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Current Electricity — CBSE Class 12 Physics Chapter Test

FREE CHAPTER TEST · CLASS XII · PHYSICS (042) · PATTERN OF THE CBSE SAMPLE QUESTION PAPER 2026-27

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
1½ hours	37	17 (A 8 · B 3 · C 3 · D 1 · E 2)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 17 questions. All questions are compulsory.
2. This question paper is divided into five sections: A, B, C, D and E.
3. Section A (Q1–8) contains 6 multiple choice questions and 2 assertion-reason based questions of 1 mark each.
4. Section B (Q9–11) contains short answer questions of 2 marks each.
5. Section C (Q12–14) contains short answer questions of 3 marks each.
6. Section D (Q15) contains case study based questions of 4 marks each, with four sub-parts of 1 mark.
7. Section E (Q16–17) contains long answer questions of 5 marks each.
8. There is no overall choice. However, an internal choice has been provided in 1 question in Section B, 1 question in Section C, 2 questions in Section E. Attempt only one of the alternatives in such questions.
9. Use of calculators is not allowed. You may use: $e = 1.6 \times 10^{-19}$ C.
10. This chapter test follows the section structure, question types and marks per question of the CBSE Class XII Physics (042) Sample Question Paper 2026-27, at about half the length of the 70-mark board paper: 37 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: Current Electricity · **Topics:** Electric current and drift velocity · Ohm's law, resistivity and mobility · Temperature dependence of resistance · Cells, emf and internal resistance · Combination of resistors and cells · Kirchhoff's rules and the Wheatstone bridge

SECTION A

This section comprises 8 questions of 1 mark each: 6 multiple choice questions (MCQs) and 2 assertion-reason based questions.

1. A current of 1.6 A flows through a copper wire of cross-sectional area 1.0 mm^2. If the number density of free electrons is $1.0 \times 10^{29}\ m^{-3}$, the drift speed of the electrons is 1

(A) $1.0 \times 10^{-2}\ m\ s^{-1}$ (B) $1.6 \times 10^{-4}\ m\ s^{-1}$

(C) $1.0 \times 10^{-4}\ m\ s^{-1}$ (D) $1.0 \times 10^{-6}\ m\ s^{-1}$

2. A wire of resistance R is stretched uniformly until its length is doubled. Its new resistance is 1

(A) 2R (B) $\frac{R}{2}$

(C) $\frac{R}{4}$ (D) 4R

3. A cell of emf 2.0 V and internal resistance 0.5 Ω is connected across a 3.5 Ω resistor. The potential difference across the terminals of the cell is 1

(A) 2.0 V (B) 1.75 V

(C) 0.25 V (D) 1.5 V

4. When the temperature of a metallic conductor rises, its resistivity increases mainly because 1

(A) the average time between collisions of the electrons decreases (B) the number density of free electrons decreases

(C) the drift velocity becomes independent of the field (D) the electrons gain mass

5. Kirchhoff's junction rule is a consequence of the conservation of 1

(A) energy (B) charge

(C) momentum (D) mass

6. In a Wheatstone bridge, the resistances of the four arms are P = 10 Ω, Q = 20 Ω, R = 15 Ω and S. The bridge is balanced when S is 1

(A) 7.5 Ω (B) 15 Ω

(C) 30 Ω (D) 45 Ω

7. **Assertion (A) :** Kirchhoff's loop rule is based on the conservation of energy. 1
Reason (R) : The electrostatic force is conservative, so the total change in potential round any closed loop is zero.

(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 and Reason (R) is also false.

8. **Assertion (A) :** The resistance of a semiconductor decreases as its temperature rises. 1

Reason (R) : The relaxation time of the charge carriers in a semiconductor increases with 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 and Reason (R) is also false.

SECTION B

This section comprises 3 short answer questions of 2 marks each.

9. A uniform wire of resistance 12 Ω is bent into a circle. Find the resistance between (i) two diametrically opposite points and (ii) two points a quarter of the circumference apart. 2

10. (a) Derive the relation between the current in a conductor and the drift velocity of its free electrons. 2

OR

(b) Define the mobility of a charge carrier. Show that the mobility of an electron is $\mu = e\tau/m$, where τ is the relaxation time. Write its SI unit.

