CH302 Test Practice Questions

1. The reaction for the synthesis of ammonia

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

is exothermic. Increasing the temperature applied to the system

- I) increases the amount of NH₃.
- II) decreases the amount of NH₃.
- III) changes the value of K_{eq}.
- IV) does not change the value of K_{eq} .
 - A. I and III only
 - B. II and III only
 - C. I and IV only
 - D. II and IV only
- 2. Given the following equilibria and equilibrium constants

$$K_1$$
 $CO_{(g)} + H_2O_{(g)} \leftrightarrow CO_{2(g)} + H_{2(g)}$

$$K_2$$
 $CH_{4(g)} + H_2O_{(g)} \leftrightarrow CO_{(g)} + 3H_{2(g)}$

$$K_3$$
 $CH_{4(g)} + 2H_2O(g) \leftrightarrow CO_{2(g)} + 4H_{2(g)}$

The correct expression for K_3 in terms of K_1 and K_2 is

A.
$$K_3 = K_1 + K_2$$

B.
$$K_3 = K_1 - K_2$$

C.
$$K_3 = K_1 K_2$$

D.
$$K_3 = K_1 / K_2$$

- E. Cannot be determined from this information.
- 3. The solubility of a gas such as O_2 in water (decreases, increases, stays the same) with increasing temperature.
- 4. For a first-order reaction, after 230 s, 33% of the reactants remain. Calculate the rate constant for the reaction.
- 5. For the reaction

$$Zn + Cu^{2+} (0.100 \text{ M}) \rightarrow Zn^{2+} (0.0100 \text{ M}) + Cu$$

the change in standard molar Gibbs free energy is -212.27 kJ/mol and the change in molar Gibbs free energy is -217.98 kJ/mol. What is the voltage produced by the cell in which this reaction occurs with the concentrations as shown in the equation and at 25°C?

- 6. What is the H⁺ ion concentration in a 0.50 mol/L solution of a weak base that has an ionization constant (K_b) of 2.0 x 10^{-8} ?
- 7. Which is the strongest base: ClO⁻, ClO₃⁻, ClO₄⁻, Cl⁻?
- 8. In the reaction $B(OH)_3 + H_2O \rightarrow B(OH)_2O + H_3O + B(OH)_3$ is acting as.a: base / acid / neither.

9. Balance the redox reaction

$$MnO_{4(aq)} + NO_{2(aq)} \rightarrow MnO_{2(s)} + NO_{3(aq)}$$

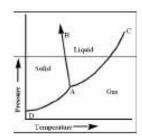
that occurs in a basic solution. What is the coefficient of MnO₄?

10. Given the following reaction:

$$Mg(OH)_{2(s)} \leftrightarrow Mg^{2+}_{(aq)} + 2OH_{(aq)}$$

Increasing the pH of the solution would cause the equilibrium to shift towards the (right, left, no shift).

- 11. If 2.50 amperes of current are passed for 45 minutes through a solution which contains Cu^{2+} , how many grams of Cu metal will be produced? Assume no other material is reduced in the process.
 - A. .9g
 - B. 1.7g
 - C. 2.2g
 - D. 2.9g
 - E. 5.6g
- 12. Given the reaction $2\text{NOCl}_{(g)} \leftrightarrow 2\text{NO}_{(g)} + \text{Cl}_{2(g)}$ $K_{eq} = 1.6 \times 10^{-5}$ If 1 mol of NOCl is placed in a 2L container, what is the equilibrium concentration of NO? Make the necessary assumptions to simplify finding your answer.
- 13. Given the reaction $2NOCl_{(g)} \leftrightarrow 2NO_{(g)} + Cl_{2(g)}$ Increasing the pressure on the system would result in an equilibrium shift to the (right, left, no shift).
- 14. Given the following phase diagram,



If the triple point is at 10 atm and 10°C, what would happen if a sample of the substance at 10 atm and 5°C was kept at constant temperature and the pressure was reduced to 0.5 atm?

15. Given the following experimental information for the reaction

$$NH_4^+_{(aq)} + NO_2^-_{(aq)} \rightarrow N_{2(g)} + 2H_2O_{(l)}$$

What is the rate law expression for this reaction?

| | Initial concentration | Initial concentration of | |
|------------|---------------------------------|--------------------------|-------------------------------------|
| Experiment | of NH ₄ ⁺ | NO_2^- | mol L ⁻¹ s ⁻¹ |
| 1 | 0.10 M | 0.0050 M | 1.35 x 10-7 |
| 2 | 0.20 M | 0.010 M | 5.40 x 10-7 |
| 3 | 0.10 M | 0.010 M | 2.70 x 10-7 |

