

Current Electricity

Class 12 Physics · 24 NEET MCQs with answers & explanations

Current Electricity covers Ohm's law, resistivity, Kirchhoff's laws, Wheatstone bridge, meter bridge, potentiometer and electrical power. NEET tests circuit analysis using Kirchhoff's laws, resistor combinations, Wheatstone bridge balance condition and potentiometer sensitivity — one of the most numerical-heavy chapters.

Key Circuit Concepts

Concept	Key Formula
Ohm's law	$V = IR$; $R = \rho L/A$; resistivity depends on material and temperature
Series resistors	$R_{eq} = R_1 + R_2$; current same; voltage divides
Parallel resistors	$1/R_{eq} = 1/R_1 + 1/R_2$; voltage same; current divides
Kirchhoff's laws	KCL: $\sum I = 0$ at junction; KVL: $\sum V = 0$ in closed loop
Wheatstone bridge	Balanced when $P/Q = R/S$; no current through galvanometer
Power	$P = VI = I^2R = V^2/R$; max power transfer when $R_{ext} = r$ (internal resistance)

Questions

Q1. The drift velocity of electrons in a conductor increases when:

- (A) Temperature alone increases
- (B) Electric field applied increases
- (C) Length of conductor increases
- (D) Area of conductor increases

Q2. A conductor has resistivity ρ at temperature T . If the temperature increases, which correctly describes the change in resistivity for a metallic conductor?

- (A) Resistivity increases because lattice vibrations increase, causing more electron collisions
- (B) Resistivity decreases because free electron density increases with temperature
- (C) Resistivity remains constant as the number of free electrons is fixed
- (D) Resistivity first decreases then increases, showing a minimum at room temperature

Q3. A copper wire carries a current of 4 A. If the number density of free electrons is doubled while all other parameters remain unchanged, the drift velocity becomes:

- (A) Remains unchanged
- (B) Doubles
- (C) Becomes four times
- (D) Half

Q4. Which of the following statements correctly represents Ohm's Law?

- (A) $V \propto 1/I$ at constant temperature
- (B) $V \propto I$ at constant temperature
- (C) V is independent of I for any conductor
- (D) $I \propto R$ at constant voltage

Q5. Three resistors of $2\ \Omega$, $3\ \Omega$ and $5\ \Omega$ are connected in series. Their equivalent resistance is:

- (A) $5\ \Omega$
- (B) $7\ \Omega$
- (C) $8\ \Omega$
- (D) $10\ \Omega$

Q6. A cell has emf 6 V and internal resistance $1\ \Omega$. It supplies a current of 2 A . The terminal voltage is:

- (A) 3 V
- (B) 4 V
- (C) 6 V
- (D) 5 V

Q7. The Wheatstone bridge is said to be balanced when which of the following conditions is satisfied?

- (A) $P + Q = R + S$
- (B) $P/Q = R/S$
- (C) $P \times Q = R \times S$
- (D) $P - Q = R - S$

Q8. A wire of length 2 m and cross-sectional area $4 \times 10^{-6}\text{ m}^2$ has a resistance of $1\ \Omega$. The resistivity of the material is:

- (A) $4 \times 10^{-6}\ \Omega\cdot\text{m}$
- (B) $2 \times 10^{-6}\ \Omega\cdot\text{m}$
- (C) $1 \times 10^{-6}\ \Omega\cdot\text{m}$
- (D) $8 \times 10^{-6}\ \Omega\cdot\text{m}$

Q9. A metre bridge works on the principle of:

- (A) Ohm's law
- (B) Wheatstone bridge
- (C) Kirchhoff's current law
- (D) Potentiometer

Q10. A potentiometer works on the principle that the potential drop along a uniform wire carrying a steady current is:

- (A) Directly proportional to resistance only
- (B) Directly proportional to its length
- (C) Inversely proportional to current
- (D) Independent of wire length

Q11. Kirchhoff's Current Law (KCL) is based on the conservation of:

- (A) Charge
- (B) Energy
- (C) Momentum
- (D) Power

Q12. A voltmeter connected across a source always reads less than the true emf. Which of the following correctly identifies why a potentiometer eliminates this error during calibration?

- (A) The potentiometer has a very high internal resistance that blocks current
- (B) At null point, no current is drawn from the source, so there is no voltage drop across its internal resistance
- (C) The potentiometer amplifies the source voltage before comparison
- (D) The potentiometer uses AC, which eliminates resistive loading

Q13. Which of the following statements is correct regarding electric current in a metallic conductor?

