18.27 \( a) \) \[ I = \frac{\Delta V}{R}, \text{ so } \Delta V = IR \]

\[ = (50 \times 10^{-3} \text{A})(10^3 \Omega) = 50 \text{V} \]

\( b) \) To ensure that there is never a current from hand-to-hand (necessarily near the heart).

In fact, safest is to put one hand deeply in a pocket, so you don't inadvertently create a closed circuit past the heart.
This is a case where you can collapse the circuit using a combination of parallel and series combinations (this is not always possible). I'll indicate which are in series or parallel below - YOU be prepared to explain WHY. Number the 4 Ω resistors $R_1$ to $R_4$, top to bottom. Then number the 2 Ω resistors $R_5$ to $R_6$, top to bottom. $R_3$ and $R_4$ are in parallel, with equiv resistance $R_{34} = 2 \, \Omega$. Then, $R_{34}$ and $R_6$ are in series, with $R_{346} = 4 \, \Omega$. Now, $R_{346}$ is in parallel with $R_2$, with equiv $R_{2346} = 2 \, \Omega$. Now, $R_{2346}$ is in series with $R_5$.
18.55cont: $R_{23456} = 4\ \Omega$. Finally, $R_1$ is in parallel to $R_{23456}$, so the final $R_{\text{equiv}} = R_{123456} = 2\ \Omega$.

ASIDE: It helps to understand what was done if you draw the equivalent circuit at each step (it also helps with the following). For example, the first is equivalent to the diagram:

![Diagram 1]

The next step is:

![Diagram 2]

AND SO ON...
18.55 b) Culminating in

So the current crossing the battery is

\[ I = \frac{\Delta V}{R_{123456}} = \frac{6 \text{ V}}{2 \Omega} = 3 \text{ A} \]

Aside: make sure you understand what the Equivalent resistance has to do with the current through the battery.

c) To answer this, we need to know how the current divides at junction B. We answer this by realizing that the voltage drop from B to A is the same as the rise across the battery (no matter which way we go from B to A).
18.55c (cont) So we know that \( V_{\text{Batt}} = I_1 R_1 \)

So \( I_1 = \frac{6V}{4.5\Omega} = 1.5A \), which leaves 1.5A

to divide among \( R_2 \rightarrow R_6 \). Consider

FIG 1 (above) - you'll see that \( I_5 = 1.5A \)

So \( V_5 = I_5 R_5 = (1.5A)(2\Omega) = 3V \),

And so \( V_2 = 3V = I_2 R_2 \) or

\( I_2 = \frac{3V}{4.5\Omega} = 0.75A \). And so

\( I_{34} = I_6 = 3A - I_1 - I_2 \)

\( = 3A - 1.5A - 0.75A = 0.75A \).

Consider the full diagram -

\( V_3 = V_4 = V_{\text{Batt}} - V_5 - V_6 \)

\( = 6V - 3V - 1.5V = 1.5V \)

So \( I_3 = I_4 = \frac{1.5V}{4.5\Omega} = 0.375A \)
18.55 C-cm² \) \text{ Check: } \]

\[ I_1 + I_2 + I_3 + I_4 = \rightarrow \]

\[ = 1.5A + 0.75A + 0.375A + 0.375A \]

\[ = 3A = I_{\text{Ball}} \]