19. Let i_1 be the current in R_1 and take it to be positive if it is to the right. Let i_2 be the current in R_2 and take it to be positive if it is upward.

(a) When the loop rule is applied to the lower loop, the result is

$$\varepsilon_2 - i_1 R_1 = 0$$

The equation yields

$$i_1 = \frac{\varepsilon_2}{R_1} = \frac{5.0\ \text{V}}{100\,\Omega} = 0.050\ \text{A}.$$

(b) When it is applied to the upper loop, the result is

$$\varepsilon_1 - \varepsilon_2 - \varepsilon_3 - i_2 R_2 = 0\ .$$

The equation yields

$$i_2 = \frac{\varepsilon_1 - \varepsilon_2 - \varepsilon_3}{R_2} = \frac{6.0\ \text{V} - 5.0\ \text{V} - 4.0\ \text{V}}{50\,\Omega} = -0.060\ \text{A}\ ,$$

or $|i_2| = 0.060\ \text{A}$. The negative sign indicates that the current in R_2 is actually downward.

(c) If V_b is the potential at point b, then the potential at point a is $V_a = V_b + \varepsilon_3 + \varepsilon_2$, so $V_a - V_b = \varepsilon_3 + \varepsilon_2 = 4.0\ \text{V} + 5.0\ \text{V} = 9.0\ \text{V}$.