- (A) It is due to the drift of free electrons under an electric field.
- (B) It is due to the motion of positive ions.
- (C) It is due to the flow of protons.
- (D) It is due to the movement of atoms.

Q14. The R-T graph for a pure metallic conductor is best described as:

- (A) A straight line with positive slope
- (B) A straight line with negative slope
- (C) An exponential decay curve
- (D) A curve that first rises then falls

Q15. A conductor carries a current of 8 A for 25 s. The total number of electrons crossing any cross-section is closest to:

- (A) 6.25×10^{20}
- (B) 1.25×10^{21}
- (C) 2.50×10^{21}
- (D) 5.00×10^{21}

Q16. Which of the following is correct about the nature of electric current as a physical quantity?

- (A) It is a vector because charge has direction of flow.
- (B) It is a vector because it follows the triangle law of addition.
- (C) It is a scalar because it obeys algebraic addition at a junction, not vector addition.
- (D) It is a scalar only inside metallic conductors, but a vector in electrolytes.

Q17. Which of the following does NOT act as a charge carrier in a metallic conductor?

- (A) Free electrons
- (B) Conduction electrons
- (C) Positive lattice ions
- (D) Electrons drifting under an electric field

Q18. Consider the following statements regarding electric current: I. Current is the rate of flow of charge. II. Current is a vector quantity. III. The SI unit of current is the ampere. IV. A current can exist through a conductor without net charge on it. How many of the above statements are correct?

- (A) Only I
- (B) Only I and III
- (C) I, II and III
- (D) I, III and IV

Q19. The SI unit of electric current, the ampere, is defined as the flow of how much charge per second?

- (A) 1 mC per second
- (B) 1 C per second
- (C) 1 μ C per second
- (D) 1 kC per second

Q20. A current of 0.8 A flows through a conductor for 15 minutes. The total charge transferred is:

- (A) 480 C
- (B) 600 C
- (C) 720 C
- (D) 900 C

Q21. In which of the following media do positive and negative ions BOTH act as charge carriers to produce electric current?

- (A) Electrolytes
- (B) Metals at room temperature
- (C) Intrinsic semiconductors at 0 K
- (D) Vacuum in a CRT

Q22. A wire carries 3 C of charge every 0.25 s. The current through the wire is:

- (A) 3 A
- (B) 6 A
- (C) 9 A
- (D) 12 A

Q23. Two wires X and Y carry currents of 4 A and 6 A respectively into a junction. What is the current leaving the junction?

- (A) 2 A
- (B) 4 A
- (C) 10 A
- (D) 6 A

Q24. As per the NCERT definition, the SI unit of electric current is defined in terms of:

- (A) Voltage across a conductor
- (B) Power dissipated per second
- (C) Rate of flow of charge through a cross-section
- (D) Energy stored in the field

Answer key

1-B	2-A	3-D	4-B	5-D	6-B	7-B	8-B
9-B	10-B	11-A	12-B	13-A	14-A	15-B	16-C
17-C	18-D	19-B	20-C	21-A	22-D	23-C	24-C

Answers with explanations

Q1 — Answer: (B) Electric field applied increases

$v_d = eE\tau/m$; increasing E directly increases drift velocity. Increasing temperature reduces relaxation time τ , so drift velocity decreases despite higher thermal energy.

Q2 — Answer: (A) Resistivity increases because lattice vibrations increase, causing more electron collisions

For metals, increasing T amplifies lattice vibrations, increasing electron scattering and hence resistivity. Option B is wrong — free electron density is nearly constant in metals. Semiconductors show Option B behavior, a common mix-up.

Q3 — Answer: (D) Half

From $v_d = I/(neA)$, with I , e , A constant, v_d is inversely proportional to n . Doubling n halves v_d . Option B is the classic inversion trap — students confuse direct with inverse proportionality.

Q4 — Answer: (B) $V \propto I$ at constant temperature

Ohm's Law: at constant temperature, $V \propto I$ for a metallic conductor, giving $V = IR$. Option A inverts the proportionality — the most common conceptual error. Option D confuses the roles of R and I .

Q5 — Answer: (D) 10 Ω

Series: $R_{eq} = R_1 + R_2 + R_3 = 2 + 3 + 5 = 10 \Omega$. Option C (8 Ω) traps students who add only two of the three resistors. R_{eq} in series is always greater than the largest individual resistance. Formula: $R_{eq} = \sum R$.

Q6 — Answer: (B) 4 V

Terminal voltage $V = E - Ir = 6 - (2 \times 1) = 4 \text{ V}$. Option A arises from halving the EMF, a common arithmetic error. Formula: $V = E - Ir$.

