CHAPTER 12

Electricity

NCERT Exemplar Problems | Class X Science | Complete Solved Study Guide

DISCLAIMER

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KEY TERMS & GLOSSARY

Electric Current (I)	Rate of flow of electric charge. I = Q/t. Unit: Ampere (A).
Potential Difference (V)	Work done per unit charge to move charge between two points. V = W/Q. Unit: Volt (V).
Resistance (R)	Opposition to flow of current. R = V/I. Unit: Ohm (Omega). R = rho x l / A.
Resistivity (rho)	Intrinsic property of a material independent of shape/size. Unit: Ohm-metre. Depends only on material and temperature.
Ohm's Law	At constant temperature, V is directly proportional to I. V = IR (for ohmic conductors).
Series Circuit	Components connected end-to-end. Same current flows through all. R_total = R1 + R2 + R3.
Parallel Circuit	Components connected across same two points. Same voltage across each. 1/R_total = 1/R1 + 1/R2 + 1/R3.
Joule's Heating	Heat produced $H = I^2Rt = VIt = V^2t/R$. Unit: Joule.
Electric Power (P)	Rate of electrical energy consumption. $P = VI = I^2R = V^2/R$. Unit: Watt (W).
Electric Energy	$E = Pt = VIt = I^2Rt$. Commercial unit: kilowatt-hour (kWh). 1 kWh = 3.6×10^6 J.
Fuse	Safety device with low melting point wire that breaks circuit on excess current.

EMF	Electromotive Force -- energy per unit charge supplied by source of electricity. Unit: Volt.
Ammeter	Measures current; connected in SERIES; should have very LOW resistance.
Voltmeter	Measures potential difference; connected in PARALLEL; should have very HIGH resistance.

KEY FORMULAE

Ohm's Law	**V = IR**	V = voltage (V), I = current (A), R = resistance (Ohm)
Resistance formula	**R = rho x L / A**	rho = resistivity, L = length, A = cross-section area
Series Resistance	**R = R1 + R2 + R3 + ...**	Total resistance increases
Parallel Resistance	**1/R = 1/R1 + 1/R2 + 1/R3**	Total resistance decreases
Electric Power	**$P = VI = I^2R = V^2/R$**	Unit: Watt (W)
Joule's Heat	**$H = I^2Rt$**	H = heat (J), R = resistance, t = time (s)
Electric Energy	**E = Pt = VIt**	Commercial unit: kWh; 1 kWh = 3.6×10^6 J
Charge & Current	**I = Q/t = ne/t**	Q = charge (C), n = number of electrons, e = 1.6×10^{-19} C
Current (fuse)	**I = P/V**	Used to calculate minimum fuse rating

SERIES vs PARALLEL CIRCUITS -- COMPARISON TABLE

Property	Series Circuit	Parallel Circuit
Current	Same through all components	Different through each branch
Voltage	Divides across components	Same across all components
Total Resistance	R = R1+R2+R3 (increases)	1/R = 1/R1+1/R2+... (decreases)
If one breaks	All components stop working	Others continue to work
Use in homes	Not used (impractical)	Used in domestic wiring
Brightness	Each bulb dimmer (less V each)	Each bulb at full brightness

MULTIPLE CHOICE QUESTIONS (Q1 -- Q18)

Q1. A cell, a resistor, a key and ammeter are arranged in circuit diagrams (Fig. 12.1). The current recorded in the ammeter will be:

ANSWER: (d) The same in all the cases

Explanation: The cell, resistor and key are all in series in every circuit arrangement shown. Rearranging the order of components in a series circuit does NOT change the current. Current depends only on total resistance and EMF of the cell.

Q2. Heat produced in resistors connected to a 12 V battery (Fig. 12.2) will be:

ANSWER: (a) Same in all the cases

Explanation: In each circuit, a single 2 Ohm resistor is connected to the 12 V battery. Heat produced $H = V^2t/R = 12^2t/2 = 72t$ J in all cases. The combination does not change the effective resistance seen by the battery.

