

12.10 The catalyst only affects the rate, not the position of the equilibrium

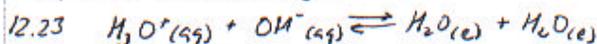
12.12 At equilibrium, $Q = K$. K_{eq} is the equilibrium constant which is constant for a given temperature. Q can be any value at all when the system isn't at equilibrium.

12.13 heterogeneous: (a), (c), (e), (f)

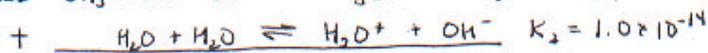
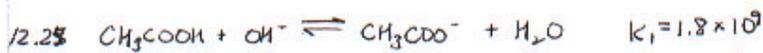
homogeneous: (b), (d)

$$12.18 \text{ (a)} \quad K = \frac{P_{NO}^4 P_{H_2O}^6}{P_{NH_3}^4 P_{O_2}^5} \quad \text{(b)} \quad K = \frac{P_{Ni} [H^+]^2}{[Cu^{2+}] [NH_4OH]^2}$$

neither $H_2O(l)$ or $Cu(s)$ appear in the equilibrium equation because they are in their "standard states".



$$K' = \frac{1}{[H_3O^+][OH^-]} = \frac{1}{K} = \frac{1}{1.0 \times 10^{-14}} = 1.0 \times 10^{14}$$



$$K_3 = K_1 K_2 = \frac{[CH_3COO^-][H_3O^+]}{[CH_3COOH][OH^-]} \times [OH^-][H_3O^+] = \frac{[CH_3COO^-][H_3O^+]}{[CH_3COOH]}$$

$$= 1.8 \times 10^9 \times 1.0 \times 10^{-14} = 1.8 \times 10^{-5}$$