P28.2 (a) $\Delta V_{\text{term}} = IR$

becomes $10.0\text{ V} = I(5.60\ \Omega)$

so $I = \boxed{1.79\text{ A}}$.

(b) $\Delta V_{\text{term}} = \varepsilon - Ir$

becomes $10.0\text{ V} = \varepsilon - (1.79\text{ A})(0.200\ \Omega)$

so $\varepsilon = \boxed{10.4\text{ V}}$.

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

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

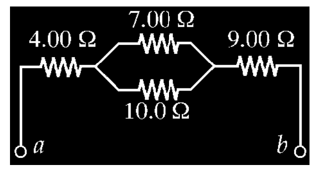

FIG. P28.6

(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.

P28.14 *When S is open,* R_1, R_2, R_3 are in series with the battery. Thus:

$$R_1 + R_2 + R_3 = \frac{6\text{ V}}{10^{-3}\text{ A}} = 6\text{ k}\Omega. \qquad (1)$$

When S is closed in position 1, the parallel combination of the two R_2's is in series with R_1, R_3, and the battery. Thus:

$$R_1 + \frac{1}{2}R_2 + R_3 = \frac{6\text{ V}}{1.2\times 10^{-3}\text{ A}} = 5\text{ k}\Omega. \qquad (2)$$

When S is closed in position 2, R_1 and R_2 are in series with the battery. R_3 is shorted. Thus:

$$R_1 + R_2 = \frac{6\text{ V}}{2\times 10^{-3}\text{ A}} = 3\text{ k}\Omega. \qquad (3)$$

From (1) and (3): $R_3 = 3\text{ k}\Omega$.

Subtract (2) from (1): $R_2 = 2\text{ k}\Omega$.

From (3): $R_1 = 1\text{ k}\Omega$.

Answers: $\boxed{R_1 = 1.00\text{ k}\Omega,\ R_2 = 2.00\text{ k}\Omega,\ R_3 = 3.00\text{ k}\Omega}$.

P28.20 $+15.0-(7.00)I_1-(2.00)(5.00)=0$

$5.00=7.00I_1$ so $\boxed{I_1=0.714\text{ A}}$

$I_3=I_1+I_2=2.00\text{ A}$

$0.714+I_2=2.00$ so $\boxed{I_2=1.29\text{ A}}$

$+\varepsilon-2.00(1.29)-5.00(2.00)=0$ $\boxed{\varepsilon=12.6\text{ V}}$

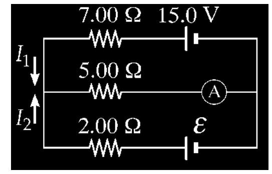

FIG. P28.20

P28.27 Using Kirchhoff's rules,

$$12.0-(0.010\,0)I_1-(0.060\,0)I_3=0$$
$$10.0+(1.00)I_2-(0.060\,0)I_3=0$$

and $I_1=I_2+I_3$

$$12.0-(0.010\,0)I_2-(0.070\,0)I_3=0$$
$$10.0+(1.00)I_2-(0.060\,0)I_3=0$$

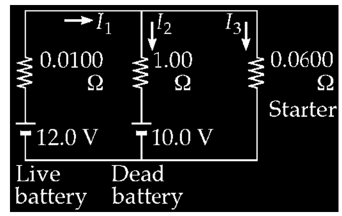

FIG. P28.27

Solving simultaneously,

$I_2=$ $\boxed{0.283\text{ A downward}}$ in the dead battery

and $I_3=$ $\boxed{171\text{ A downward}}$ in the starter.

The currents are forward in the live battery and in the starter, relative to normal starting operation. The current is backward in the dead battery, tending to charge it up.

P28.32 (a) $I(t)=-I_0e^{-t/RC}$

$$I_0=\frac{Q}{RC}=\frac{5.10\times10^{-6}\text{ C}}{(1\,300\ \Omega)(2.00\times10^{-9}\text{ F})}=1.96\text{ A}$$

$$I(t)=-(1.96\text{ A})\exp\left[\frac{-9.00\times10^{-6}\text{ s}}{(1\,300\ \Omega)(2.00\times10^{-9}\text{ F})}\right]=\boxed{-61.6\text{ mA}}$$

(b) $$q(t)=Qe^{-t/RC}=(5.10\ \mu\text{C})\exp\left[\frac{-8.00\times10^{-6}\text{ s}}{(1\,300\ \Omega)(2.00\times10^{-9}\text{ F})}\right]=\boxed{0.235\ \mu\text{C}}$$

(c) The magnitude of the maximum current is $I_0=\boxed{1.96\text{ A}}$.

P28.36 (a) $\tau=RC=(1.50\times10^{5}\ \Omega)(10.0\times10^{-6}\text{ F})=\boxed{1.50\text{ s}}$

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

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

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

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

P28.42 Applying Kirchhoff's loop rule, $-I_g(75.0\ \Omega) + (I - I_g)R_p = 0$.

Therefore, if $I = 1.00\text{ A}$ when $I_g = 1.50\text{ mA}$,

$$R_p = \frac{I_g(75.0\ \Omega)}{(I - I_g)} = \frac{(1.50\times10^{-3}\text{ A})(75.0\ \Omega)}{1.00\text{ A} - 1.50\times10^{-3}\text{ A}} = \boxed{0.113\ \Omega}.$$

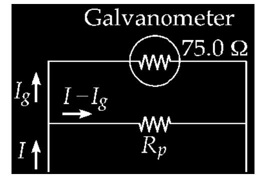

FIG. P28.42

P28.50 $I_{Al}^2 R_{Al} = I_{Cu}^2 R_{Cu}$ so $I_{Al} = \sqrt{\frac{R_{Cu}}{R_{Al}}}I_{Cu} = \sqrt{\frac{\rho_{Cu}}{\rho_{Al}}}I_{Cu} = \sqrt{\frac{1.70}{2.82}}(20.0) = 0.776(20.0) = \boxed{15.5\text{ A}}$

P28.64 The battery supplies energy at a changing rate .

Then the total energy put out by the battery is $\int dE = \int_{t=0}^{\infty} \frac{\varepsilon^2}{R}\exp\left(-\frac{t}{RC}\right)dt$

$$\int dE = \frac{\varepsilon^2}{R}(-RC)\int_0^{\infty}\exp\left(-\frac{t}{RC}\right)\left(-\frac{dt}{RC}\right) = -\varepsilon^2 C\exp\left(-\frac{t}{RC}\right)\Big|_0^{\infty} = -\varepsilon^2 C[0-1] = \varepsilon^2 C.$$

The power delivered to the resistor is .

So the total internal energy appearing in the resistor is $\int dE = \int_0^{\infty}\frac{\varepsilon^2}{R}\exp\left(-\frac{2t}{RC}\right)dt$

$$\int dE = \frac{\varepsilon^2}{R}\left(-\frac{RC}{2}\right)\int_0^{\infty}\exp\left(-\frac{2t}{RC}\right)\left(-\frac{2\,dt}{RC}\right) = -\frac{\varepsilon^2 C}{2}\exp\left(-\frac{2t}{RC}\right)\Big|_0^{\infty} = -\frac{\varepsilon^2 C}{2}[0-1] = \frac{\varepsilon^2 C}{2}.$$

The energy finally stored in the capacitor is $U = \frac{1}{2}C(\Delta V)^2 = \frac{1}{2}C\varepsilon^2$. Thus, energy of the circuit is conserved $\varepsilon^2 C = \frac{1}{2}\varepsilon^2 C + \frac{1}{2}\varepsilon^2 C$ and resistor and capacitor share equally in the energy from the battery.