

1. (2 Pts) For the following reaction at equilibrium, which gives a change that will shift the position of equilibrium to favor formation of more products?



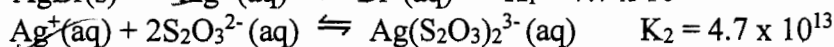
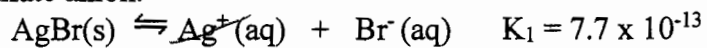
- (A) Remove Br_2 .
 B) Increase the total pressure by decreasing the volume.
 C) Remove NOBr selectively.
 D) Add more NO .
 E) Lower the temperature.

2. (4 Pts) What is the equilibrium constant, K_c , for an equilibrium mixture for the reaction

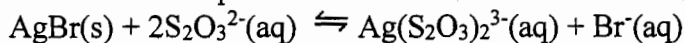
$2\text{BrCl}_3(g) \rightleftharpoons \text{Br}_2(g) + 3\text{Cl}_2(g)$ that was found to contain 1.0 mol BrCl_3 , 2.0 mol Br_2 and 6.0 mol Cl_2 in a 6.0 L vessel.

$$K_c = \frac{[\text{Br}_2][\text{Cl}_2]^3}{[\text{BrCl}_3]^2} = \frac{\left[\frac{2.0}{6.0}\right] \left[\frac{6.0}{6.0}\right]^3}{\left[\frac{1.0}{6.0}\right]^2} = 12$$

3. (5 Pts) The solubility of silver bromide can be increased by dissolving it in a solution containing the thiosulfate anion.



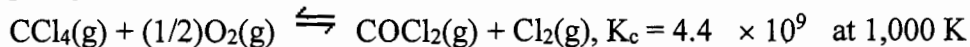
What is the value of the equilibrium constant for the overall reaction?



Since the reactions add up to \rightarrow

$$K = K_1 \times K_2 = 36$$

4. (4 Pts) Carbon tetrachloride reacts at high temperatures with oxygen to produce two toxic gases, phosgene and chlorine.



Calculate K_c for the reaction $2\text{CCl}_4(g) + \text{O}_2(g) \rightleftharpoons 2\text{COCl}_2(g) + 2\text{Cl}_2(g)$.

Since the second reaction is the first reaction doubled,

$$K = (K_{c1})^2 = (4.4 \times 10^9)^2 = 1.9 \times 10^{19}$$

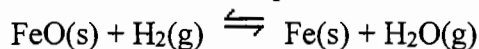
5. (3 Pts) At 700 K, the reaction $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$ has the equilibrium constant $K_c = 4.3 \times 10^6$, and the following concentrations are present: $[\text{SO}_2] = 0.10 \text{ M}$; $[\text{SO}_3] = 10. \text{ M}$; $[\text{O}_2] = 0.10 \text{ M}$. Which of the following is true based on the above? YOU MUST SHOW A CALCULATION TO SUPPORT YOUR ANSWER.

- (A) $Q_c < K_c$, the reaction proceeds from left to right to reach equilibrium
 B) $Q_c > K_c$, the reaction proceeds from left to right to reach equilibrium
 C) $Q_c < K_c$, the reaction proceeds from right to left to reach equilibrium
 D) $Q_c = K_c$, the reaction is currently at equilibrium
 E) $Q_c > K_c$, the reaction proceeds from right to left to reach equilibrium *E on tan form*

$$Q_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2 [\text{O}_2]} = \frac{(10)^2}{(0.10)^2 (0.10)} = 1.0 \times 10^5$$

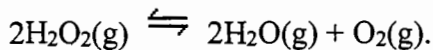
$Q_c < K_c$ more products needed \rightarrow

6. (2 Pts) Write the correct equilibrium constant expression for the following reaction?



$$K_c = \frac{[\text{H}_2\text{O}]}{[\text{H}_2]}$$

7. (5 Pts) 1.75 moles of H_2O_2 were placed in a 2.50 L reaction chamber at 307°C . After equilibrium was reached, 1.20 moles of H_2O_2 remained. Calculate the equilibrium constant, K_c , for the reaction



I 0.7M 0 0

C -2x 2x x

E $0.7\text{M} - 2x = 0.48$ 2x x

$x = 0.11 \text{ M}$

$2x = 0.22 \text{ M}$

$$K_c = \frac{[0.22]^2 [0.11]}{[0.48]^2}$$

$K_c = 2.3 \times 10^{-2}$