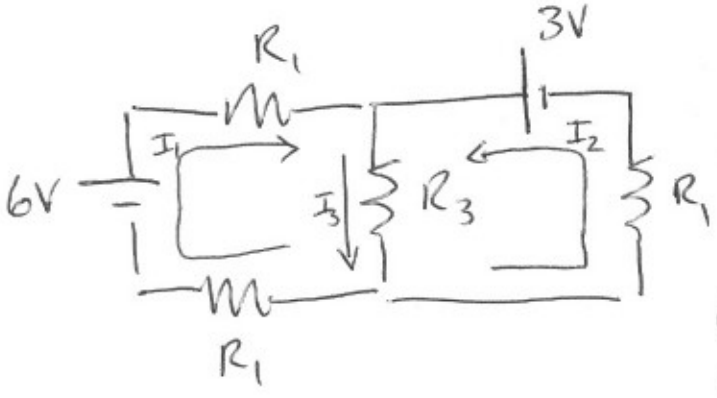
Circuits Review



$R_1 = 3\Omega$

$R_3 = 10\Omega$

(A) Find Power in R_3

(B) Find Power provided by Both Batteries.

Want Power used in R_3:

$I_3 = I_1 + I_2 \quad I_2 = I_3 - I_1$

$6V - I_1 R_1 - I_3 R_3 - I_1 R_1 = 0$

$3V - I_3 R_3 - I_2 R_1 = 0 = 3V - I_3 R_3 - (I_3 - I_1) R_1 =$ (substitute for I_2)

$6V - I_1(2.3\Omega) - I_3 10\Omega = 0$

$\frac{6V - I_3 10\Omega}{6\Omega} = I_1$ solve for I_1 and substitute in

$3V - I_3 10\Omega - I_3 3\Omega + I_1 3\Omega = 0$

$3V - I_3 13\Omega + 3\Omega\left(\frac{6V - I_3 10\Omega}{6\Omega}\right) = 0$ solve for I_3

$3V - I_3 13\Omega + 3V - I_3 5\Omega = 0 = 6V - I_3 18\Omega$

$$I_3 = \frac{6V}{18\Omega} = \frac{1}{3} A$$

$P_3 = I_3 V_3 = I_3(I_3 R_3) = I_3^2 R_3$

$P_3 = \left(\frac{1}{3}A\right)^2 \cdot 10\Omega =$ **1.11 W = $\frac{10}{9}$ W**

Find I_1 and I_2

$$I_1 = \frac{6V - I_3 10\Omega}{6\Omega} = 1A - \frac{1}{3}A \cdot \frac{10\Omega}{6\Omega} = \frac{8}{18}A = \boxed{\frac{4}{9}A = 0.44A = I_1}$$

$$I_2 = I_3 - I_1 = \frac{1}{3}A - \frac{4}{9}A = \boxed{\frac{-1}{9}A = -0.11A = I_2}$$

(so I_2 is "charging" the 3V battery.)

$$P_{6V} = I_1 V_6 = \frac{4}{9}A \cdot 6V = \boxed{2.66\,W = \frac{8}{3}\,W}$$

$$P_{3V} = I_2 V_3 = \frac{-1}{9}A \cdot 3V = \boxed{-0.33\,W = -\frac{1}{3}\,W}$$

Check Power $P_{6V} + P_{3V} + P_{R_3} + \Sigma P_{R_1} = 0$

$\frac{8}{3}W + \frac{-1}{3}W + \frac{-10}{9}W + 1.22W = 0$ ✓

(2.66) (-.33) (-1.11) (-1.22)

$\Sigma P_{R_1} = 3\Omega\left(\frac{4}{9}A\right)^2 \cdot 2 + 3\Omega\left(\frac{1}{9}\right)^2 = 1.22\,W$

Check I_2 from $\Delta V = 0$ equation

$3V - I_3 R_3 - I_2 R_1 = 0$ $\quad I_2 = \frac{3V - \frac{1}{3}A \cdot 10\Omega}{3\Omega} = 1A - \frac{10}{9}A = \frac{-1}{9}A$ ✓

Check units — ✓