# Current Electricity — CBSE Pattern Test 2

Class 12 Physics · 90 minutes · 40 marks · Sections A–D with answer key · Narayan Gurukul Academy

## Test 2 — CBSE Pattern (90 minutes, 40 marks)

Class 12 Physics · Current Electricity · Narayan Gurukul Academy (ClassApna)

General Instructions: (1) This paper has four sections — Section A (1 × 10), Section B (2 × 4), Section C (3 × 4) and Section D (5 × 2) — total 40 marks. Time allowed: 90 minutes.
(2) All questions are compulsory. No overall choice is given; internal choice, where allowed, is clearly marked.
(3) For MCQ questions choose the single correct option; for VSA answers write a single line.
(4) Take g = 10 m/s^2. All symbols carry their usual meaning. Use of a calculator is not permitted.

## Section A — MCQ & VSA (10 × 1 = 10 marks)

1. The balance condition of a Wheatstone bridge with arms P, Q, R, S in cyclic order is

(A) P/Q = R/S
(B) P·R = Q·S
(C) P + Q = R + S
(D) P = Q = R = S

2. A galvanometer of resistance G giving full-scale deflection for current I_g is shunted with a resistance S. The range of the resulting ammeter is

(A) I_g(1 + G/S)
(B) I_g(1 + S/G)
(C) I_g G/S
(D) I_g/(G + S)

3. While discharging, the terminal voltage V of a cell of emf ε and internal resistance r carrying a current I is

(A) V = ε − I r
(B) V = ε + I r
(C) V = ε
(D) V = I r − ε

4. In a potentiometer, two cells of emfs $\varepsilon_1$ and $\varepsilon_2$ give balance lengths $l_1$ and $l_2$ on the same wire. The ratio $\varepsilon_1/\varepsilon_2$ equals

(A) $l_1/l_2$
(B) $l_2/l_1$
(C) $l_1 l_2$
(D) $l_1 - l_2$

5. In a metre bridge experiment the balance point is at 39.5 cm when the resistor S in the right gap is 12.5 Ω. The unknown resistance R is

(A) 8.2 Ω
(B) 12.5 Ω
(C) 4.7 Ω
(D) 20.5 Ω

6. For a cell whose balance length is $l_1$ in open circuit and $l_2$ with a shunt R in its external circuit, the internal resistance r is

(A) $r = (l_1/l_2 - 1)\ R$
(B) $r = (l_2/l_1 - 1)\ R$
(C) $r = (l_1 - l_2)\ R$
(D) $r = (l_1 + l_2)\ R/l_1$

7. State the balance condition of a metre bridge in terms of the two gap resistances and the ratio of the two wire lengths.

8. Why must an ammeter have a very low resistance?

9. Why are the connecting strips of a metre bridge made of thick copper?

10. What is a balance point in a potentiometer experiment?

## Section B — Short Answer I (4 × 2 = 8 marks)

11. A galvanometer of resistance 20 Ω gives full-scale deflection for a current of 10 mA. Find the shunt resistance needed to convert it into an ammeter of range 0–5 A.

12. The same galvanometer (20 Ω, 10 mA) is to be converted into a voltmeter of range 0–50 V. Find the resistance that must be connected in series with it.

13. In a metre bridge experiment the balance point shifts from 39.5 cm to 60.5 cm when the resistors R and S are interchanged. If S = 12.5 Ω, find R.

14. Six lead-acid secondary cells, each of emf 2.0 V and internal resistance 0.015 Ω, are joined in series to supply a resistance of 8.5 Ω. Find the current drawn from the supply and its terminal voltage.

## Section C — Short Answer II (4 × 3 = 12 marks)

15. Describe how a galvanometer is converted into an ammeter and derive the expression $S = I_g G/(I - I_g)$ for the shunt resistance.

16. Derive the balance condition $P/Q = R/S$ of a Wheatstone bridge using Kirchhoff's laws.

17. A galvanometer of resistance 30 Ω gives full-scale deflection for a current of 2 mA. Find (i) the shunt needed to measure currents up to 2 A and (ii) the series resistance needed to measure voltages up to 2 V.

18. A potentiometer is used to compare the emfs of two cells: a cell of emf 1.25 V balances at a length of 35.0 cm, and the second cell balances at 63.0 cm. Find the emf of the second cell.

## Section D — Long Answers (2 × 5 = 10 marks)

19. (a) Describe, with a labelled circuit diagram, how a potentiometer is used to determine the internal resistance of a cell, and derive the formula $r = (l_1/l_2 - 1) R$. (b) A 1.5 V cell gives a balance point at 76.3 cm in open circuit and at 64.8 cm when a resistor of 9.5 Ω is connected across it. Determine the internal resistance of the cell.

20. (a) Why is the galvanometer in a potentiometer more accurate than a voltmeter for measuring the emf of a cell? (b) Determine the current in each branch of the network of Fig 3.30 (AB = 10 Ω, BC = 5 Ω, CD = 10 Ω, DA = 5 Ω, BD = 5 Ω) connected to a 10 V battery in series with a 10 Ω resistor across A–C.

## Answer Key (Marking Scheme)

Q1 – (A) $P/Q = R/S$. Q2 – (A) $I_g(1 + G/S)$. Q3 – (A) $V = \varepsilon - I r$. Q4 – (A) $l_1/l_2$. Q5 – (A) 8.2 Ω. Q6 – (A) $r = (l_1/l_2 - 1) R$.

Q7 – $R/S = l/(100 - l)$. Q8 – An ammeter is connected in series; a large resistance would alter the current it measures. Q9 – Thick copper strips keep the (unaccounted) connection resistance negligible in the bridge formula. Q10 – The jockey position where the galvanometer shows zero deflection; the cell then draws no current.

Q11 – $S = (0.010 \times 20)/(5 - 0.010) = 0.20/4.99 \approx 0.04$ Ω. Q12 – $R = 50/0.010 - 20 = 4980$ Ω. Q13 – $R = 12.5 \times 39.5/60.5 = 8.2$ Ω. Q14 – $\varepsilon = 12$ V, $r = 0.09$ Ω: $I = 12/8.59 = 1.4$ A; $V = I \times 8.5 = 11.9$ V.

Q15 – Shunt in parallel draws $(I - I_g)$; equal p.d. Ì_g G = (I − I_g) S S̀ = $I_g G/(I - I_g)$. Q16 – At balance $I_G = 0$, potential division gives $P/Q = R/S$. Q17 – (i) $S = (0.002 \times 30)/(2 - 0.002) = 0.030$ Ω; (ii) $R = 2/0.002 - 30 = 970$ Ω. Q18 – $\varepsilon_2 = 1.25 \times 63.0/35.0 = 2.25$ V.

Q19 – (a) Standard set-up + derivation (see note); (b) $r = (76.3/64.8 - 1) \times 9.5 = 1.685 \approx 1.7\ \Omega$. Q20 – (a) At balance the cell draws no current, so the true emf is measured (a voltmeter draws a finite current and reads $V = \varepsilon - I r$). (b) Branch currents: AB = 4/17 A, BC = 6/17 A, CD = −4/17 A, DA = 6/17 A, BD = −2/17 A; total = 10/17 A.