Q3. Electrical resistivity of a given metallic wire depends upon:

ANSWER: (d) Nature of the material

Explanation: Electrical resistivity (rho) is an intrinsic property of the material itself. It does NOT depend on length, thickness or shape of the wire. It depends only on: (1) the nature/type of material, and (2) temperature.

Q4. A current of 1 A is drawn by a filament. Number of electrons passing through in 16 seconds would be roughly:

ANSWER: (a) 10^{20}

Explanation: I = ne/t, so n = It/e = $1 \times 16 / (1.6 \times 10^{-19}) = 10^{20}$ electrons.

Q5. Identify the circuit (Fig. 12.3) in which the electrical components have been properly connected:

ANSWER: (b) Circuit (ii)

Explanation: In a correct Ohm's law circuit: Ammeter (A) is in SERIES with R; Voltmeter (V) is in PARALLEL across R; current flows from + to - externally. Circuit (ii) satisfies all these conditions correctly.

Q6. What is the maximum resistance which can be made using five resistors each of 1/5 Ohm?

ANSWER: (d) 1 Ohm

Explanation: Maximum resistance = series connection = sum of all five = 5 x (1/5) = 1 Ohm.

Q7. What is the minimum resistance which can be made using five resistors each of 1/5 Ohm?

ANSWER: (b) 1/25 Ohm

Explanation: Minimum resistance = parallel connection. $R_{parallel}$ = (1/5)/5 = 1/25 Ohm.

Q8. The proper representation of series combination of cells (Fig. 12.4) obtaining maximum potential is:

ANSWER: (a) Circuit (i)

Explanation: For maximum potential, cells should be in series with SAME orientation (positive terminal of one connected to negative of next). Circuit (i) shows this correctly.

Q9. Which of the following represents voltage?

ANSWER: (a) Work done / (Current x Time)

Explanation: Voltage V = W/Q and Q = I x t, so V = W/(I x t) = Work done / (Current x Time).

Q10. A cylindrical conductor of length l and area A has resistance R. Another conductor of length 2l and resistance R of same material has area of cross section:

ANSWER: (c) 2A

Explanation: R = rho x L/A. Since same material (same rho), same R, but length 2L: A must be 2A to keep R constant. R = rho x 2L / (2A) = rho x L/A. Confirmed.

Q11. A student plots V-I graph of three nichrome wires with R1, R2 and R3 (Fig. 12.5). Which is true?

ANSWER: (c) R3 > R2 > R1

Explanation: In V-I graph, steeper slope = higher current for same voltage = lower resistance. R1 has steepest slope (lowest R), R3 has smallest slope (highest R). So R3 > R2 > R1.

Q12. If current I through a resistor is increased by 100%, the increase in power dissipated will be:

ANSWER: (c) 300%

Explanation: P = I^2R. If I doubles (100% increase), new P = $(2I)^2$R = 4I^2R = 4P. Increase = 4P - P = 3P = 300% of original.

Q13. The resistivity does NOT change if:

ANSWER: (c) The shape of the resistor is changed

Explanation: Resistivity depends on material and temperature ONLY. Changing shape (length/area) changes resistance but NOT resistivity.

Q14. Three bulbs A (40 W), B (60 W), C (100 W) connected in parallel. Regarding brightness:

ANSWER: (c) Brightness of bulb B will be more than that of A

Explanation: In parallel, same voltage across each. P = V^2/R. Higher wattage rating = lower resistance = more power = brighter. So C brightest, then B, then A. B is brighter than A is correct.

Q15. Two resistors 2 Ohm and 4 Ohm in series with 6 V battery. Heat dissipated by 4 Ohm in 5 s:

ANSWER: (c) 20 J

Explanation: Series: total R = 2+4 = 6 Ohm. I = V/R = 6/6 = 1 A. Heat in 4 Ohm: H = $I^2Rt = 1^2$ x 4 x 5 = 20 J.

Q16. An electric kettle consumes 1 kW at 220 V. What fuse rating must be used?

