



Electricity — CBSE Class 10 Science Chapter Test

FREE CHAPTER TEST · CLASS X · SCIENCE (086) · PATTERN OF THE CBSE BOARD PAPER

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
1½ hours	40	20 (A 10 · B 4 · C 3 · D 1 · E 2)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 20 questions. All questions are compulsory.
2. This question paper is divided into five sections: A, B, C, D and E.
3. In Section A, Questions 1 to 8 are multiple choice questions (MCQs) and Questions 9 and 10 are assertion-reason based questions of 1 mark each.
4. In Section B, Q11–14 are very short answer (VSA) type questions, carrying 2 marks each.
5. In Section C, Q15–17 are short answer (SA) type questions, carrying 3 marks each.
6. In Section D, Q18 are long answer (LA) type questions, carrying 5 marks each.
7. In Section E, Q19–20 are case study based questions, carrying 4 marks each, with sub-parts of the values of 1, 1 and 2 marks.
8. There is no overall choice. However, an internal choice has been provided in 1 question of Section B, 1 question of Section C, 1 question of Section D and in the 2-mark sub-part of each question of Section E.
9. Use of calculators is not allowed.
10. This chapter test follows the section structure, question types and marks per question of the CBSE Class X Science (086) board paper, at about half the length of the 80-mark board paper: 40 marks in 1½ hours.
11. The answer key and the marking scheme are at the end of this booklet. Attempt the paper in 1½ hours before you look at them.

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Chapter: Electricity · **Topics:** Ohm's law · Resistors in series · Resistors in parallel · Combinations of resistors · Heating effect of electric current · Electric power · Electric charge and work

SECTION A

This section comprises 10 questions of 1 mark each: 8 multiple choice questions (MCQs) and 2 assertion-reason based questions.

1. Four resistors of $4\ \Omega$ each are available. In which arrangement is the equivalent resistance $3\ \Omega$? 1
(A) All four in parallel
(B) Two in series, in parallel with the other two in series
(C) Three in series, in parallel with the fourth
(D) Two in parallel, in series with the other two in series
2. A $12\ \Omega$ resistor and an unknown resistor R are connected in series with a $9\ \text{V}$ battery, and an ammeter in the circuit reads $0.5\ \text{A}$. The potential difference across R is 1
(A) $6\ \text{V}$
(B) $3\ \text{V}$
(C) $4.5\ \text{V}$
(D) $1.5\ \text{V}$
3. Two identical resistors connected in series across a battery together consume $20\ \text{W}$. If they are connected in parallel across the same battery, they together consume 1
(A) $20\ \text{W}$
(B) $40\ \text{W}$
(C) $10\ \text{W}$
(D) $80\ \text{W}$
4. The heating coil of a heater is cut into two equal halves, and only one half is used on the same supply. Compared with the full coil, the power of the heater becomes 1
(A) double
(B) half
(C) the same
(D) four times
5. A $6\ \Omega$ resistor is connected across a battery. When a second resistor R is connected in parallel with it, the current drawn from the battery becomes 2.5 times as large. R is 1
(A) $6\ \Omega$
(B) $2.4\ \Omega$
(C) $4\ \Omega$
(D) $15\ \Omega$
6. Three resistors of $3\ \Omega$ each are connected to form a triangle. The equivalent resistance between any two corners of the triangle is 1
(A) $2\ \Omega$
(B) $9\ \Omega$
(C) $1\ \Omega$
(D) $4.5\ \Omega$
7. A $4\ \Omega$ and a $12\ \Omega$ resistor are connected in series, and this combination is connected in parallel with a $16\ \Omega$ resistor across an $8\ \text{V}$ battery. The heat produced per second in the $12\ \Omega$ resistor is 1
(A) $4\ \text{W}$
(B) $3\ \text{W}$
(C) $12\ \text{W}$
(D) $1\ \text{W}$
8. n identical resistors have an equivalent resistance of R_s when joined in series and R_p when joined in parallel. If $R_s : R_p = 81 : 1$, then n is 1
(A) 81
(B) 27
(C) 3
(D) 9

9. **Assertion (A):** Electrical appliances in a house are connected in parallel with one another. 1
Reason (R): In a parallel arrangement each appliance gets the full mains voltage and can be switched on or off without affecting the others.
 (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.
10. **Assertion (A):** When two resistors are connected in parallel, their equivalent resistance is less than the 1
 smaller of the two.
Reason (R): In a parallel arrangement, the potential difference across each resistor is the same.
 (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.

