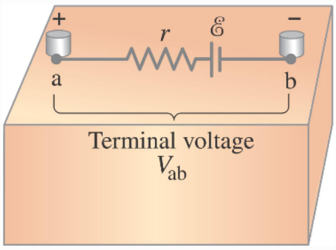
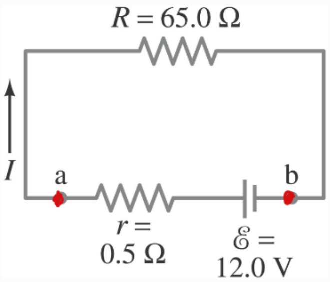
Chapter 26: DC Circuits

Emf and Terminal Voltage:



$V_{ab} = \mathcal{E} - Ir$ → r: internal resistance of battery; $\mathcal{E}$: Emf

Example 26.1



a) $V_{ab} = \mathcal{E} - Ir$, Ohm's Law: $V_{ab} = IR$

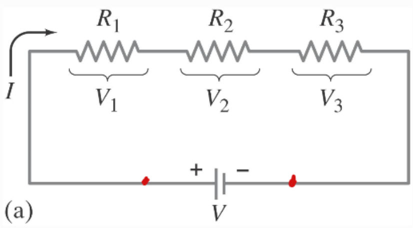
$$IR = \mathcal{E} - Ir \Rightarrow I = \mathcal{E}/(R+r)$$

$$I = \frac{12.0\,V}{(65 + 0.5)\,\Omega} \Rightarrow I = 0.183\,A$$

b) $V_{ab} = \mathcal{E} - Ir = 12.0\,V - (0.183\,A)(0.5\,\Omega) \Rightarrow V_{ab} = 11.9\,V$

c) $P = I^2R$, $P_R = (0.183\,A)^2(65.0\,\Omega) = 2.18\,W$, $P_r = (0.183\,A)^2(0.5\,\Omega) = 0.02\,W$

Resistors in Series configuration:

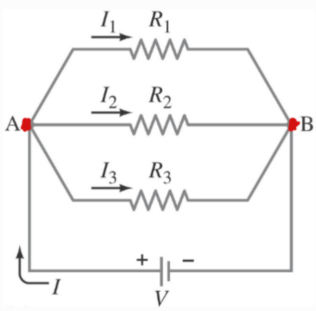


$V = V_1 + V_2 + V_3$, $V = IR_{eq}$

$$IR_{eq} = IR_1 + IR_2 + IR_3 = I(R_1 + R_2 + R_3)$$

$$R_{eq} = R_1 + R_2 + R_3$$

Resistors in Parallel configuration:

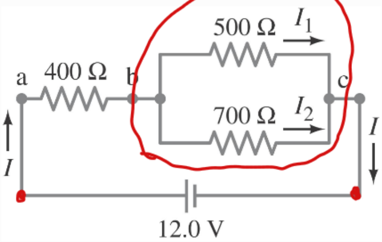


$I = I_1 + I_2 + I_3$, $I = \frac{V}{R_{eq}}$

$$\frac{V}{R_{eq}} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3} \Rightarrow \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Example 26.4

Rp



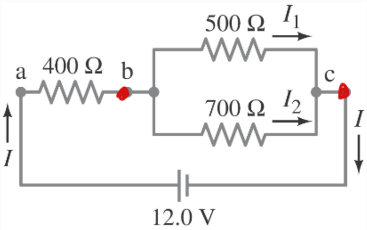
$$\frac{1}{R_P} = \frac{1}{500\,\Omega} + \frac{1}{700\,\Omega} = 0.0020\,\Omega^{-1} + 0.0014\,\Omega^{-1} = 0.0034\,\Omega^{-1}$$

$$R_p = 1/0.0034\,\Omega^{-1} \Rightarrow R_p = 290\,\Omega$$

$$R_{eq} = R_p + 400\,\Omega \Rightarrow R_{eq} = 290\,\Omega + 400\,\Omega = 690\,\Omega, \quad V = IR_{eq}$$

$$I = V/R_{eq} = 12.0\,V / 690\,\Omega = 0.0174\,A \approx 17\,mA$$

Example 26.5



$$V_{ac} = V_{ab} + V_{bc}, \quad V_{ab} = (0.0174\,A)(400\,\Omega) = 7.0\,V$$

$$V_{bc} = 12.0\,V - 7.0\,V = 5.0\,V$$

$$I_1 = (5.0\,V)/(500\,\Omega) = 1.0 \times 10^{-2}\,A = 10\,mA$$

$$I_2 = (5.0\,V)/(700\,\Omega) = 7\,mA$$

$$I_1 + I_2 = I$$