ANSWER: (d) 5 A

Explanation: I = P/V = 1000/220 = 4.54 A. The fuse must be rated slightly above this. Nearest standard value above 4.54 A is 5 A.

Q17. Two resistors 2 Ohm and 4 Ohm connected to a battery will have:

ANSWER: (b) Same current flowing through them when connected in series

Explanation: In series, SAME current flows through all components. In parallel, same voltage but DIFFERENT currents. In series, potential difference is NOT the same (V = IR, different R means different V).

Q18. Unit of electric power may also be expressed as:

ANSWER: (a) Volt ampere

Explanation: P = V x I, so unit = Volt x Ampere = VA. Note: kWh is unit of energy (not power), Watt-second = Joule (energy), Joule-second has no standard meaning.

TIP -- Reading V-I Graphs (Q11):

In a V-I graph: slope = V/I = R (resistance). STEEPER slope = HIGHER resistance. R1 has the steepest slope so highest R. Wait -- re-read: x-axis is V (volts), y-axis is I (ampere). Then slope = I/V = 1/R. STEEPER slope = LOWER resistance. R1 has highest slope so LOWEST R. R3 has flattest slope so HIGHEST R. Therefore R3 > R2 > R1. Answer: (c).

MCQ ANSWER KEY -- QUICK REFERENCE GRID

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
(d)	(a)	(d)	(a)	(b)	(d)	(b)	(a)	(a)
Q10	**Q11**	**Q12**	**Q13**	**Q14**	**Q15**	**Q16**	**Q17**	**Q18**
(c)	(c)	(c)	(c)	(c)	(c)	(d)	(b)	(a)

SHORT ANSWER QUESTIONS (Q19 -- Q28)

Q19. A child has drawn the electric circuit to study Ohm's law (Fig. 12.6). The teacher said corrections are needed. Redraw the corrected circuit.

Errors in the original circuit (Fig 12.6):

1. Ammeter polarity is WRONG -- the + terminal of ammeter faces the - terminal of battery (current must enter + of ammeter).

2. Battery is shown with wrong symbol (multiple cells in series appear reversed).

3. Voltmeter polarity is WRONG -- V+ should connect to the positive side.

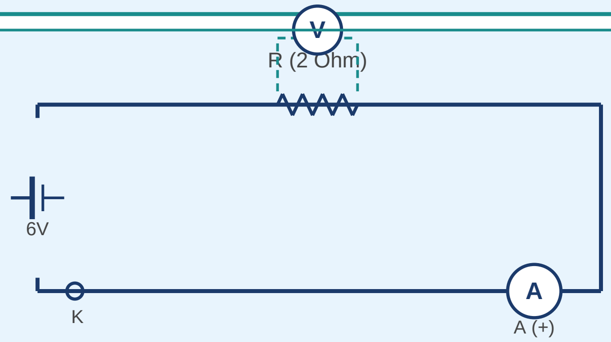

Fig. 12.6 (Corrected): Circuit for Ohm's Law

Corrected circuit must have:

* Ammeter (A) in SERIES with resistor R. Current enters + terminal of A.

* Voltmeter (V) in PARALLEL across R. V+ connects to R's high-potential end.

* Battery's + terminal connected towards the + of ammeter (conventional current direction).

* Key (K) in series with the circuit.

Q20. Three 2 Ohm resistors A, B, C are connected as shown (Fig. 12.7). Each can withstand max power 18 W. Find maximum current through each.

Circuit Description (Fig 12.7):

Resistor A is in series with the input. Resistors B and C are in PARALLEL with each other, and this parallel combination is in series with A. Total current I enters A, then splits equally between B and C (since B = C = 2 Ohm).

SOLUTION:

Step 1: Find max current through A

$P\_max = I^2R \rightarrow 18 = I^2 \times 2 \rightarrow I^2 = 9 \rightarrow I = 3$ A

Step 2: Current through B and C

B and C are in parallel, equal resistance. Total current I = 3 A splits equally: I_B = I_C = 3 x (1/2) = 1.5 A

Verification: *P_B = $(1.5)^2$ x 2 = 4.5 W < 18 W [Safe]*

ANSWER: Max current through A = 3 A; through B and C = 1.5 A each.