SECTION B

This section comprises 4 very short answer (VSA) type questions of 2 marks each.

11. (a) A resistor connected across a 6 V battery draws 2 A. When another resistor is connected in series 2
 with it, the current falls to 1.2 A. Find the resistance of the second resistor and the potential difference across it.
- OR**
- (b) Two resistors give an equivalent resistance of $9\ \Omega$ when connected in series and $2\ \Omega$ when connected in parallel. Find the two resistances.
12. The potential difference across a $10\ \Omega$ resistor in a circuit is 5 V. How much charge flows through it in 2
 one minute, and how much work does the source do in moving this charge through the resistor?
13. Resistors of $2\ \Omega$ and $4\ \Omega$ are connected in series with a 6 V battery. Find the potential difference across 2
 each resistor and the power dissipated in each.
14. n identical resistors, each of resistance r, have an equivalent resistance of $18\ \Omega$ when connected in 2
 series and $0.5\ \Omega$ when connected in parallel. Find n and r.

SECTION C

This section comprises 3 short answer (SA) type questions of 3 marks each.

15. (a) Resistors of $2\ \Omega$, $4\ \Omega$ and $6\ \Omega$ are connected in series, in that order, across a $12\ \text{V}$ battery. The negative terminal of the battery is taken to be at $0\ \text{V}$. Find (i) the current, (ii) the potentials of the two junctions between the resistors, (iii) the power dissipated in the $6\ \Omega$ resistor. 3

OR

(b) What resistance must be connected in parallel with a $12\ \Omega$ resistor to obtain an equivalent resistance of $4\ \Omega$? If this combination is connected across a $6\ \text{V}$ battery, find the current through each resistor and the total current.

16. An unknown resistor R and a $6\ \Omega$ resistor are connected in parallel across a $12\ \text{V}$ battery, and the battery supplies $3\ \text{A}$. Find R , and the power dissipated in R and in the $6\ \Omega$ resistor. 3
17. An electric iron has two heating coils, A of $20\ \Omega$ and B of $30\ \Omega$, and works on $220\ \text{V}$. Find the power of the iron when (i) coil A alone is used, (ii) the two coils are used in series, (iii) the two coils are used in parallel. Which setting heats the iron fastest? 3

SECTION D

This section comprises 1 long answer (LA) type questions of 5 marks each.

18. (a) (i) Write the expression for the heat H produced in a resistor R carrying a current I for a time t . 5
(ii) Resistors of $3\ \Omega$ and $6\ \Omega$ are connected in parallel across a $6\ \text{V}$ battery for 5 minutes. Find the heat produced in each, and the total heat.
(iii) Which of the two produces more heat in this arrangement, and why?
(iv) If the two resistors are instead connected in series across the same battery for 5 minutes, find the heat produced in each.

OR

(b) The current I through two resistors R_1 and R_2 was measured for different potential differences V :
 R_1 : $V = 2, 4, 6\ \text{V}$; $I = 0.5, 1.0, 1.5\ \text{A}$. R_2 : $V = 2, 4, 6\ \text{V}$; $I = 0.25, 0.50, 0.75\ \text{A}$.
(i) Find R_1 and R_2 . (ii) Which of them has the steeper V - I graph (V on the y-axis)? (iii) Find their equivalent resistance in series and in parallel. (iv) If they are connected in parallel across $6\ \text{V}$, find the total current and the ratio of the heat produced per second in R_1 to that in R_2 .

