P28.1 (a) $\mathcal{P} = \frac{(\Delta V)^2}{R}$

becomes $20.0\text{ W} = \frac{(11.6\text{ V})^2}{R}$

so $R = \boxed{6.73\ \Omega}$.

(b) $\Delta V = IR$

so $11.6\text{ V} = I(6.73\ \Omega)$

and $I = 1.72\text{ A}$

$\varepsilon = IR + Ir$

so $15.0\text{ V} = 11.6\text{ V} + (1.72\text{ A})r$

$r = \boxed{1.97\ \Omega}$.

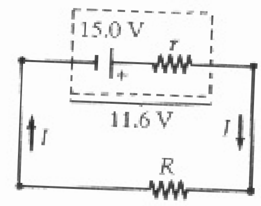


FIG. P28.1

P28.6 (a) $R_p = \frac{1}{(1/7.00\ \Omega) + (1/10.0\ \Omega)} = 4.12\ \Omega$

$R_s = R_1 + R_2 + R_3 = 4.00 + 4.12 + 9.00 = \boxed{17.1\ \Omega}$

(b) $\Delta V = IR$

$34.0\text{ V} = I(17.1\ \Omega)$

$I = \boxed{1.99\text{ A}}$ for $4.00\ \Omega$, $9.00\ \Omega$ resistors.

Applying $\Delta V = IR$, $(1.99\text{ A})(4.12\ \Omega) = 8.18\text{ V}$

$8.18\text{ V} = I(7.00\ \Omega)$

so $I = \boxed{1.17\text{ A}}$ for $7.00\ \Omega$ resistor

$8.18\text{ V} = I(10.0\ \Omega)$

so $I = \boxed{0.818\text{ A}}$ for $10.0\ \Omega$ resistor.

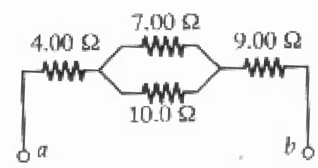


FIG. P28.6

P28.15 $R_p = \left(\frac{1}{3.00} + \frac{1}{1.00}\right)^{-1} = 0.750\ \Omega$

$R_s = (2.00 + 0.750 + 4.00)\ \Omega = 6.75\ \Omega$

$I_{\text{battery}} = \frac{\Delta V}{R_s} = \frac{18.0\text{ V}}{6.75\ \Omega} = 2.67\text{ A}$

$\mathcal{P} = I^2R$: $\mathcal{P}_2 = (2.67\text{ A})^2(2.00\ \Omega)$

$\mathcal{P}_2 = \boxed{14.2\text{ W}}$ in $2.00\ \Omega$

$\mathcal{P}_4 = (2.67\text{ A})^2(4.00\text{ A}) = \boxed{28.4\text{ W}}$ in $4.00\ \Omega$

$\Delta V_2 = (2.67\text{ A})(2.00\ \Omega) = 5.33\text{ V}$,

$\Delta V_4 = (2.67\text{ A})(4.00\ \Omega) = 10.67\text{ V}$

$\Delta V_p = 18.0\text{ V} - \Delta V_2 - \Delta V_4 = 2.00\text{ V}(= \Delta V_3 = \Delta V_1)$

$\mathcal{P}_3 = \frac{(\Delta V_3)^2}{R_3} = \frac{(2.00\text{ V})^2}{3.00\ \Omega} = \boxed{1.33\text{ W}}$ in $3.00\ \Omega$

$\mathcal{P}_1 = \frac{(\Delta V_1)}{R_1} = \frac{(2.00\text{ V})^2}{1.00\ \Omega} = \boxed{4.00\text{ W}}$ in $1.00\ \Omega$

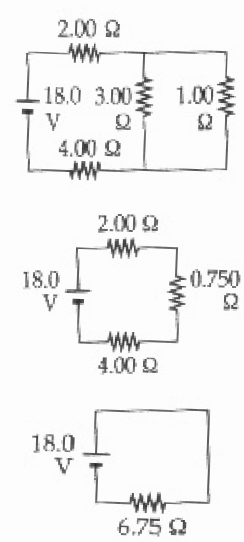


FIG. P28.15

P28.21 We name currents I_1, I_2, and I_3 as shown.

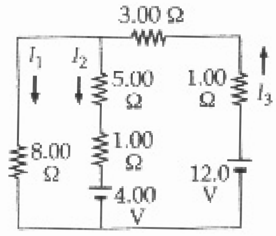


FIG. P28.21

From Kirchhoff's current rule, $I_3 = I_1 + I_2$.

Applying Kirchhoff's voltage rule to the loop containing I_2 and I_3,

$$12.0 \text{ V} - (4.00)I_3 - (6.00)I_2 - 4.00 \text{ V} = 0$$

$$8.00 = (4.00)I_3 + (6.00)I_2$$

Applying Kirchhoff's voltage rule to the loop containing I_1 and I_2,

$$-(6.00)I_2 - 4.00 \text{ V} + (8.00)I_1 = 0 \qquad (8.00)I_1 = 4.00 + (6.00)I_2.$$

Solving the above linear system, we proceed to the pair of simultaneous equations:

$$\begin{cases} 8 = 4I_1 + 4I_2 + 6I_2 \\ 8I_1 = 4 + 6I_2 \end{cases} \quad \text{or} \quad \begin{cases} 8 = 4I_1 + 10I_2 \\ I_2 = 1.33I_1 - 0.667 \end{cases}$$

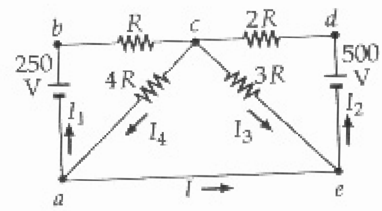
and to the single equation $8 = 4I_1 + 13.3I_1 - 6.67$

$$I_1 = \frac{14.7 \text{ V}}{17.3\ \Omega} = 0.846 \text{ A}. \qquad \text{Then} \qquad I_2 = 1.33(0.846 \text{ A}) - 0.667$$

and $\quad I_3 = I_1 + I_2 \quad$ give $\quad \boxed{I_1 = 846 \text{ mA},\ I_2 = 462 \text{ mA},\ I_3 = 1.31 \text{ A}}$.