Q21. Should the resistance of an ammeter be low or high? Give reason.

ANSWER: Resistance of an ammeter should be as LOW as possible (ideally zero).

Reason: Ammeter is connected in SERIES in a circuit to measure current. If its resistance is high, it will significantly change the total resistance of the circuit and thus alter the current it is trying to measure. A very low resistance ensures the ammeter does not disturb the circuit current.

Q22. Draw a circuit with: cell, key, ammeter, 2 Ohm resistor in series with parallel combination of two 4 Ohm resistors, and voltmeter across parallel combination. Will the PD across 2 Ohm equal PD across parallel combination?

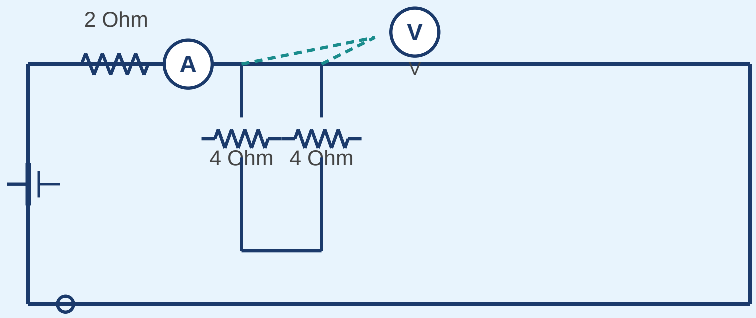

Fig. Q22: Circuit Diagram

Calculation:

Parallel combination of two 4 Ohm resistors: R_parallel = (4 x 4)/(4+4) = 2 Ohm

Total resistance = 2 Ohm (series) + 2 Ohm (parallel) = 4 Ohm

Current I = V_battery / 4 (depends on battery voltage)

V across 2 Ohm = I x 2; V across parallel combo = I x 2

YES, the potential difference across 2 Ohm resistor EQUALS the PD across the parallel combination -- because both have the same effective resistance of 2 Ohm and carry the same series current.

Q23. How does use of a fuse wire protect electrical appliances?

ANSWER:

A fuse wire is made of an alloy (lead-tin) with a LOW melting point. It is rated for a specific maximum current value.

When current in the circuit EXCEEDS the rated value (due to short circuit or overloading), the fuse wire heats up rapidly. Its temperature rises to its MELTING POINT, and it MELTS, BREAKING THE CIRCUIT completely.

This prevents excessive current from flowing through appliances, protecting them from damage due to overheating.

Q24. What is electrical resistivity? In a series circuit with metallic wire, ammeter reads 5 A. Reading decreases to half when wire length is doubled. Why?

Electrical Resistivity (rho):

Resistivity is the resistance of a conductor of UNIT LENGTH and UNIT AREA of cross-section. It is an intrinsic property of the material. Unit: Ohm-metre (Ohm m).

Formula: R = rho x L / A

Why current halves when length doubles:

R = rho x L / A. When L is doubled (to 2L), new R = rho x 2L / A = 2R.

From V = IR: I = V/R. If R doubles and V (battery emf) is constant, I halves.

So current decreases from 5 A to 5/2 = 2.5 A. The ammeter reads HALF of original.

Q25. What is the commercial unit of electrical energy? Represent it in terms of joules.

ANSWER:

Commercial unit of electrical energy = **kilowatt-hour (kWh)**

1 kWh = 1 kilowatt x 1 hour = 1000 W x 3600 s = 3,600,000 J = 3.6×10^6 *J*

This unit is used by electricity boards for billing. It is commonly called "one unit" of electricity.

Q26. 1 A flows through a series circuit with electric lamp + 5 Ohm conductor on 10 V battery. Find resistance of lamp. Then a 10 Ohm resistor is connected in parallel with this combination -- what changes occur?