SECTION E

This section comprises 2 case study based questions of 4 marks each, with sub-parts of 1, 1 and 2 marks.

19. A string of decorative lights has 20 identical bulbs, each of resistance $55\ \Omega$, connected in series and plugged into the $220\ \text{V}$ mains.
- (i) Find the current in the string. [1]
(ii) One bulb's filament breaks. What happens to the other bulbs, and why? [1]
(iii) Find the power of each bulb in the string, and the total power drawn from the mains. [2]

OR

(iii) The broken bulb is removed and its two wires are joined, so the string has 19 bulbs. Find the new current, and say whether each bulb is now brighter or dimmer than before, with a reason. [2]

- 20.** A lamp of resistance $40\ \Omega$ is connected in series with a rheostat (a variable resistor that can be set anywhere from 0 to $60\ \Omega$) across a 20 V battery, so that its brightness can be adjusted.
- (i)** Find the greatest current that can flow through the lamp. [1]
 - (ii)** Find the least current that can flow through the lamp. [1]
 - (iii)** To what value must the rheostat be set for the lamp to dissipate 2.5 W? [2]

OR

- (iii)** Find the power of the lamp and the potential difference across the rheostat when the current is least. [2]

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
(C)	(B)	(D)	(A)	(C)	(A)	(B)	(D)	(A)	(B)

MARKING SCHEME AND WORKED SOLUTIONS

Marks for each step are shown in brackets, as in the CBSE marking scheme. Any correct alternative method earns full marks.

Q1. Answer (C). Three in series give $12\ \Omega$; $12\ \Omega$ in parallel with $4\ \Omega$ gives $12 \times 4/16 = 3\ \Omega$. The others give $1\ \Omega$, $4\ \Omega$ and $2 + 8 = 10\ \Omega$.

Q2. Answer (B). The total resistance is $9/0.5 = 18\ \Omega$, so $R = 6\ \Omega$ and the potential difference across it is $0.5 \times 6 = 3\ \text{V}$ (the $12\ \Omega$ resistor takes the other $6\ \text{V}$).

Q3. Answer (D). $P = V^2/R_{\text{eq}}$. In series $R_{\text{eq}} = 2R$; in parallel $R_{\text{eq}} = R/2$, a quarter as much. So the power is 4 times: $80\ \text{W}$.

Q4. Answer (A). Half the length has half the resistance. On the same voltage, $P = V^2/R$ doubles. (The coil also carries twice the current.)

Q5. Answer (C). The same battery gives 2.5 times the current, so the equivalent resistance is $6/2.5 = 2.4\ \Omega$. Then $1/R = 1/2.4 - 1/6 = 5/12 - 2/12 = 1/4$, so $R = 4\ \Omega$. $2.4\ \Omega$ is the equivalent resistance, not R .

Q6. Answer (A). Between two corners there is one $3\ \Omega$ resistor directly and a $6\ \Omega$ path through the third corner, in parallel: $3 \times 6/9 = 2\ \Omega$.

Q7. Answer (B). The series branch ($16\ \Omega$) has the full $8\ \text{V}$ across it, so it carries $0.5\ \text{A}$. Heat per second in the $12\ \Omega$ resistor = $I^2R = 0.25 \times 12 = 3\ \text{J/s} = 3\ \text{W}$.

Q8. Answer (D). With each resistor r : $R_s = nr$ and $R_p = r/n$, so $R_s/R_p = n^2$. $n^2 = 81$ gives $n = 9$.

Q9. Answer (A). Both are true, and R is exactly why the parallel arrangement is used: in series the voltage would be shared, each appliance's current would depend on the others, and one switched off would switch off all. Answer (A).

Q10. Answer (B). A is true: $1/R = 1/R_1 + 1/R_2$ is larger than $1/R_1$ and $1/R_2$, so R is smaller than both. R is true, but A follows from the currents adding up (each branch is an extra path for current), not just from the equal potential differences. Answer (B).