11. The resistance of a heating element is 80 Ω at 20 °C. When it glows, its resistance is 92 Ω. Find its temperature, given that the temperature coefficient of resistance of its material is $1.50 \times 10^{-4}\ °C^{-1}$. 2

SECTION C

This section comprises 3 short answer questions of 3 marks each.

12. Two cells, of emf 6 V and internal resistance 1 Ω, and of emf 4 V and internal resistance 2 Ω, are connected in parallel (positive terminals together) across a 4 Ω resistor. Using Kirchhoff's rules, find the current through the resistor and through each cell. 3

13. (a) n identical cells, each of emf E and internal resistance r, are connected in series to an external resistance R. Obtain the current. When is it nearly n times the current one cell would drive through R? Find the current for 5 cells of 1.5 V and 0.2 Ω each with R = 6 Ω. 3

OR

(b) Derive the condition for the balance of a Wheatstone bridge using Kirchhoff's rules.

14. A 12 V storage battery of internal resistance 0.5 Ω is charged from an 18 V dc supply through a series resistor of 2.5 Ω. Find (i) the charging current, (ii) the potential difference across the terminals of the battery during charging and (iii) the purpose of the series resistor. 3

SECTION D

This section comprises 1 case study based question of 4 marks, with four sub-parts of 1 mark each.

15. Electrical wiring in homes uses copper, a good conductor, while the elements of heaters and toasters use nichrome, an alloy of nickel and chromium. The resistivity of copper is about 1.7×10^{-8} Ω m and that of nichrome about 1.0×10^{-6} Ω m; nichrome also has a high melting point and does not oxidise readily when hot. Consider wires each 10 m long with a cross-sectional area of 1.0 mm^2.

(I) The resistance of the copper wire is
(A) 0.017 Ω (B) 0.17 Ω (C) 1.7 Ω (D) 17 Ω [1]

(II) The resistance of the nichrome wire is
(A) 1.0 Ω (B) 100 Ω (C) 0.10 Ω (D) 10 Ω [1]

(III) If the nichrome wire is used as a heating element on a 220 V supply, the power it draws (neglecting the change of resistance with temperature) is
(A) 22 W (B) 484 W (C) 4840 W (D) 2200 W [1]

(IV) Nichrome rather than copper is used for heating elements because it has
(A) low resistivity and a low melting point (B) high resistivity and a high melting point (C) low resistivity and a high melting point (D) high resistivity and a low melting point [1]

SECTION E

This section comprises 2 long answer questions of 5 marks each.

16. (a) (i) Using the idea of drift of electrons, derive the expression $\rho = \dfrac{m}{ne^2\tau}$ for the resistivity of a conductor. 5

(ii) Wire A has twice the length and half the diameter of wire B, both being made of the same material. Find the ratio of their resistances $R_A : R_B$.

OR

(b) (i) State Kirchhoff's two rules.

(ii) A battery of emf 10 V and negligible internal resistance is connected to a 4 Ω resistor in series with a parallel combination of 6 Ω and 3 Ω. Find the current through each resistor.

17. (a) (i) Define the emf and the internal resistance of a cell. Show that the terminal potential difference of a cell delivering a current I is $V = E - Ir$. 5

(ii) A cell drives a current of 2.0 A through a 5 Ω resistor and 1.2 A through a 9 Ω resistor. Find its emf and internal resistance.

(iii) What is the largest current this cell can deliver?

OR

(b) (i) Two cells of emfs E_1, E_2 and internal resistances r_1, r_2 are connected in parallel, positive terminals together. Derive the expressions for the emf and the internal resistance of the equivalent cell.

(ii) Find them for $E_1 = 2.0$ V, $r_1 = 0.4$ Ω and $E_2 = 1.5$ V, $r_2 = 0.6$ Ω.

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

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

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). $v_d = I/(neA) = 1.6/(1.0 \times 10^{29} \times 1.6 \times 10^{-19} \times 1.0 \times 10^{-6}) = 1.0 \times 10^{-4}$ m s^{-1}.

Q2. Answer (D). The volume is unchanged: doubling l halves A, so $R = \rho l/A$ becomes $\rho(2l)/(A/2) = 4R$.