Part 1 -- Resistance of lamp:

V = I x R_total -> 10 = 1 x R_total -> R_total = 10 Ohm

R_total = R_lamp + R_conductor -> 10 = R_lamp + 5 -> R_lamp = 5 Ohm

Part 2 -- 10 Ohm resistor added in PARALLEL with the series combination:

The series combination (lamp + 5 Ohm) = 10 Ohm total.

Now 10 Ohm || 10 Ohm = 5 Ohm (new effective resistance from battery).

Battery sees 5 Ohm total. Total current from battery = 10/5 = 2 A.

Current through original series branch = 10/10 = 1 A (UNCHANGED -- same V = 10 V across it).

Conclusion:

* Current through 5 Ohm conductor: NO CHANGE (still 1 A)

* Potential difference across lamp: NO CHANGE (5 Ohm x 1 A = 5 V, unchanged)

(The 10 Ohm parallel branch draws extra current but does not affect the original branch since battery voltage stays at 10 V.)

Q27. Why is parallel arrangement used in domestic wiring?

ANSWER -- Reasons for parallel wiring at home:

1. **Same voltage:** Each appliance gets the same supply voltage (220 V in India), ensuring each works at its rated capacity.

2. **Independent operation:** If one appliance fails or is switched off, others continue to work (circuit not broken for others).

3. **Different power ratings:** Each appliance can have its own power rating and draws only the current it needs.

4. **Easy control:** Each device can be switched on/off independently.

5. **Lower overall resistance:** More appliances can be connected without drastically reducing current to others.

Q28. B1, B2 and B3 are three identical bulbs in parallel (Fig. 12.8). Total current = 3 A. (i) What if B1 fuses? (ii) What happens to A1, A2, A3, A if B2 fuses? (iii) Power dissipated when all three glow.

Given: 3 identical bulbs in parallel, battery = 4.5 V, total I = 3 A

Each bulb carries 3/3 = 1 A (since identical and in parallel)

(i) If B1 fuses (open circuit):

B1 branch is broken. B2 and B3 remain connected to same 4.5 V source. Their current and brightness remain UNCHANGED. Each still carries 1 A.

(ii) If B2 fuses -- readings of A1, A2, A3, A:

A1 (branch of B1) = 1 A (unchanged)

A2 (branch of B2) = 0 A (B2 is fused, no current)

A3 (branch of B3) = 1 A (unchanged)

A (main line) = A1 + A2 + A3 = 1 + 0 + 1 = 2 A

(iii) Total power when all three glow:

P = V x I_total = 4.5 x 3 = 13.5 W

LONG ANSWER QUESTIONS (Q29 -- Q35)

Q29. Three 100 W bulbs in series vs three 100 W bulbs in parallel from same source. (a) Same brightness? (b) If one fuses in each, what happens?

(a) Will brightness be the same?

NO, the brightness will NOT be the same.

Series circuit analysis:

Total resistance = 3R (three times one bulb). Current I_series = V/(3R).

Power per bulb in series = $I\_series^2 \times R = V^2/(9R)$

Parallel circuit analysis:

Each bulb gets full supply voltage V. Power per bulb = V^2/R

Ratio: P_parallel / P_series = 9. Parallel bulbs glow 9 TIMES brighter.

Conclusion: Parallel bulbs glow much more brightly.

(b) If one bulb fuses:

Series circuit: Circuit is BROKEN. All remaining bulbs STOP glowing (no current path).

Parallel circuit: Only the fused bulb goes off. The OTHER TWO bulbs CONTINUE to glow with same brightness (each still has full voltage).

Q30. State Ohm's law. How can it be verified experimentally? Does it hold good under all conditions?

Ohm's Law:

At CONSTANT TEMPERATURE, the potential difference (V) across a conductor is DIRECTLY PROPORTIONAL to the current (I) flowing through it.

Mathematically: V proportional to I -> V = IR (where R = constant resistance)

Experimental Verification:

Setup: Connect a resistor R, ammeter A (series), voltmeter V (parallel across R), a rheostat (variable resistor), battery, and key in a circuit.

