33. (a) We note that the R_1 resistors occur in series pairs, contributing net resistance $2R_1$ in each branch where they appear. Since $\mathcal{E}_2 = \mathcal{E}_3$ and $R_2 = 2R_1$, from symmetry we know that the currents through $\mathcal{E}_2$ and $\mathcal{E}_3$ are the same: $i_2 = i_3 = i$. Therefore, the current through $\mathcal{E}_1$ is $i_1 = 2i$. Then from $V_b - V_a = \mathcal{E}_2 - iR_2 = \mathcal{E}_1 + (2R_1)(2i)$ we get

$$i = \frac{\mathcal{E}_2 - \mathcal{E}_1}{4R_1 + R_2} = \frac{4.0\,\mathrm{V} - 2.0\,\mathrm{V}}{4(1.0\,\Omega) + 2.0\,\Omega} = 0.33\,\mathrm{A}\ .$$

Therefore, the current through $\mathcal{E}_1$ is $i_1 = 2i = 0.67\,\mathrm{A}$, flowing downward. The current through $\mathcal{E}_2$ is $0.33\,\mathrm{A}$, flowing upward; the same holds for $\mathcal{E}_3$.

(b) $V_a - V_b = -iR_2 + \mathcal{E}_2 = -(0.333\,\mathrm{A})(2.0\,\Omega) + 4.0\,\mathrm{V} = 3.3\,\mathrm{V}$.