

Name _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

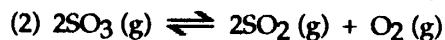
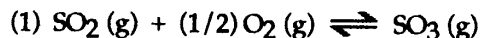
1) The relationship between the rate constants for the forward and reverse reactions and the equilibrium constant for the process is $k_{eq} =$ _____.

- A) $k_f - k_r$ B) $k_f k_r$ C) $k_f + k_r$ D) k_r / k_f E) k_f / k_r

2) The equilibrium-constant expression depends on the _____ of the reaction.

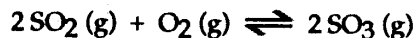
- A) stoichiometry
 B) mechanism
 C) stoichiometry and mechanism
 D) temperature
 E) the quantities of reactants and products initially present

3) The equilibrium constant for reaction 1 is K . The equilibrium constant for reaction 2 is _____.



- A) $1/2K$ B) K^2 C) $-K^2$ D) $2K$ E) $1/K^2$

4) Consider the following equilibrium.



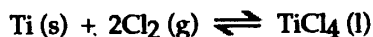
The equilibrium cannot be established when _____ is/are placed in a 1.0-L container.

- A) 1.0 mol $\text{SO}_3(\text{g})$
 B) 0.75 mol $\text{SO}_2(\text{g})$
 C) 0.25 mol of $\text{SO}_2(\text{g})$ and 0.25 mol of $\text{SO}_3(\text{g})$
 D) 0.25 mol $\text{SO}_2(\text{g})$ and 0.25 mol $\text{O}_2(\text{g})$
 E) 0.50 mol $\text{O}_2(\text{g})$ and 0.50 mol $\text{SO}_3(\text{g})$

5) A 25.00-mL sample of 0.723 M HClO_4 is titrated with a 0.273 M KOH solution. The H_3O^+ concentration after the addition of 10.0 mL of KOH is _____ M.

- A) 1.00×10^{-7} B) 0.273 C) 0.723 D) 2.81×10^{-13} E) 0.440

6) The equilibrium-constant expression for the reaction



is given by

A) $\frac{[\text{TiCl}_4 \text{ (l)}]}{[\text{Ti (s)}] [\text{Cl}_2 \text{ (g)}]^2}$

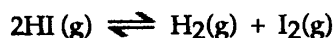
B) $\frac{[\text{TiCl}_4 \text{ (l)}]}{[\text{Ti (s)}] [\text{Cl}_2 \text{ (g)}]}$

C) $\frac{[\text{TiCl}_4 \text{ (l)}]}{[\text{Cl}_2 \text{ (g)}]^2}$

D) $\frac{[\text{Ti (s)}] [\text{Cl}_2 \text{ (g)}]^2}{[\text{TiCl}_4 \text{ (l)}]}$

E) $[\text{Cl}_2 \text{ (g)}]^{-2}$

7) A reaction vessel is charged with hydrogen iodide, which partially decomposes to molecular hydrogen and iodine:



When the system comes to equilibrium at 425°C, $P_{\text{HI}} = 0.708$ atm, and $P_{\text{H}_2} = P_{\text{I}_2} = 0.0960$ atm. The value of K_{eq} at this temperature is _____.

A) 6.80×10^{-2}

B) 1.84×10^{-2}

C) K_{eq} cannot be calculated for this gas reaction when the volume of the reaction vessel is not given.

D) 1.30×10^{-2}

E) 54.3

8) At 22°C, $K_{\text{eq}} = 0.070$ for the equilibrium:



A sample of solid NH_4HS is placed in a closed vessel and allowed to equilibrate. Calculate the equilibrium partial pressure (atm) of ammonia, assuming that some solid NH_4HS remains.

A) 4.9×10^{-3}

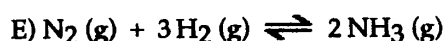
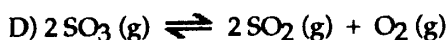
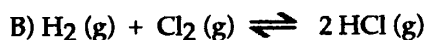
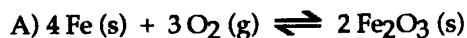
B) 0.26

C) 0.070

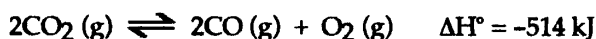
D) 0.52

E) 3.8

9) Of the following equilibria, only _____ will shift to the left in response to a decrease in volume.



10) Consider the following reaction at equilibrium:



Le Châtelier's principle predicts that an increase in temperature will _____.