Procedure: Vary the rheostat to change current. Record V and I for each setting.

Observation: Plot V vs I graph. If Ohm's law holds, a STRAIGHT LINE through origin is obtained.

Conclusion: The ratio V/I = R = constant for all settings. Law is verified.

Limitations (NOT valid for):

* Non-ohmic devices: diodes, transistors, LEDs (V-I graph is NOT linear)

* When temperature changes significantly (resistance of conductors increases with temperature)

* Electrolytes (resistance depends on concentration)

Q31. What is electrical resistivity? What is its unit? Describe an experiment to study factors on which resistance of conducting wire depends.

Electrical Resistivity:

Resistivity (rho) of a material is numerically equal to the resistance of a wire of that material having UNIT LENGTH and UNIT AREA of cross-section.

From R = rho x L/A: rho = RA/L. Unit: Ohm x m^2/m = Ohm-m (or Ohm metre).

Resistivity depends ONLY on: (1) Nature/type of material, (2) Temperature

Experiment -- Factors affecting resistance:

Setup: Battery, rheostat, ammeter, key + nichrome/copper/aluminium wires of various lengths and gauges.

Factor 1 -- Length: Use same material and cross-section, vary length.

Result: Longer wire -> higher resistance. R is directly proportional to L.

Factor 2 -- Area of cross-section: Use same material and length, vary thickness.

Result: Thicker wire -> lower resistance. R is inversely proportional to A.

Factor 3 -- Material: Same length and area, use different materials.

Result: Different materials give different resistances (due to different rho values).

Q32. How will you infer with an experiment that the same current flows through every part of a circuit with three resistances in series connected to a battery?

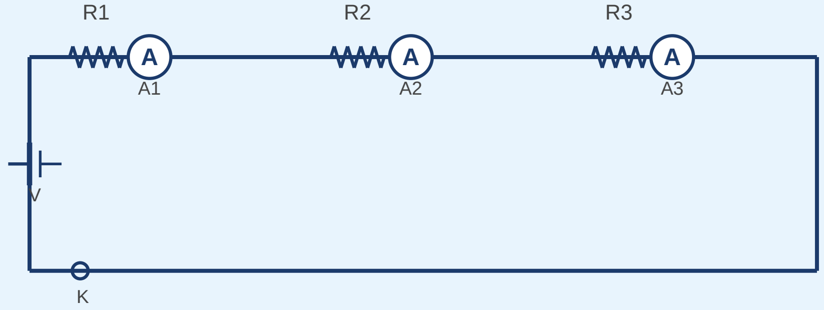

Fig. Q32: Experiment for Series Circuit Current

Apparatus: Battery, key, three resistors R1, R2, R3 in series, three ammeters A1, A2, A3.

Procedure:

Connect R1, R2, R3 in series. Insert ammeter A1 between battery and R1, A2 between R1 and R2, A3 between R2 and R3. Close key.

Observation:

Record readings of A1, A2 and A3. Repeat by changing battery voltage using rheostat.

Result: A1 = A2 = A3 for ALL settings of the rheostat.

Inference: Since all ammeters show the SAME current regardless of position, the SAME current flows through every part of a series circuit.

Q33. How will you conclude that the same potential difference exists across three resistors connected in parallel?

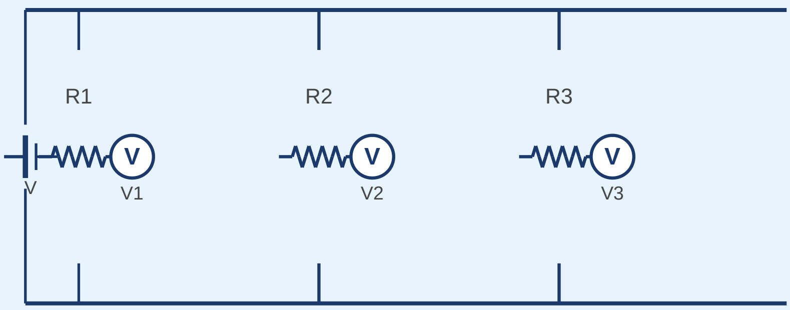

Fig. Q33: Experiment for Parallel Circuit Voltage

Apparatus: Battery, key, three resistors R1, R2, R3 in parallel, three voltmeters V1, V2, V3.