Q3. Answer (B). $I = E/(R + r) = 2.0/4.0 = 0.5$ A; $V = E - Ir = 2.0 - 0.25 = 1.75$ V (= IR).

Q4. Answer (A). $\rho = m/(ne^2\tau)$. In a metal n hardly changes with temperature; the ions vibrate more and collisions become more frequent, so the relaxation time τ falls and ρ rises.

Q5. Answer (B). Charge does not accumulate at a junction in steady state: the charge flowing in per second equals that flowing out.

Q6. Answer (C). Balance: $P/Q = R/S$, so $S = RQ/P = 15 \times 20/10 = 30\ \Omega$.

Q7. Answer (A). A unit charge taken round a closed loop returns to the same potential: the gains in emf equal the IR drops. That is energy conservation for a conservative field: R explains A. Answer (A).

Q8. Answer (C). A is true. The reason is that the number density of charge carriers rises steeply with temperature; the relaxation time actually decreases. R is false. Answer (C).

Q9. (2 marks) Answer: (i) 3 Ω; (ii) 2.25 Ω.
Resistance is proportional to length. (i) Two halves of 6 Ω each in parallel: $6 \times 6/12 = 3\ \Omega$. [1]
(ii) Arcs of 3 Ω and 9 Ω in parallel: $3 \times 9/12 = 2.25\ \Omega$. [1]

Q10. (2 marks) Answer: (a) $I = neAv_d$; (b) $\mu = v_d/E = e\tau/m$, m^2 V^{-1} s^{-1}.
(a) Consider a conductor of cross-section A with n free electrons per unit volume moving with drift velocity v_d. In time Δt they move $v_d\Delta t$, so the electrons crossing a section are those in volume $A\,v_d\Delta t$: charge = $neA\,v_d\Delta t$. [1]
I = charge/time = $neA\,v_d$. [1]
OR (b) Mobility is the drift speed per unit electric field: $\mu = v_d/E$. [½]
The field gives acceleration eE/m; between collisions the average gain in velocity is $v_d = eE\tau/m$, so $\mu = v_d/E = e\tau/m$. [1] SI unit: m^2 V^{-1} s^{-1}. [½]

Q11. (2 marks) Answer: 1020 °C.
$R = R_0[1 + \alpha(T - T_0)]$: $92 = 80[1 + 1.50 \times 10^{-4}\,(T - 20)]$. [1]
$T - 20 = (92/80 - 1)/(1.50 \times 10^{-4}) = 0.15/(1.50 \times 10^{-4}) = 1000$, so $T = 1020$ °C. [1]

Q12. (3 marks) Answer: 8/7 A ≈ 1.14 A; 10/7 A ≈ 1.43 A; 2/7 A ≈ 0.29 A charging the 4 V cell.
Let V be the potential of the common positive terminal (negative terminals at 0). Junction rule: $(6 - V)/1 + (4 - V)/2 = V/4$. [1]
Multiplying by 4: $24 - 4V + 8 - 2V = V$, so $V = 32/7$ V ≈ 4.57 V. [1]
Through 4 Ω: $V/4 = 8/7$ A ≈ 1.14 A. Through the 6 V cell: $(6 - 32/7)/1 = 10/7$ A ≈ 1.43 A (discharging). Through the 4 V cell: $(4 - 32/7)/2 = -2/7$ A, i.e. 0.29 A flows into its positive terminal (it is being charged). [1]

Q13. (3 marks) Answer: (a) $I = nE/(R + nr)$; $R \gg nr$; ≈ 1.07 A; (b) $P/Q = R/S$.

(a) The emfs and internal resistances add: $I = nE/(R + nr)$. [1]

One cell: $E/(R + r)$. For $R \gg nr$, $I \approx nE/R \approx n \times (E/R)$: nearly n times. [1]

$I = 7.5/(6 + 1.0) \approx 1.07$ A. [1]

OR (b) Arms P (A to B), Q (B to C), R (A to D), S (D to C); galvanometer between B and D; battery across A and C. At balance, $I_g = 0$, so the current I_1 in P also flows in Q and I_2 in R also flows in S. [1]

Loop ABDA: $-I_1P + 0 + I_2R = 0$, so $I_1P = I_2R$. Loop BCDB: $-I_1Q + I_2S = 0$, so $I_1Q = I_2S$. [1½]

Dividing: $P/Q = R/S$. [½]

Q14. (3 marks) Answer: (i) 2 A; (ii) 13 V; (iii) limits the current.

