26.62. Find the rate at which heat is generated in the $20.0\text{-}\Omega$ resistor using $P = V^2/R$. Then use the heat of fusion of ice to find the rate at which the ice melts. The heat dH to melt a mass of ice dm is $dH = L_F$ dm, where L_F is the latent heat of fusion. The rate at which heat enters the ice, dH/dt, is the power P in the resistor, so $P = L_F\ dm/dt$. Therefore the rate of melting of the ice is $dm/dt = P/L_F$.

The equivalent resistance of the parallel branch is $5.00\ \Omega$, so the total resistance in the circuit is $35.0\ \Omega$.

Therefore the total current in the circuit is $I_{\text{Total}} = (45.0\text{ V})/(35.0\ \Omega) = 1.286\text{ A}$.

The potential difference across the $20.0\text{-}\Omega$ resistor in the ice is the same as the potential difference across the parallel branch: $V_{\text{ice}} = I_{\text{Total}}R_{\text{p}} = (1.286\text{ A})(5.00\ \Omega) = 6.429\text{ V}$.

The rate of heating of the ice is $P_{\text{ice}} = V_{\text{ice}}^2/R = (6.429\text{ V})^2/(20.0\ \Omega) = 2.066\text{ W}$.

This power goes into to heat to melt the ice, so

$$dm/dt = P/L_F = (2.066\text{ W})/(3.34\times10^5\text{ J/kg}) = 6.19\times10^{?}\ \text{ kg/s} = 6.19\times10^{?}\ \text{ g/s}$$

26.74. Just after the switch is closed the charge on the capacitor is zero, the voltage across the capacitor is zero and the capacitor can be replaced by a wire in analyzing the circuit. After a long time the current to the capacitor is zero, so the current through R_3 is zero. After a long time the capacitor can be replaced by a break in the circuit.

(a) Ignoring the capacitor for the moment, the equivalent resistance of the two parallel resistors is

$$\frac{1}{R_{\text{eq}}} = \frac{1}{6.00\ \Omega} + \frac{1}{3.00\ \Omega} = \frac{3}{6.00\ \Omega};\ R_{\text{eq}} = 2.00\ \Omega.$$

In the absence of the capacitor, the total current in the circuit (the current through the $8.00\text{-}\Omega$ resistor) would be $i = \dfrac{\varepsilon}{R} = \dfrac{42.0\text{ V}}{8.00\ \Omega + 2.00\ \Omega} = 4.20\text{ A}$, of which 2/3, or 2.80 A, would go through the $3.00\text{-}\Omega$ resistor and 1/3, or 1.40 A, would go through the 6.00-Ω resistor. Since the current through the capacitor is given by $i = \dfrac{V}{R}e^{-t/RC}$, at the instant $t = 0$ the circuit behaves as through the capacitor were not present, so the currents through the various resistors are as calculated above.

(b) Once the capacitor is fully charged, no current flows through that part of the circuit. The 8.00-Ω and the 6.00-Ω resistors are now in series, and the current through them is $i = \varepsilon/R = (42.0\text{ V})/(8.00\ \Omega + \ 6.00\ \Omega) = 3.00\text{ A}$.

The voltage drop across both the $6.00\text{-}\Omega$ resistor and the capacitor is thus $V = iR = (3.00\text{ A})(6.00\ \Omega) = 18.0\text{ V}$. (There is no current through the $3.00\text{-}\Omega$ resistor and so no voltage drop across it.)

The charge on the capacitor is $Q = CV = (4.00\times10^{-6}\text{ F})(18.0\text{ V}) = 7.2\times10^{-5}\text{ C}$.

The equivalent resistance of R_2 and R_3 in parallel is less than R_3, so initially the current through R_1 is larger than its value after a long time has elapsed.

78.

a) In the steady state with the switch open, there is no current through the resistors and the capacitors are fully charged. So the potential across the the resistors is zero. Relative to ground, $V_a = 18.0\,\mathrm{V}$ and $V_b = 0\,\mathrm{V}$, so $V_{a,b} = 18.0\,\mathrm{V}$.

b) a

c) After a long time, the capacitors have reached a different charge level and the only current is through the resistors, which are connected in series by the switch. $R_{\mathrm{eff}} = 6.00\,\Omega + 3.00\,\Omega = 9.00\,\Omega$; $I = \dfrac{V}{R_{\mathrm{eff}}} = \dfrac{18.0\,\mathrm{V}}{9.00\,\Omega} = 2.00\,\mathrm{A}$; $V_b = I\,(3.00\,\Omega) = 6.00\,\mathrm{V}$.

d) The initial charges are $Q_{1,\mathrm{i}} = C_1\,V$, $Q_{2,\mathrm{i}} = C_2\,V$, where C_1 is the $3.00\,\mu\mathrm{F}$ capacitor. The final charges (after the new steady state is reached) are $Q_{1,\mathrm{f}} = C_1\,V_b$, $Q_{2,\mathrm{f}} = C_2\,(V - V_b)$; so $\Delta Q_1 = C_1\,(V_b - V) = (3.00\,\mu\mathrm{F})\,(6.00\,\mathrm{V} - 18.0\,\mathrm{V}) = -48.0\,\mu\mathrm{C}$; $\Delta Q_2 = C_2\,(-V_b) = -(6.00\,\mu\mathrm{F})\,(6.00\,\mathrm{V}) = -36.0\,\mu\mathrm{C}$.

84.

a) $U_{\mathrm{i}} = \dfrac{Q_{\mathrm{i}}^2}{2\,C} = \dfrac{(6.92\,\mathrm{mC})^2}{2\,(4.62\,\mu\mathrm{F})} = 5.183\,\mathrm{J}$.

b) $p(0) = v(0)\,i(0) = V_{\mathrm{i}}\,\dfrac{V_{\mathrm{i}}}{R} = \dfrac{(Q_{\mathrm{i}}/C)^2}{R} = \dfrac{(6.92\,\mathrm{mC})^2}{(850\,\Omega)\,(4.62\,\mu\mathrm{F})^2} = 2640\,\mathrm{W}$.

c) $u = \frac{1}{2}\,C\,v^2 = \frac{1}{2}\,U_{\mathrm{i}}$, so $v = \sqrt{\dfrac{U_{\mathrm{i}}}{C}}$, $p = \dfrac{v^2}{R} = \dfrac{U_{\mathrm{i}}}{R\,C} = \dfrac{5.183\,\mathrm{J}}{(850\,\Omega)\,(4.62\,\mu\mathrm{F})} = 1320\,\mathrm{W}$.