Chapter 15 Worksheet 2 (Reaction Quotient and Altering the Equation)

Name: UGA ID:

Instructions:

- Please enter your first and last name as it appears on the eLC roster (do not use a nickname).
- Your UGA myID is a combination of letters and numbers (example: mine is wpe28548). **Do not use your 81x number.**
- If you do not have a printer, type your answers in the then upload the worksheet template to Gradescope by Monday, March 7 at 11:59 pm. Write your work on separate sheets of paper, convert to a PDF and upload to eLC.
- If you have a printer download the worksheet, convert it to a PDF and upload to Gradescope by Monday, March 7 at 11:59 pm. You do not need to upload anything to eLC.

1a. The equilibrium constant for the reaction below is 49 at 450 °C. 0.22 mole of I_2, 0.22 mole of H_2, and 0.66 mole of HI were put into an evacuated 1.00-liter container:

$$H_2(g) + I_2(g) \rightleftharpoons 2\ HI(g)$$

A. The system is at equilibrium.

B. Reactants need to be made to get to equilibrium.

C. Products need to be made to get to equilibrium

1b. What is the equilibrium constant for the reaction when the container is 2.00 L?

2. Which of these statements about the reaction quotient, Q, is FALSE?

A. The reaction quotient and the equilibrium constant always have the same numerical value.

B. The reaction quotient may sometimes be zero.

C. The reaction quotient may be larger than the equilibrium constant.

D. The numerical value of the reaction quotient changes as the reaction proceeds.

3. Consider the following equilibria:

$H_2O(g) + CO(g) \rightleftharpoons H_2(g) + CO_2(g)$ K_1

$FeO(s) + CO(g) \rightleftharpoons Fe(s) + CO_2(g)$ K_2

Which of the following expressions gives the equilibrium constant for:

$Fe(s) + H_2O(g) \rightleftharpoons H_2(g) + FeO(s)$

A. $K = K_1K_2$

B. $K = K_1K_2^2$

C. $K = K_2/K_1$

D. $K = K_1/K_2$

E. $K = 1/(K_1K_2)$

4. Consider the following equilibria involving $SO_2(g)$ and their corresponding equilibrium constants.

$SO_2(g) + ½\ O_2(g) \rightleftharpoons SO_3(g)$ K_1

$2\ SO_3(g) \rightleftharpoons 2\ SO_2(g) + O_2(g)$ K_2

Which of the following expressions relates K_1 to K_2?

A. $K_2 = K_1^2$

B. $K_2^2 = K_1$

C. $K_2 = K_1$

D. $K_2 = 1/K_1$

E. $K_2 = 1/K_1^2$

5. For the reaction below, K_c is 1.4×10^4. The concentrations at a particular time were sampled and found to be [A] = 1.1×10^{-4} M and [B] = 0.12 M. In order to reach equilibrium

$$A \rightleftharpoons B$$

A. Nothing will happen. It is at equilibrium.

B. More A will need to be converted into B.

C. More B will need to be converted into A.

6. When reaction (1) and (2) below are added together, the result is reaction (3).

(1) $H_2O(l) + HNO_2(aq) \rightleftharpoons H_3O^+(aq) + NO_2^-(aq)$

(2) $H_3O^+(aq) + OH^-(aq) \rightleftharpoons 2\ H_2O(l)$

(3) $HNO_2(aq) + OH^-(aq) \rightleftharpoons NO_2^-(aq) + H_2O(l)$

If $K_1 = 4.50 \times 10^{-4}$, and $K_2 = 1.00 \times 10^{14}$, find the equilibrium constant, K_3.

7. Consider the reaction: HCO_3^- (aq) + H_2O (l) ⇌ CO_3^{-2} (aq)+ H_3O^+ (aq)

The K_{eq} for this reaction is 5.6×10^{-11}. Describe what will happen to the reaction if the concentration of each reactant is

$[HCO_3^-] = 5.6 \times 10^{-11}$ $[H_3O^+] = 1.2 \times 10^{-11}$ $[CO_3^-] = 5.6 \times 10^{-11}$

A. Reaction will shift right, concentration of products will increase.

B. Reaction will shift left, concentration of reactants will increase.

C. Reaction will not change, it is at equilibrium.

D. Not enough information to determine the answer.

8. For acid solutions of the same molarity acid strength is proportional to the equilibrium concentration of H_3O^+. For equimolar solutions of acids, which equilibrium expression below corresponds to the strongest acid?

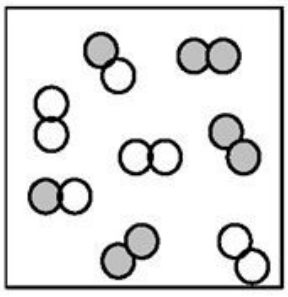
A. $K_C = \frac{[H_3O^+][F^-]}{[HF]} = 3.5 \times 10^{-4}$

B. $K_C = \frac{[H_3O^+][OC1^-]}{[HOC1]} = 3.5 \times 10^{-8}$

C. $K_C = \frac{[H_3O^+][NO_2^-]}{[HNO_2]} = 4.5 \times 10^{-4}$

D. $K_C = \frac{[H_3O^+][CN^-]}{[HCN} = 4.9 \times 10^{-10}$

9. The following picture represents the equilibrium state for the reaction $A_2 + B_2 ⇌ 2AB$. What is the relationship between the rate constant for the forward reaction, k_f, and the rate constant for the reverse reaction k_r?



A. $k_f < k_r$

B. $k_f = k_r = 0$

C. $k_f = k_r$

D. $k_f > k_r$

10. The equilibrium constant, K_p, equals 3.40 at 25 °C for the isomerization reaction:

cis-2-butene ⇌ *trans*-2-butene.

If a flask initially contains 3.00 atm of each gas, in what direction will the system shift to reach equilibrium?

A. It will shift left.

B. It will shift right.

C. The system is already at equilibrium.

D. The system is not at equilibrium and will remain in an unequilibrated state.

11. For the reaction: $N_2(g) + 2\ O_2(g) \rightleftharpoons 2\ NO_2(g)$, $K_c = 8.3 \times 10^{-10}$ at 25 °C. What is the concentration of N_2 gas at equilibrium when the concentration of NO_2 is twice the concentration of O_2 gas?

For questions 12-17, match the following:

A. reaction favors formation of more products

B. reverse reaction is favored

C. reaction will favor formation of reactants

D. reaction has a larger amount of products than reactants

E. reaction is at equilibrium

F. reaction does not strongly favor reactants or products

12. K << 1

13. K ≈ 1

14. Q < K

15. Q > K

16. Q = K

17. Q >> 1