2024 Ph H1 Q20

Section: Electricity

Topic: Sources, Internal Resistance

Question Summary
A battery is tested using a variable resistor. Measurements of terminal voltage V and current I are plotted to give a straight-line V–I graph. A student states: (I) EMF is 12 V, (II) internal resistance is 10 Ω, (III) short-circuit current is 1.2 A. Which statements are correct?

Worked Solution
For a source with internal resistance: $V = E - Ir$ (straight line with intercept E and slope $-r$).

• Internal resistance: Using points (I = 0.20 A, V = 2 V) and (I = 1.20 A, V = 12 V): $\Delta V/\Delta I = (12 - 2) / (1.20 - 0.20) = 10\ \text{V A}^{-1} \Rightarrow r = 10\ \Omega$. ☑ II correct.

• EMF: From the V-axis intercept (I = 0), E ≈ 14 V (from the graph), not 12 V ⇒ I false. ☒

• Short-circuit current: V = 0 ⇒ $I_{sc} = E/r \approx 14/10 = 1.4$ A, not 1.2 A ⇒ III false. ☒

Final Answer: B

Revision Tips

- • On V–I graphs: y-intercept gives EMF; the magnitude of the slope gives internal resistance.
- • I-intercept (where V = 0) gives the short-circuit current $I_{sc} = E/r$.
- • Use two well-spaced points on the straight line to compute gradient reliably.