- A) increase the partial pressure of CO
B) decrease the value of the equilibrium constant
C) increase the value of the equilibrium constant
D) decrease the partial pressure of $\text{CO}_2(\text{g})$
E) increase the partial pressure of $\text{O}_2(\text{g})$
- 11) What is the conjugate acid of NH_3 ?
A) NH_2^+ B) NH_4OH C) NH_3 D) NH_3^+ E) NH_4^+
- 12) The molar concentration of hydronium ion in pure water at 25°C is _____.
A) 1.0×10^{-7} B) 7.00 C) 1.00 D) 1.0×10^{-14} E) 0.00
- 13) What is the pH of an aqueous solution at 25°C in which $[\text{OH}^-]$ is 0.0025 M?
A) +2.60 B) -2.60 C) +11.40 D) -11.40 E) -2.25
- 14) The hydride ion, H^- , is a stronger base than the hydroxide ion, OH^- . The product(s) of the reaction of hydride ion with water is/ are _____.
A) $\text{OH}^-(\text{aq}) + \text{H}_2(\text{g})$
B) no reaction occurs
C) $\text{H}_3\text{O}^+(\text{aq})$
D) $\text{H}_2\text{O}_2(\text{aq})$
E) $\text{OH}^-(\text{aq}) + 2\text{H}^+(\text{aq})$
- 15) Of the following, _____ is a weak acid.
A) HCl B) HF C) HBr D) HClO_4 E) HNO_3
- 16) HZ is a weak acid. An aqueous solution of HZ is prepared by dissolving 0.020 mol of HZ in sufficient water to yield 1.00 L of solution. The pH of the solution was 4.93 at 25°C . The K_a of HZ is _____.
A) 9.9×10^{-2} B) 2.8×10^{-12} C) 1.2×10^{-5} D) 1.4×10^{-10} E) 6.9×10^{-9}
- 17) The pH of a 0.55-M aqueous solution of hypobromous acid, HBrO , at 25°C is 4.48. What is the value of K_a for HBrO ?
A) 2.0×10^{-9} B) 3.0×10^4 C) 3.3×10^{-5} D) 1.1×10^{-9} E) 6.0×10^{-5}
- 18) The acid-dissociation constants of phosphoric acid (H_3PO_4) are $K_{a1} = 7.5 \times 10^{-3}$, $K_{a2} = 6.2 \times 10^{-8}$, and $K_{a3} = 4.2 \times 10^{-13}$ at 25°C . What is the pH of a 2.5-M aqueous solution of phosphoric acid?
A) 0.13 B) 0.40 C) 0.87 D) 1.8 E) 2.5

19) Classify the following compounds as weak acids (W) or strong acids (S):

hypochlorous acid perchloric acid chloric acid

- A) W W W B) W S S C) W S W D) S S S E) S W W

20) The K_a for HCN is 4.9×10^{-10} . What is the value of K_b for CN^- ?

- A) 4.0×10^{-6} B) 2.0×10^{-5} C) 4.9×10^4 D) 4.9×10^{-24} E) 2.0×10^9

21) Of the following substances, an aqueous solution of _____ will form basic solutions.

NH_4Cl $Cu(NO_3)_2$ K_2CO_3 NaF

- A) K_2CO_3 , NH_4Cl
B) NH_4Cl , $Cu(NO_3)_2$
C) NH_4Cl only
D) NaF, K_2CO_3
E) NaF only

22) An acid containing the COOH group is called a _____.

- A) strong acid
B) double oxoacid
C) carbonaceous acid
D) carbo-oxo acid
E) carboxylic acid

23) Which one of the following pairs cannot be mixed together to form a buffer solution?

- A) H_3PO_4 , KH_2PO_4
B) NH_3 , NH_4Cl
C) KOH, HF
D) RbOH, HBr
E) $NaC_2H_3O_2$, HCl ($C_2H_3O_2^-$ = acetate)

24) What change will be caused by addition of a small amount of HCl to a solution containing fluoride ions and hydrogen fluoride?

- A) The concentration of fluoride ion will decrease and the concentration of hydrogen fluoride will increase.
B) The concentration of hydronium ions will increase significantly.
C) The concentration of fluoride ions will increase as will the concentration of hydronium ions.
D) The concentration of hydrogen fluoride will decrease and the concentration of fluoride ions will increase.
E) The fluoride ions will precipitate out of solution as its acid salt.

25) The K_a of acetic acid is 1.7×10^{-5} . The pH of a buffer prepared by combining 50.0 mL of 1.00 M potassium acetate and 50.0 mL of 1.00 M acetic acid is _____.

- A) 2.38 B) 1.70 C) 3.40 D) 0.85 E) 4.77