Kingdom of Saudi Arabia
Ministry of Education
Taibah University
Unified Scientific Track

Studetn Name:
Student ID:
Section No.:

INTRODUCTION TO CHEMISTRY (CHEM 101)

Assessment on Chapter 05 - Topic 16

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1. Express the equilibrium constant for the following reaction.

$$2\ CH_3Cl_{(g)} + Cl_{2\,(g)} \rightleftharpoons 2\ CH_2Cl_{2\,(g)} + H_{2\,(g)}$$

❑ a. $K=\frac{[CH_2Cl_2].[H_2]}{[CH_3Cl].[Cl_2]}$

❑ b. $K=\frac{[CH_2Cl_2]^2[H_2]}{[CH_3Cl]^2[Cl_2]}$

❑ c. $K=\frac{[CH_3Cl]^2[Cl_2]}{[CH_2Cl_2]^2[H_2]}$

❑ d. $K=\frac{[CH_2Cl_2]^2[H_2]}{[CH_3Cl]\,[Cl_2]}$

2 Express the equilibrium constant for the following reaction.

$$N_{2\,(g)} + 3\ H_{2\,(g)} \rightleftharpoons 2\ NH_{3\,(g)}$$

❑ a. $K=\frac{[NH_3]^{1/2}}{[N_2].[H_2]^{1/3}}$

❑ b. $K=\frac{[NH_3]}{[N_2].[H_2]}$

❑ c. $K=\frac{[NH_3]^2}{[N_2].[H_2]^3}$

❑ d. $K=\frac{[N_2].[H_2]^3}{[NH_3]^2}$

3. Which of the following is the correct expression for the equilibrium constant?

❑ a. $K_c=\frac{[\text{Reactants}]}{[\text{Products}]}$

❑ b. $K_c = [\text{Reactants}] \times [\text{Products}]$

❑ c. $K_c=\frac{[\text{Products}]}{[\text{Reactants}]}$

❑ d. $K_c = [\text{Reactants}] + [\text{Products}]$

4. If K_c << 1, the reverse reaction is favored.

❑ a. True

❑ b. False

5. A chemical system is considered to have reached dynamic equilibrium when …….

❑ a. the amount of the products equals the amount of the reactants.

❑ b. all of reactants have been converted to products.

❑ c. the sum of the concentrations of the reactant species is equal to the sum of the concentrations of the product species.

❑ d. the rate of the forward reaction is equal to the rate of the reverse reaction.

6. Express the equilibrium constant for the following reaction.

$$\mathbf{P_{4\,(s)} + 5\,O_{2\,(g)} \rightleftharpoons P_4O_{10\,(s)}}$$

❑ a. $K_{eq} = \frac{[P_4].[O_2]^5}{[P_4O_{10}]}$

❑ b. $K_{eq} = \frac{[P_4O_{10}]}{[P_4].[O_2]^5}$

❑ c. $K_{eq} = [O_2]^{-5}$

❑ d. $K_{eq} = [O_2]^5$

7. Express the equilibrium constant for the following reaction.

$$\mathbf{2\,Na_{\,(s)} + 2\,H_2O_{\,(l)} \rightleftharpoons 2\,NaOH_{\,(aq)} + H_{2\,(g)}}$$

❑ a. $K_{eq} = \frac{[NaOH]^2\,[H_2]}{[Na]^2\,[H_2O]^2}$

❑ b. $K_{eq} = [H_2][NaOH]^{-2}$

❑ c. $K_{eq} = \frac{[Na]^2\,[H_2O]^2}{[NaOH]^2\,[H_2]}$

❑ d. $K_{eq} = [H_2][NaOH]^2$

8. Determine the value of Kc for the following reaction if the equilibrium concentrations are as follows: $[N_2]_{eq} = 3.6$ M; $[O_2]_{eq} = 4.1$ M; $[N_2O]_{eq} = 3.3 \times 10^{-18}$ M

$$\mathbf{2\,N_{2\,(g)} + O_{2\,(g)} \rightleftharpoons 2\,N_2O_{\,(g)}}$$

❑ a. 2.2×10^{-19} ❑ b. 4.5×10^{18} ❑ c. 2.0×10^{-37} ❑ d. 5.0×10^{36}

9. Determine the value of K_c for the following reaction, if the equilibrium concentrations are as follows: $[N_2]_{eq} = 1.5$ M; $[H_2]_{eq} = 1.1$ M; $[NH_3]_{eq} = 0.47$ M

$$\mathbf{N_{2\,(g)} + 3\,H_{2\,(g)} \rightleftharpoons 2\,NH_{3\,(g)}}$$

❑ a. 3.5 ❑ b. 0.28 ❑ c. 9.1 ❑ d. 0.11

10. Consider the following reaction at equilibrium. What effect will adding more SO_3 have on the system?

$$\mathbf{SO_{2\,(g)} + NO_{2\,(g)} \rightleftharpoons SO_{3\,(g)} + NO_{\,(g)}}$$

❑ a. The reaction will shift in the direction of products.

❑ b. The reaction will shift to decrease the pressure.

❑ c. No change will occur since SO_3 is not included in the equilibrium expression.

❑ d. The reaction will shift in the direction of reactants.

11. Consider the following reaction at equilibrium. What effect will adding more H_2S have on the system?

$$2\ H_2S_{(g)} + 3\ O_{2\ (g)} \rightleftharpoons 2\ H_2O_{(g)} + 2\ SO_{2\ (g)}$$

❑ a. The reaction will shift to the left.

