Two similar wires made of the same material each of length 50cm and cross-sectional area 2mm .they are connected in series in an electric circuit to a battery of an internal resistance 0.5ohm . an electric current of 2A flows. When the wires are connected in parallel to the same battery the total current in the circuit increase to 6A : calculate the electromotive force of the battery used.

Solution

If the resistance of wire is R, resistance of battery is $r = 0.5 Ohm$, electromotive force is E, we have resistance of R_1 when they are connected in series

$$R_1 = 2R + r$$

and electric current

$$I_1 = \frac{E}{R_1} = \frac{E}{2R + r}$$

We have resistance R_2 when wires are connected in parallel

$$R_2 = \frac{R * R}{2R} + r = \frac{R}{2} + r$$

and electric current

$$I_2 = \frac{E}{R_2} = \frac{E}{\frac{R}{2} + r}$$

Hence

$$\frac{I_2}{I_1} = \frac{2R + r}{\frac{R}{2} + r} \Rightarrow$$

$$R = \frac{I_2 r - I_1 r}{2I_1 - \frac{I_2}{2}} = 2 Ohm \Rightarrow$$

$$E = I_1 * (2R + r) = 9V$$

Answer

$$E = I_1 * (2R + r) = 9V$$