Q11. (2 marks) Answer: (a) $2\ \Omega$, $2.4\ \text{V}$; (b) $3\ \Omega$ and $6\ \Omega$.

(a) First resistor: $6/2 = 3\ \Omega$. With both, the total is $6/1.2 = 5\ \Omega$, so the second resistor is $5 - 3 = 2\ \Omega$. [1]

Potential difference across it = $1.2 \times 2 = 2.4\ \text{V}$. [1]

OR (b) $R_1 + R_2 = 9$ and $R_1R_2/(R_1 + R_2) = 2$, so $R_1R_2 = 18$. [1]

Two numbers with sum 9 and product 18: $3\ \Omega$ and $6\ \Omega$. [1]

Q12. (2 marks) Answer: $30\ \text{C}$, $150\ \text{J}$.

$I = V/R = 5/10 = 0.5\ \text{A}$, so $Q = It = 0.5 \times 60 = 30\ \text{C}$. [1]

$W = QV = 30 \times 5 = 150\ \text{J}$. [1]

Q13. (2 marks) Answer: $2\ \text{V}$ and $4\ \text{V}$; $2\ \text{W}$ and $4\ \text{W}$.

$I = 6/(2 + 4) = 1\ \text{A}$; $V_1 = 1 \times 2 = 2\ \text{V}$ and $V_2 = 1 \times 4 = 4\ \text{V}$. [1]

$P_1 = VI = 2\ \text{W}$ and $P_2 = 4\ \text{W}$ (in series the larger resistor dissipates more power). [1]

Q14. (2 marks) Answer: $n = 6$, $r = 3\ \Omega$.

$nr = 18$ and $r/n = 0.5$. Multiplying, $r^2 = 9$, so $r = 3\ \Omega$. [1]

$n = 18/3 = 6$. [1]

Q15. (3 marks) Answer: (a) 1 A; 10 V and 6 V; 6 W; (b) 6 Ω ; 0.5 A, 1 A, 1.5 A.

(a) (i) $R = 2 + 4 + 6 = 12 \Omega$, so $I = 12/12 = 1 \text{ A}$. [1]

(ii) The current enters the 2 Ω resistor at 12 V and loses $1 \times 2 = 2 \text{ V}$ in it: the first junction is at 10 V. It loses 4 V in the 4 Ω resistor: the second junction is at 6 V (and the 6 Ω resistor drops the last 6 V to 0 V). [1]

(iii) $P = I^2 R = 1 \times 6 = 6 \text{ W}$. [1]

OR (b) $1/R = 1/4 + 1/12 = 2/12$, so $R = 6 \Omega$. [1]

Across 6 V: $6/12 = 0.5 \text{ A}$ through 12 Ω and $6/6 = 1 \text{ A}$ through 6 Ω . [1]

Total current 1.5 A (= 6 V/4 Ω). [1]

Q16. (3 marks) Answer: $R = 12 \Omega$; 12 W and 24 W.

Equivalent resistance = $12/3 = 4 \Omega$. [1]

$1/R = 1/4 + 1/6 = 1/12$, so $R = 12 \Omega$. [1]

Power in $R = V^2/R = 144/12 = 12 \text{ W}$; in the 6 Ω resistor $144/6 = 24 \text{ W}$ (total 36 W = 12 V $\times$ 3 A). [1]

Q17. (3 marks) Answer: 2420 W, 968 W, about 4033 W; parallel.

(i) $P = V^2/R = 220^2/20 = 2420 \text{ W}$. [1]

(ii) $R = 50 \Omega$, $P = 48400/50 = 968 \text{ W}$. [1]

(iii) $R = 20 \times 30/50 = 12 \Omega$, $P = 48400/12 \approx 4033 \text{ W}$: the parallel setting has the least resistance and heats fastest. [1]

Q18. (5 marks) Answer: (a) $H = I^2 R t$; 3600 J, 1800 J, 5400 J; the 3 Ω resistor; 400 J and 800 J; (b) 4 Ω and 8 Ω ; R_2 ; 12 Ω and 8/3 Ω ; 2.25 A, 2 : 1.