All currents are in the directions indicated by the arrows in the circuit diagram.

P28.25 Label the currents in the branches as shown in the first figure. Reduce the circuit by combining the two parallel resistors as shown in the second figure.



(a)

Apply Kirchhoff's loop rule to both loops in Figure (b) to obtain:

$$(2.71R)I_1 + (1.71R)I_2 = 250$$

and

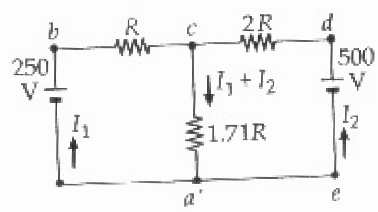
$$(1.71R)I_1 + (3.71R)I_2 = 500.$$

With $R = 1\,000\ \Omega$, simultaneous solution of these equations yields:

$$I_1 = 10.0 \text{ mA}$$

and

$$I_2 = 130.0 \text{ mA}.$$



(b)

FIG. P28.25

From Figure (b), $\quad V_c - V_a = (I_1 + I_2)(1.71R) = 240 \text{ V}.$

Thus, from Figure (a), $\quad I_4 = \dfrac{V_c - V_a}{4R} = \dfrac{240 \text{ V}}{4\,000\ \Omega} = 60.0 \text{ mA}.$

Finally, applying Kirchhoff's point rule at point *a* in Figure (a) gives:

$$I = I_4 - I_1 = 60.0 \text{ mA} - 10.0 \text{ mA} = +50.0 \text{ mA},$$

or

$$I = \boxed{50.0 \text{ mA from point } a \text{ to point } e}.$$

P28.29 We name the currents I_1, I_2, and I_3 as shown.

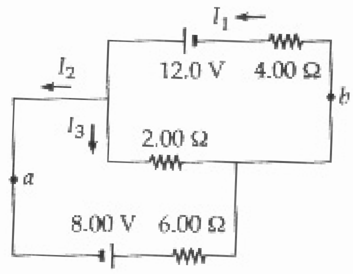


FIG. P28.29

(a) $I_1 = I_2 + I_3$

Counterclockwise around the top loop,

$12.0\text{ V} - (2.00\ \Omega)I_3 - (4.00\ \Omega)I_1 = 0.$

Traversing the bottom loop,

$8.00\text{ V} - (6.00\ \Omega)I_2 + (2.00\ \Omega)I_3 = 0$

$I_1 = 3.00 - \frac{1}{2}I_3$, $I_2 = \frac{4}{3} + \frac{1}{3}I_3$, and $\boxed{I_3 = 909\text{ mA}}$.

(b) $V_a - (0.909\text{ A})(2.00\ \Omega) = V_b$

$V_b - V_a = \boxed{-1.82\text{ V}}$

P28.31

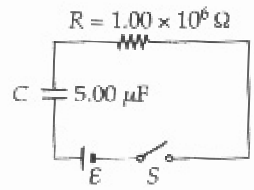


FIG. P28.31

(a) $RC = \left(1.00\times10^{6}\ \Omega\right)\left(5.00\times10^{-6}\text{ F}\right) = \boxed{5.00\text{ s}}$

(b) $Q = C\varepsilon = \left(5.00\times10^{-6}\text{ C}\right)(30.0\text{ V}) = \boxed{150\ \mu\text{C}}$

(c) $I(t) = \frac{\varepsilon}{R}e^{-t/RC} = \left(\frac{30.0}{1.00\times10^{6}}\right)\exp\left[\frac{-10.0}{\left(1.00\times10^{6}\right)\left(5.00\times10^{-6}\right)}\right] = \boxed{4.06\ \mu\text{A}}$

P28.33 $U = \frac{1}{2}C(\Delta V)^2$ and $\Delta V = \frac{Q}{C}$.

Therefore, $U = \frac{Q^2}{2C}$ and when the charge decreases to half its original value, the stored energy is one-quarter its original value: $\boxed{U_f = \frac{1}{4}U_0}$.

P28.36

(a) $\tau = RC = \left(1.50\times10^{5}\ \Omega\right)\left(10.0\times10^{-6}\text{ F}\right) = \boxed{1.50\text{ s}}$

(b) $\tau = \left(1.00\times10^{5}\ \Omega\right)\left(10.0\times10^{-6}\text{ F}\right) = \boxed{1.00\text{ s}}$

(c) The battery carries current $\frac{10.0\text{ V}}{50.0\times10^{3}\ \Omega} = 200\ \mu\text{A}$.

The 100 kΩ carries current of magnitude $I = I_0e^{-t/RC} = \left(\frac{10.0\text{ V}}{100\times10^{3}\ \Omega}\right)e^{-t/1.00\text{ s}}$.

So the switch carries downward current $\boxed{200\ \mu\text{A} + (100\ \mu\text{A})e^{-t/1.00\text{ s}}}$.