Procedure:

Connect R1, R2, R3 in parallel between points A and B. Connect a voltmeter across EACH resistor (V1 across R1, V2 across R2, V3 across R3). Close key.

Observation: V1 = V2 = V3 for all battery voltages.

Conclusion: Since all voltmeters show the SAME reading, the potential difference across each resistor in a parallel combination is EQUAL.

Q34. What is Joule's heating effect? How can it be demonstrated experimentally? List its four applications in daily life.

Joule's Heating Effect:

When electric current flows through a conductor, electrical energy is converted into HEAT ENERGY. This is called the heating effect of electric current or Joule's heating effect.

Formula: H = I^2Rt (Joule's law)

where H = heat produced (J), I = current (A), R = resistance (Ohm), t = time (s).

Experimental Demonstration:

Connect different resistance wires in series with a battery. The higher resistance wire heats up more (glows brighter). Connect a high-resistance wire submerged in water -- temperature rise can be measured. H = I^2Rt; greater R or I -> more heat.

Four Applications of Heating Effect:

1. Electric iron (laundry) -- nichrome coil heating element

2. Electric heater / room heater -- high resistance coil

3. Electric bulb (incandescent) -- tungsten filament glows white hot

4. Electric kettle / water heater (geyser) -- immersion heater

(Also: toaster, electric oven, electric fuse melting)

Q35. Find the following in the electric circuit (Fig. 12.9): (a) Effective resistance of two 8 Ohm in combination, (b) Current through 4 Ohm, (c) PD across 4 Ohm, (d) Power in 4 Ohm, (e) Difference in ammeter readings.

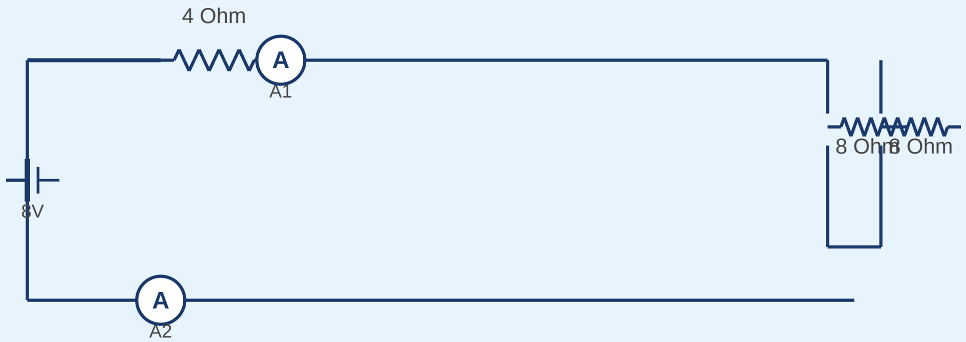

Fig. 12.9: Circuit for Q35 (8V battery, 4 Ohm + two 8 Ohm parallel)

SOLUTION (Circuit: 8V battery, 4 Ohm in series with two 8 Ohm in parallel):

(a) Effective resistance of two 8 Ohm resistors in parallel:

R_parallel = (R1 x R2)/(R1 + R2) = (8 x 8)/(8 + 8) = 64/16 = 4 Ohm

(b) Current through 4 Ohm resistor:

Total resistance in circuit = 4 Ohm (series) + 4 Ohm (parallel) = 8 Ohm

Total current I = V/R_total = 8/8 = 1 A

This 1 A flows through the 4 Ohm series resistor. ***I = 1 A***

(c) Potential difference across 4 Ohm:

$V = IR = 1 \times 4 = 4$ V

(d) Power dissipated in 4 Ohm:

$P = I^2R = 1^2 \times 4 = 4$ W (or $P = V^2/R = 16/4 = 4$ W)

(e) Difference in ammeter readings (A1 and A2):

In a series circuit, the SAME current flows through every element. A1 is in the main line (between 4 Ohm and parallel combination) = 1 A. A2 is in the main line (return path from battery) = 1 A.