(a) (i) $H = I^2 R t$ (Joule's law of heating). [1]

(ii) Each resistor has the full 6 V across it: 2 A through 3 Ω and 1 A through 6 Ω . In $t = 300 \text{ s}$: $H_3 = 2^2 \times 3 \times 300 = 3600 \text{ J}$ and $H_6 = 1^2 \times 6 \times 300 = 1800 \text{ J}$; total 5400 J. [2]

(iii) The 3 Ω resistor: with the same voltage, $H = V^2 t/R$, so the smaller resistance produces more heat. [1]

(iv) $I = 6/9 = 2/3 \text{ A}$ in both: $H_3 = (4/9) \times 3 \times 300 = 400 \text{ J}$ and $H_6 = (4/9) \times 6 \times 300 = 800 \text{ J}$ — now the larger resistance produces more heat (same current, $H = I^2 R t$). [1]

OR (b) (i) V/I is constant: $R_1 = 2/0.5 = 4 \Omega$ and $R_2 = 2/0.25 = 8 \Omega$. [1]

(ii) The slope of a V – I graph is $V/I = R$, so R_2 has the steeper graph. [1]

(iii) Series $4 + 8 = 12 \Omega$; parallel $4 \times 8/12 = 8/3 \Omega$. [1]

(iv) Across 6 V: 1.5 A through R_1 and 0.75 A through R_2 , a total of 2.25 A. [1]

Heat per second V^2/R : $36/4 = 9 \text{ W}$ and $36/8 = 4.5 \text{ W}$, a ratio of 2 : 1 (the smaller resistance gets more heat in parallel). [1]

Q19. (4 marks) Answer: (i) 0.2 A; (ii) all go out; (iii)(a) 2.2 W, 44 W; (b) about 0.21 A, brighter.

(i) $R = 20 \times 55 = 1100 \Omega$; $I = 220/1100 = 0.2 \text{ A}$. [1]

(ii) All the bulbs go out: in series there is only one path, so a break anywhere stops the current everywhere. [1]

(iii)(a) Each bulb: $P = I^2 R = 0.04 \times 55 = 2.2 \text{ W}$. [1]

Total: $20 \times 2.2 = 44 \text{ W}$ (= 220 V $\times$ 0.2 A). [1]

OR (iii)(b) $R = 19 \times 55 = 1045 \Omega$; $I = 220/1045 \approx 0.21 \text{ A}$. [1]

Each bulb's power $I^2 R \approx 0.0443 \times 55 \approx 2.4 \text{ W}$, more than 2.2 W, so each bulb is brighter (the current has increased). [1]

Q20. (4 marks) Answer: (i) 0.5 A; (ii) 0.2 A; (iii)(a) 40 Ω ; (b) 1.6 W, 12 V.

(i) With the rheostat at 0 Ω : $I = 20/40 = 0.5 \text{ A}$. [1]

(ii) With the rheostat at 60 Ω : $I = 20/100 = 0.2 \text{ A}$. [1]

(iii)(a) $I^2 R = 2.5$ with $R = 40 \Omega$ gives $I^2 = 1/16$, $I = 0.25 \text{ A}$. [1]

Total resistance = $20/0.25 = 80 \Omega$, so the rheostat must be set to 40 Ω . [1]

OR (iii)(b) At 0.2 A, the lamp's power = $0.04 \times 40 = 1.6 \text{ W}$. [1]

The rheostat has $0.2 \times 60 = 12 \text{ V}$ across it (the lamp has 8 V). [1]

All questions are original and © Master Testing Agency. Free to download and use for personal practice; not for resale. Every answer in this paper was checked independently by computer: every circuit solved by nodal analysis (Kirchhoff's laws, exact fractions), with powers and heats computed from the node voltages and every arrangement listed.