❑ b. No change will be observed.

❑ c. The equilibrium constant will increase.

❑ d. The reaction will shift in the direction of products.

12. Consider the following reaction at equilibrium. What effect will reducing the volume of the reaction mixture have on the system?

$$CuS_{(s)} + O_{2\ (g)} \rightleftharpoons Cu_{(s)} + SO_{2\ (g)}$$

❑ a. The equilibrium constant will decrease.

❑ b. No effect will be observed.

❑ c. The reaction will shift to the right in the direction of the product.

❑ d. The equilibrium constant will increase.

13. Consider the following reaction at equilibrium. What effect will increasing the volume of the reaction mixture have on the system?

$$2\ H_2S_{(g)} + 3\ O_{2\ (g)} \rightleftharpoons 2\ H_2O_{(g)} + 2\ SO_{2\ (g)}$$

❑ a. The reaction will shift to the right in the direction of products.

❑ b. No effect will be observed.

❑ c. The reaction will shift to the left in the direction of reactants.

❑ d. The equilibrium constant will decrease.

14. What will happen to the following <u>endothermic</u> reaction in equilibrium if the temperature is raised?

$$N_2O_{4\ (g)} \rightleftharpoons 2\ NO_{2\ (g)}$$

❑ a. More NO_2 will be produced.

❑ b. Less NO_2 will be produced.

❑ c. More N_2O_4 will be produced.

❑ d. There will be no change in concentrations.

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1. Which of the following compounds is the weakest acid?

❑ a. HBr ❑ b. HCl ❑ c. HF ❑ d. HI

2. According to Arrhenius definition, an acid is a substance that produces …….. in water.

❑ a. NaCl ❑ b. H_2O^+ ❑ c. H^+ or H_3O^+ ❑ d. OH^-

3. One of the following acids is a diprotic acid

❑ a. HNO_3 ❑ b. $HClO_4$ ❑ c. H_2SO_3 ❑ d. H_3PO_4

4. What is the conjugate acid of HCO_3^-?

❑ a. H_3O^+ ❑ b. H_2O ❑ c. CO_3^{2-} ❑ d. OH^- ❑ e. H_2CO_3

5. What is the conjugate base of $H_2PO_4^-$?

❑ a. HPO_4^{2-} ❑ b. PO_4^{3-} ❑ c. H_3PO_4 ❑ d. H_3O^+ ❑ e. OH^-

6. Which of the following is NOT a conjugate acid-base pair?

❑ a. NH_4^+ / NH_3 ❑ b. H_3O^+ / OH^-

❑ c. H_2SO_3 / HSO_3^- ❑ d. $HC_2H_3O_2$ / $C_2H_3O_2^-$

❑ e. All of them

7. Which pair is NOT a conjugate acid-base pair?

❑ a. $(CH_3)_3NH^+$ / $(CH_3)_3N$ ❑ b. H_2SO_4 / H_2SO_3

❑ c. HNO_2 / NO_2^- ❑ d. H_3O^+ / H_2O

8. Identify a triprotic acid.

❑ a. CH_3COOH ❑ b. H_3PO_4 ❑ c. H_2SO_3 ❑ d. $HClO_4$ ❑ e. H_2SO_4

9. Calculate the pH of a solution that contains 3.9×10^{-4} M H_3O^+ at 25°C.

❑ a. 4.59 ❑ b. 3.41 ❑ c. 10.59 ❑ d. 9.41 ❑ e. 0.59

10. Calculate the pH of a solution that contains 2.4×10^{-5} M H_3O^+ at 25°C.

❑ a. 2.40 ❑ b. 9.38 ❑ c. 4.62 ❑ d. 11.60 ❑ e. 4.17

11. Calculate the hydronium ion concentration in an aqueous solution with a pH of 9.85 at 25°C.

❑ a. 7.1×10^{-5} M ❑ b. 4.2×10^{-10} M ❑ c. 8.7×10^{-10} M ❑ d. 6.5×10^{-5} M ❑ e. 1.4×10^{-10} M

12. Calculate the pH of a solution that contains 7.8×10^{-6} M OH^- at 25°C.

❑ a. 1.28 ❑ b. 5.11 ❑ c. 12.72 ❑ d. 8.89 ❑ e. 9.64

13. Calculate the pH for an aqueous solution of acetic acid that contains 2.15×10^{-3} M H_3O^+.

❑ a. 4.65×10^{-12} M ❑ b. 2.15×10^{-3} M ❑ c. 2.67 ❑ d. 11.33

14. Calculate the pH for an aqueous solution of pyridine that contains 2.15×10^{-4} M hydroxide ion.

❑ a. 4.65×10^{-11} ❑ b. 2.15×10^{-4} ❑ c. 3.67 ❑ d. 10.33

15. What is the hydronium ion concentration of an acid rain sample that has a pH of 3.45?

❑ a. 2.82×10^{-11} M ❑ b. 3.55×10^{-4} M ❑ c. 3.45 M ❑ d. 10.55 M

16. What is the hydroxide ion concentration of a lye solution that has a pH of 9.20?

❑ a. 6.31×10^{-10} M ❑ b. 1.58×10^{-5} M ❑ c. 4.80 M ❑ d. 9.20 M

17. A Lewis base is ……..

❑ a. an electron pair donor. ❑ b. an electron pair acceptor.

❑ c. a proton donor. ❑ d. proton acceptor.