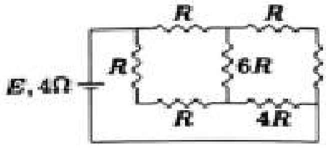
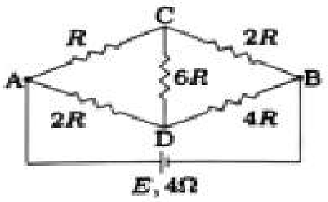
Q 14

A battery of internal resistance 4 Ω is connected to the network resistances as shown in the figure. In order that the maximum power can be delivered to the network, the value of R (in Ω) should be (1995)



(A) 4/9 (B) 2 (C) 8/3 (D) 18

Sol. Given circuit forms a balanced Wheatstone bridge.



Thus, the resistance $6R$ in branch CD can be removed. Equivalent resistance between the nodes A and B is $R_e = (R+2R) \parallel (2R+4R) = 3R \parallel 6R = 2R$. The current through the circuit is $i = \frac{E}{R_e+r} = \frac{E}{2R+4}$ and the power delivered to the network is

$$P = i^2 R_e = \frac{E^2}{2} \frac{R}{(R+2)^2}.$$

The power attains its maxima when

$$\frac{dP}{dR} = \frac{E^2}{2} \frac{(2-R)}{(R+2)^3} = 0,$$

which gives $R = 2\ \Omega$. Note that the power delivered by the battery is maximum when the load resistance (R_e) is equal to the internal resistance of the battery.

Ans. B □