Q7 — Answer: (B) $P/Q = R/S$

At balance, no current flows through the galvanometer because both its terminals are at equal potential, giving $P/Q = R/S$. Option A and C are dimensionally plausible traps but have no physical basis in circuit analysis.

Q8 — Answer: (B) $2 \times 10^{-6} \Omega \cdot m$

$\rho = RA/L = (1 \times 4 \times 10^{-6})/2 = 2 \times 10^{-6} \Omega \cdot m$. Option A traps students who use $\rho = RL/A$ (inverted formula). Formula: $\rho = RA/L$.

Q9 — Answer: (B) Wheatstone bridge

The metre bridge replicates the four-arm Wheatstone bridge topology — the wire forms two arms and the known and unknown resistances form the other two. At balance, $P/Q = R/S$ is satisfied.

Q10 — Answer: (B) Directly proportional to its length

For a uniform wire with constant current, $V = IRI/L$, so V is directly proportional to length l . Equal lengths produce equal potential drops.

Q11 — Answer: (A) Charge

KCL states that the algebraic sum of currents at a junction is zero, which directly follows from conservation of charge — no charge accumulates at a steady-state junction. Option B (energy) is the basis of KVL, not KCL.

Q12 — Answer: (B) At null point, no current is drawn from the source, so there is no voltage drop across its internal resistance

At balance, zero current flows from the source — terminal voltage equals true emf. A voltmeter always draws current, causing a drop Ir across internal resistance, reading terminal voltage instead of emf.

Q13 — Answer: (A) It is due to the drift of free electrons under an electric field.

In metals, free electrons drift opposite to the applied electric field; positive ions stay fixed in the lattice. This directed electron drift constitutes conventional current opposite to electron flow.

Q14 — Answer: (A) A straight line with positive slope

For metals, $R = R_0(1 + \alpha \Delta T)$ with $\alpha > 0$ gives a linear increase — a straight line with positive slope on an R - T graph. Option B (negative slope) is the semiconductor graph, the most common confusion. Formula: $R = R_0(1 + \alpha \Delta T)$.

Q15 — Answer: (B) 1.25×10^{21}

$Q = It = 8 \times 25 = 200 \text{ C}$. $n = Q/e = 200 / 1.6 \times 10^{-19} = 1.25 \times 10^{21}$. Option A errors arise from using $Q = I/t$ instead of $Q = It$.

Q16 — Answer: (C) It is a scalar because it obeys algebraic addition at a junction, not vector addition.

Current has magnitude and a sense of flow but does not obey the triangle law of vector addition at junctions — it follows algebraic (scalar) addition via KCL. Option A confuses sense of flow with vector nature.

Q17 — Answer: (C) Positive lattice ions

Positive ions in a metal are fixed in the crystal lattice and cannot drift. Only free (conduction) electrons move under an applied field. Options A, B, D all describe the same mobile electron population.

Q18 — Answer: (D) I, III and IV

Statement I: correct ($I = Q/t$). Statement II: incorrect — current is a scalar. Statement III: correct. Statement IV: correct — steady current leaves conductor neutral. Three statements (I, III, IV) are correct.

Q19 — Answer: (B) 1 C per second

By definition, 1 ampere = 1 coulomb per second ($1 \text{ A} = 1 \text{ C/s}$), directly from $I = Q/t$. Options A, C, D use wrong multiples of coulomb, a common unit-confusion trap.

Q20 — Answer: (C) 720 C

$t = 15 \times 60 = 900 \text{ s}$. $Q = It = 0.8 \times 900 = 720 \text{ C}$. Option A arises from using $t = 600 \text{ s}$ (forgetting $\times 60$ conversion), a very common exam error.

Q21 — Answer: (A) Electrolytes

In electrolytes, cations move toward the cathode and anions toward the anode — both contribute to current. In metals only electrons carry charge. At 0 K semiconductors have no free carriers.

Q22 — Answer: (D) 12 A

$I = Q/t = 3 / 0.25 = 12 \text{ A}$. Option A arises from $I = Q \times t$ (inverting the formula), a common algebraic slip that gives a tempting small value.

Q23 — Answer: (C) 10 A

By KCL, total current leaving = total entering = $4 + 6 = 10 \text{ A}$. Option D (6 A) traps students who subtract rather than add the incoming currents.

Q24 — Answer: (C) Rate of flow of charge through a cross-section

NCERT defines $I = Q/t$; hence the ampere is based on charge flow rate. Options A and B involve secondary derived quantities and are not the defining relation.

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