Q. 02

A storage battery of emf 8.0 V and internal resistance 0.5 Ω is being charged by a 120 V dc supply using a series resistor of 15.5 Ω. What is the terminal voltage of the battery during charging? What is the purpose of having a series resistor in the charging circuit?

Answer

Emf of the storage battery, E = 8.0 V

Internal resistance of the battery, r = 0.5 Ω

DC supply voltage, V = 120 V

Resistance of the resistor, R = 15.5 Ω

Effective voltage in the circuit = V^1

R is connected to the storage battery in series. Hence, it can be written as

$V^1 = V - E$

$V^1 = 120 - 8 = 112$ V

Current flowing in the circuit = I, which is given by the relation,

$$I = \frac{V^1}{R+r}$$

$$= \frac{112}{15.5+5} = \frac{112}{16} = 7\,\text{A}$$

Voltage across resistor R given by the product, $IR = 7 \times 15.5 = 108.5$ V

DC supply voltage = Terminal voltage of battery + Voltage drop across R

Terminal voltage of battery = 120 − 108.5 = 11.5 V

A series resistor in a charging circuit limits the current drawn from the external source.

The current will be extremely high in its absence. This is very dangerous.