook's Exercise Q1).
- For 3 equal resistors (R/3) in parallel: R′ = (R/3)/3 = R/9.
- So R/R′ = 9. This mirrors the textbook Exercise Q1 (5 parts → ratio 25); here with 3 parts the ratio is 3^2 = **9**.

Q89. § 11.7.1 Practical Applications of Heating Effect of Electric Current **[1]**

An electric bulb is rated 220 V; 11W. The resistance of its filament when it glows with a power supply of 220 V is :

(a) 4400 Ω
(b) 440 Ω
(c) 400 Ω
(d) 20 Ω

Previously asked in: 2025 31/4/1 Q13

◆ **Electricity** Electric Power and Resistance Calculation ($P = V^2/R$)

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Model Answer

(a) 4400 Ω

Using $R = \dfrac{V^2}{P} = \dfrac{(220)^2}{11} = \dfrac{48400}{11} = 4400\ \Omega$

Explanation

The formula $R = V^2/P$ is derived from $P = V^2/R$. Always use rated voltage and rated power to find filament resistance. Option (a) is correct.

Q90. § 11.6.2 Resistors in Parallel **[1]**

The minimum number of identical bulbs of rating 4V; 6W, that can work safely with desired brightness, when connected in series with a 240 V mains supply is :

(a) 20
(b) 40
(c) 60
(d) 80

Previously asked in: 2025 31/4/1 Q14

◆ **Electricity** Series combination of bulbs and voltage distribution

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Model Answer

Each bulb rating: 4V, 6W. Resistance of each bulb = $V^2/P = 16/6 = 8/3\ \Omega$.

For safe operation, voltage across each bulb must not exceed 4V.

Number of bulbs needed = Total supply voltage ÷ Voltage per bulb = 240/4 = **60**.

(c) 60

Explanation

The key idea: bulbs in series share the supply voltage equally. Each bulb is rated for 4V, so the number of bulbs = 240V ÷ 4V = 60. This ensures each bulb gets exactly its rated voltage (4V) and operates at desired brightness without damage. The power/resistance calculation is not required here — just the voltage division in series.

Q91. § 11.6 RESISTANCE OF A SYSTEM OF RESISTORS | § 11.6.1 Resistors in Series | § 11.6.2 Resistors in Parallel **[4]**

> In a domestic circuit five LED bulbs are arranged as shown. The source voltage is 220 V and the power rating of each bulb is marked in the circuit diagram.

In a domestic circuit five LED bulbs are arranged as shown. The source voltage is 220 V and the power rating of each bulb is marked in the circuit diagram. Based on the following circuit diagram, answer the following questions :

- **(a)** State what happens when (i) key K_1 is closed. (ii) key K_2 is closed. [1]
- **(b)** Find the current drawn by the bulb B when it glows. [1]
- **(c)** Calculate (i) the resistance of bulb B, and (ii) total resistance of the combination of four bulbs B, C, D and E. [2]

Previously asked in: 2024 31/3/1 Q39

◆ **Electricity** | Domestic electric circuit and parallel combination of bulbs | Electric power and current calculation (P = VI, I = P/V) | Resistance calculation using $P = V^2/R$ and equivalent resistance of parallel combination

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Model Answer

(a)
(i) When K_1 is closed: Bulb A glows (top branch is complete).
(ii) When K_2 is closed: Bulbs B, C, D, and E glow (lower branch is complete).

(b) Each of bulbs B, C, D, E is rated 11 W, 55 V.

$$I_B = \frac{P}{V} = \frac{11}{55} = \mathbf{0.2\ A}$$

(c)
(i) Resistance of bulb B:

$$R_B = \frac{V^2}{P} = \frac{55 \times 55}{11} = \frac{3025}{11} = \mathbf{275\ \Omega}$$

(ii) Since all four bulbs (B, C, D, E) are identical and connected in series (total voltage = 4 × 55 V = 220 V):

$$R_{total} = 4 \times 275 = \mathbf{1100\ \Omega}$$

Explanation

- **(a)** Each key activates a separate branch — K_1 for bulb A alone, K_2 for the group of four bulbs.
- **(b)** Use $I = P/V$ with the rated values of bulb B (11 W, 55 V), not the source voltage.
- **(c)(i)** Use $R = V^2/P$ with bulb B's own rated voltage (55 V). **(c)(ii)** Four identical bulbs in series: $R_{total} = 4R_B$. The series arrangement is confirmed because 4 × 55 V = 220 V (source voltage), consistent with series connection sharing equal voltage.

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