KIRUBHA ACADEMICS

CBSE- CLASS XII	PHYSICS	Worksheet 2 — Current Electricity & Moving Charges
Name: _____	Date: _____	Time: 60 minutes Max Marks: 28

Chapters: 3. Current Electricity | 4. Moving Charges and Magnetism

General Instructions: All questions are compulsory. Use standard constants wherever required. Draw neat, labelled diagrams where applicable. Symbols carry their usual meanings.

Section A — Multiple Choice Questions (1 mark each)

Choose the most appropriate option.

1. Ohm's law states that the current through a conductor is proportional to the potential difference across it, provided:(a) temperature is constant(b) length is constant(c) area of cross-section is constant(d) resistivity is variable *[1 mark]*
2. Resistivity of a conductor depends upon:(a) length of the conductor(b) area of cross-section(c) nature and temperature of the material(d) both length and area of cross-section *[1 mark]*
3. A charged particle moves perpendicular to a magnetic field. The particle undergoes:(a) linear motion with increasing speed(b) linear motion with constant speed(c) uniform circular motion(d) parabolic motion *[1 mark]*
4. The SI unit of magnetic field strength (B) is:(a) Ampere per metre(b) Tesla(c) Weber(d) Henry *[1 mark]*
5. When cells are connected in parallel, the effective internal resistance:(a) increases(b) decreases(c) remains the same(d) becomes zero *[1 mark]*

Section B — Assertion–Reason Questions (1 mark each)

(A) Both A and R are true, R is the correct explanation.(B) Both A and R are true, R is NOT the correct explanation.(C) A is true, R is false. (D) A is false, R is true.

6. Assertion (A): The drift velocity of electrons in a conductor decreases with increase in temperature.Reason (R): As temperature increases, the relaxation time of electrons decreases due to more frequent collisions. *[1 mark]*

7. Assertion (A): The force on a current-carrying conductor placed parallel to a magnetic field is zero.Reason (R): The magnetic force on a current-carrying conductor is F = IL × B, which is zero when current and field are parallel. *[1 mark]*

Section C — Very Short Answer Questions (2 marks each)

8. State Kirchhoff's two laws. Write the sign convention used for each. *[2 marks]*

9. Define drift velocity of electrons. How is it related to current in a conductor? *[2 marks]*

10. A wire of resistance 10 Ω is stretched to twice its original length. What is its new resistance? Justify your answer. *[2 marks]*

11. State the Biot-Savart law. Write its vector form and explain the direction of the magnetic field element. *[2 marks]*

12. What is the principle of a Wheatstone bridge? Write the balanced condition. *[2 marks]*

Section D — Short Answer Questions (3 marks each)

13. Derive the expression for the equivalent resistance of three resistors connected:(a) in series, (b) in parallel.Hence state in which case is the equivalent resistance smaller than the smallest individual resistance. *[3 marks]*

14. Using Biot-Savart law, derive an expression for the magnetic field at the centre of a circular current-carrying loop of radius R carrying current I. *[3 marks]*

15. (a) State Ampere's Circuital Law.(b) Using it, derive the expression for the magnetic field inside a long straight solenoid with n turns per unit length carrying current I. *[3 marks]*

Section E — Long Answer / Numerical Questions (5 marks each)

16. (a) Derive an expression for the drift velocity of free electrons in a conductor in terms of relaxation time τ, electric field E, and mass m of an electron.(b) Hence derive Ohm's law and show that resistivity $\rho = m / (ne^2\tau)$, where n is the number density of electrons.(c) A copper wire of diameter 1 mm carries a current of 0.5 A. Given $n = 8 \times 10^{28}$ m^{-3} for copper, calculate the drift velocity. *[5 marks]*

17. (a) A charge +q moves with velocity v in a magnetic field B. Derive the expression for the magnetic force acting on it. Under what conditions is this force maximum and zero?(b) A proton moves with a velocity of 2×10^6 m/s in a magnetic field of 0.5 T perpendicular to the velocity. Calculate the radius of the circular path. (Mass of proton = 1.67×10^{-27} kg, charge = 1.6×10^{-19} C) *[5 marks]*

Section F — Case-Based / Application Question (4 marks)

A student sets up a circuit to verify Kirchhoff's laws. She uses a battery of EMF 12 V and internal resistance 1 Ω connected to an external circuit with resistors R_1 = 3 Ω, R_2 = 6 Ω in parallel, and R_3 = 2 Ω in series with the combination. Answer the following based on this circuit:

18. Find the equivalent resistance of R_1 and R_2 in parallel. *[1 mark]*
19. Find the total current drawn from the battery. *[1 mark]*
20. Using Kirchhoff's Current Law, find the current through each of R_1 and R_2. *[1 mark]*
21. What is the terminal voltage of the battery? What does terminal voltage tell us about the battery under load? *[1 mark]*

Answer Key & Marking Notes (For Teacher Use)

Section A: 1-(a), 2-(c), 3-(c), 4-(b), 5-(b)

Section B: 1-(A), 2-(A)

Section C:

Q6: Kirchhoff's Junction Law ($\Sigma I = 0$) and Loop Law ($\Sigma V = 0$) with correct sign convention — 1 mark each.

Q7: $v_d = I / (nAe)$ — 1 mark for definition, 1 mark for relation.

Q8: $R \propto l/A$; stretching doubles l and halves A, so R increases 4×. New R = 40 Ω.

Q9: Statement of Biot-Savart law (1 mark) + vector form with direction explanation (1 mark).

Q10: Principle (no current through galvanometer) + balanced condition $P/Q = R/S$.

Section D:

Q11: Series: $R = R_1+R_2+R_3$; Parallel: $1/R = 1/R_1+1/R_2+1/R_3$ — 1 mark derivation each, 1 mark comparison.

Q12: Full Biot-Savart derivation for circular loop: $B = \mu_0 I / 2R$ at centre — step-wise marking.

Q13: Statement (1) + derivation using Ampere's law for solenoid → $B = \mu_0 nI$ (2 marks).

Section E:

Q14: (a) $v_d = eE\tau/m$ (b) $J = \sigma E \rightarrow \rho = m/ne^2\tau$ (c) $v_d = I/(nAe) \approx 7.96 \times 10^{-5}$ m/s

Q15: (a) $F = q(v \times B)$, max when $\theta = 90°$, zero when $\theta = 0°$ (b) $r = mv/qB \approx 0.04$ m (4 cm)

Section F:

Q16: $R_{12} = 2$ Ω. Total R = 2+2+1 = 5 Ω. I = 12/5 = 2.4 A.

Q17: V across $R_{12} = 2.4 \times 2 = 4.8$ V. $I_1 = 4.8/3 = 1.6$ A; $I_2 = 4.8/6 = 0.8$ A.

Q18: Terminal voltage = EMF − Ir = 12 − (2.4 × 1) = 9.6 V. Terminal voltage is less than EMF due to internal resistance drop — indicates the practical (usable) voltage delivered by the battery.