Difference = 0. Both ammeters read the same (1 A).

(Same current flows through every part of a series circuit.)

COMMON MISTAKES & MISCONCEPTIONS

Ammeter vs Voltmeter connection

WRONG: WRONG: Connecting voltmeter in series or ammeter in parallel.

CORRECT: CORRECT: Ammeter ALWAYS in series (low R). Voltmeter ALWAYS in parallel (high R).

Resistivity vs Resistance

WRONG: WRONG: Saying resistivity changes when shape of wire changes.

CORRECT: CORRECT: Resistivity depends ONLY on material and temperature. Resistance changes with shape.

Parallel vs Series current

WRONG: WRONG: Thinking current is same in all branches of a parallel circuit.

CORRECT: CORRECT: Current is same in series. Voltage is same in parallel.

Power increase calculation

WRONG: WRONG: If I doubles, power doubles (100% increase).

CORRECT: CORRECT: P = I^2 R. If I doubles, P = (2I)^2 R = 4P. Increase = 300%.

Maximum parallel resistance

WRONG: WRONG: Maximum resistance by connecting in parallel.

CORRECT: CORRECT: Maximum resistance = SERIES connection. Minimum = PARALLEL.

Fuse rating

WRONG: WRONG: Using any available fuse wire regardless of appliance rating.

CORRECT: CORRECT: Fuse rating must be calculated as I = P/V and chosen just above this value.

Ohm's Law universality

WRONG: WRONG: Ohm's law applies to ALL electrical components.

CORRECT: CORRECT: Ohm's law is valid only for OHMIC conductors at constant temperature. It fails for diodes, LEDs, thermistors, electrolytes etc.

V-I graph slope interpretation

WRONG: WRONG: Steeper slope in V(x-axis)-I(y-axis) graph means higher resistance.

CORRECT: CORRECT: If x=V, y=I, slope = I/V = 1/R. Steeper slope = lower resistance.

QUICK REVISION TABLE

Electric Current	Rate of charge flow; direction opposite to electron flow	*$I = Q/t = ne/t$; 1 A = 1 C/s*
Potential Difference	Work done per unit charge; drives current	*$V = W/Q$; unit: Volt*
Resistance	Opposition to current; depends on L, A, material	*R = V/I = rhoL/A; unit: Ohm*
Resistivity	Intrinsic property -- material + temperature only	*rho = RA/L; unit: Ohm-m*
Series Circuit	Same I, V divides; R adds up; one break stops all	*$R_s = R1+R2+R3$*
Parallel Circuit	Same V, I divides; R reduces; independent control	*$1/R_p = 1/R1+1/R2+1/R3$*
Joule Heating	Higher R or I = more heat; basis of many appliances	*$H = I^2Rt = VIt$; unit: J*
Electric Power	Rate of energy; P-rated at given V	*$P = VI = I^2R = V^2/R$; unit: W*
Electric Energy	Total energy consumed; 1 unit = 1 kWh	*$E = Pt$; 1 kWh = 3.6×10^6 J*
Fuse	Low melting point alloy; breaks circuit on excess current	*Rating I = P/V (minimum required)*
Ammeter	In SERIES; measures I; R must be nearly zero	*Ideal R = 0*
Voltmeter	In PARALLEL; measures V; R must be very high	*Ideal R = infinity*
Charge of electron	Fundamental unit of charge	*$e = 1.6 \times 10^{-19}$ C*

IMPORTANT NOTE TO STUDENTS

This solved study guide is meant to supplement your learning. Always refer to your NCERT textbook and class notes as primary resources. Practise drawing circuit diagrams yourself. For numericals, always write: Given, To find, Formula, Calculation, Result -- as expected in board examinations. Good luck!

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