(i) The battery's emf opposes the supply: $I = (18 - 12)/(0.5 + 2.5) = 2$ A. [1]

(ii) While being charged, $V = E + Ir = 12 + 2 \times 0.5 = 13$ V. [1]

(iii) It limits the charging current to a safe value; without it $I = 6/0.5 = 12$ A. [1]

Q15. (4 marks) Answer: (I) B; (II) D; (III) C; (IV) B.

(I) (B) $R = \rho l/A = 1.7 \times 10^{-8} \times 10/1.0 \times 10^{-6} = 0.17\ \Omega$. [1]

(II) (D) $R = 1.0 \times 10^{-6} \times 10/1.0 \times 10^{-6} = 10\ \Omega$. [1]

(III) (C) $P = V^2/R = 220^2/10 = 4840$ W. [1]

(IV) (B) High resistivity gives the required resistance (and heat) with a short wire, and it stays solid and unoxidised when red hot. [1]

Q16. (5 marks) Answer: (a) $\rho = m/ne^2\tau$; 8 : 1; (b) 5/3 A, 5/9 A, 10/9 A.

(a) (i) In a field E an electron gains average velocity $v_d = eE\tau/m$ between collisions. [1]

$I = neAv_d = ne^2A\tau\ E/m$, and with $E = V/l$: $I = (ne^2A\tau/ml)\ V$. [1]

So $R = V/I = (m/ne^2\tau)(l/A)$; comparing with $R = \rho l/A$ gives $\rho = m/(ne^2\tau)$. [1]

(ii) $R = \rho l/A \propto l/d^2$: $R_A/R_B = 2/(½)^2 = 8$, i.e. 8 : 1. [2]

OR (b) (i) Junction rule: the sum of the currents entering any junction equals the sum of the currents leaving it. Loop rule: the algebraic sum of the changes in potential round any closed loop is zero. [2]

(ii) $6\ \Omega \parallel 3\ \Omega = 2\ \Omega$; total $4 + 2 = 6\ \Omega$, so $I = 10/6 = 5/3$ A ≈ 1.67 A through the 4 Ω resistor. [1½]

The parallel pair has $V = (5/3) \times 2 = 10/3$ V: through 6 Ω, 5/9 A ≈ 0.56 A; through 3 Ω, 10/9 A ≈ 1.11 A. [1½]

Q17. (5 marks) Answer: (a) E = 12 V, r = 1 Ω, 12 A; (b) 1.8 V, 0.24 Ω.

(a) (i) The emf is the potential difference between the terminals of a cell when no current is drawn; the internal resistance is the resistance of the electrolyte and electrodes inside the cell. [1]

With current I, part of the emf is used inside the cell: $E = IR + Ir$, so $V = IR = E - Ir$. [1]

(ii) $E = 2.0(5 + r) = 1.2(9 + r)$: $10 + 2r = 10.8 + 1.2r$, so $r = 1\ \Omega$ [1] and $E = 12$ V. [1]

(iii) On short circuit ($R = 0$): $I_{max} = E/r = 12$ A. [1]

OR (b) (i) With terminal voltage V: $I_1 = (E_1 - V)/r_1$, $I_2 = (E_2 - V)/r_2$, and $I = I_1 + I_2$. [1]

So $V(1/r_1 + 1/r_2) = E_1/r_1 + E_2/r_2 - I$, giving $V = (E_1r_2 + E_2r_1)/(r_1 + r_2) - I\ r_1r_2/(r_1 + r_2)$. Compare with $V = E_{eq} - I\ r_{eq}$: $E_{eq} = (E_1r_2 + E_2r_1)/(r_1 + r_2)$, $r_{eq} = r_1r_2/(r_1 + r_2)$. [2]

(ii) $E_{eq} = (2.0 \times 0.6 + 1.5 \times 0.4)/1.0 = 1.8$ V; $r_{eq} = 0.4 \times 0.6/1.0 = 0.24\ \Omega$. [2]

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