12)

a. $Q < 1$ and $Q < K$

b. stay the same

c. decrease

d. $\frac{Q_{new}}{Q_{old}} = \frac{9}{1}$

$$Q_{new} = \frac{[3C]^2}{[A][B]} = 9\left(\frac{[C]^2}{[A][B]}\right) = 9\,Q_{old} \rightarrow \frac{Q_{new}}{Q_{old}} = 9$$

$$Q_{old} = \frac{[C]^2}{[A][B]}$$

e. $E_{new} = E^\circ - \frac{0.05912}{n_e} \log(9Q_{old})$

$$E_{new} = E_{old} - \frac{0.05912}{n_e} \log 9$$

$$\underbrace{E^\circ - 0.05912 \log(9Q_{old})}_{E_{new}} = \underbrace{E^\circ - \frac{0.05912}{n_e} \log Q_{old}}_{E_{old}} - \frac{0.05912}{n_e} \log 9$$

$$E_{new} = E_{old} - \frac{0.05912}{n_e} \log 9$$

$$E_{new} = 5.00\,V - \frac{0.05912}{3} V \log 9$$

$$\boxed{E_{new} = 4.98\,V}$$

$$2H^{\oplus}_A + 2e^{\ominus} \longrightarrow H_2(g)$$

$$H_2(g) + 2H^{\oplus}_A + 2e^{\ominus} \longrightarrow 2H^{\oplus}_B + 2e^{\ominus} + H_2(g)$$

$H^{\oplus}_A \longrightarrow H^{\oplus}_B$ $\quad n_e = 1$

H_A: high, outside $\qquad$ H_B: low, inside

$$E = \frac{-0.06}{n_e} \log\left(\frac{Q}{K}\right)$$

Recall $E = E^\circ - \frac{0.06}{n_e} \log Q$

$E^\circ = 0$ so $E \cdot n_e = -0.06 \log Q$

$$-\frac{E n_e}{0.06} = \log Q \leftarrow \underline{\text{KEY}}!$$

$$Q_{old} = \frac{[H^+]_{low}}{[H^+]_{high}} = 10^{-\frac{(0.150)(1)}{0.06}} = 10^{-2.5}$$

$$Q_{new} = \frac{[H^+]_{high}}{[H^+]_{low}} = \frac{1}{10^{-2.5}} = \boxed{3 \times 10^2}$$