- 16. A 100 mL sample of a liquid is contained in a 500 mL closed container at 50°C. If the temperature was increased, the vapor pressure of the liquid would (increase/decrease/stay the same).
- 17. What is E°cell for the voltaic cell utilizing this reaction: $Zn_{(s)} + Cl_{2(g)} \rightarrow ZnCl_{2(aq)}$ Given: Standard reduction potentials

$$Cl_{2(g)} + 2e \rightarrow 2 Cl_{(aq)}^{-}$$
 $E^{\circ} = +1.358 \text{ V}$
 $Zn_{(aq)}^{2+} + 2e \rightarrow Zn_{(s)}$ $E^{\circ} = -0.763 \text{ V}$

- 18. Calculate the pH of a 0.08 M HCl solution.
- 19. Calculate the pH of a 1.0 M HCN solution ($K_a = 6.2 \times 10^{-10}$).
- 20. Adding HF to water will reduce / increase / have no effect on the pH.
- 21. Calculate the pH of a solution containing 0.50 M CH₃COOH, $K_a = 1.8 \times 10^{-5}$, and 0.50 M sodium acetate, NaCH₃COO.

Consider the following unbalanced reaction for questions 22 and 23:

$$Sb + H^+ + NO_3 \rightarrow Sb_4O_6 + NO + H_2O$$

- 22. What is the oxidizing agent?
 - A. Sb
 - B. H⁺
 - C. NO₃
 - $D.\ Sb_4O_6$
 - E. NO
- 23. What is the coefficient for H^+ in the balanced equation (using the set of smallest whole numbers)?
 - A. 7
 - B. 1
 - C. 8
 - D. 2
 - E. 4

| 24. Which of the following aqueous solutions, formed by mixing the two components in each case, would act as an acid-base buffer solution? A. 100 ml of 1M HCl and 100 ml of 1M NaOH B. 100 ml of 1M NH₄Cl and 100 ml of 1M NH₃ C. 100 ml of 1M NH₃ and 100 ml of 1M HC₂H₃O₂ D. 10 ml of 1M HCl and 100 ml of 1M NaCl |
|---|
| 25. The solubility of M_2Y_3 is 1 x 10^{-10} mole per liter. What is the K_{sp} for the compound? A. 3.6×10^{-49} B. 6×10^{-28} C. 1×10^{-20} D. 1×10^{-56} |
| 26. If the ionization constant for an acid, HA, is equal to that of a base, BOH, then the solution of the salt, BA, in water (at 25°C) is expected to have a pH A. greater than 7. B. equal to 7. C. less than 7. D. which is impossible to predict. |
| 27. Consider the following reaction, initially at equilibrium. 4NH_{3(g)} + 5O_{2(g)} ↔ 4NO_(g) + 6H₂O_(g) The addition of more O₂ would: A. decrease the number of moles of NH₃ present. B. increase the number of moles of NH₃ present. C. decrease the number of moles of NO present. D. cause no change in the number of moles of H₂O present. |
| 28. At 400°C the reaction $H_{2(g)} + I_{2(g)} \leftrightarrow 2HI_{(g)}$ has an equilibrium constant, K_p , of 50.00. If an equilibrium mixture of H_2 , I_2 , and HI is such that the partial pressure of H_2 is 0.200 atm., and the partial pressure of I_2 is 0.250 atm., the <i>total</i> pressure of the equilibrium mixture is: A. 3.61 atm B. 2.03 atm C. 0.45 atm D. 32.07 atm |
| 29. Consider a reaction which is endothermic and which is accompanied by a decrease in the randomness of the system. This reaction would spontaneous at temperature. A. be, a high B. be, a low C. not be, a low D. not be, a high E. not be, any |

30. If the heat of formation, ΔH°_{f} , of $CO_{2(g)}$ is -94 kcal/mol while the heat of formation, ΔH°_{f} , of CO(g) is -26 kcal/mol, the enthalpy charge would be ____ for the unbalanced reaction below:

- A. -68 kcal/mol
- B. -120 kcal/mol
- C. -136 kcal/mol
- D. -240 kcal/mol
- E. Insufficient information given

CH302 Practice Questions Answers

- 1. B
- 2. C
- 3. decreases
- 4. 0.00482 s⁻¹
- 5. 1.13 volts
- 6. 1.0 x 10-10 mol/L
- 7. ClO-
- 8. an acid
- 9. 2 the equation is $2MnO_{4(aq)} + 3NO_{2(aq)} \rightarrow 2MnO_{2(s)} + 3NO_{3(aq)} + 2OH_{(aq)}$
- 10. left
- 11. C
- 12. 2 x 10^{-2} M Note a simplifying assumption has been made: $0.5 2x \approx 0.5$
- 13. left
- 14. it would sublime 15. Rate = $(2.7 \times 10^{-4} \text{ L mol}^{-1} \text{ s}^{-1}) [\text{NH}_4^+][\text{NO}_2^-]$
- 16. increase
- 17. 2.121 V
- 18. 1.10
- 19.4.60
- 20. reduce
- 21.4.74
- 22. C the equation is $4Sb + 4H^{+} + 4NO_{3} \rightarrow Sb_{4}O_{6} + 4NO + 2H_{2}O$
- 23. E
- 24. B
- 25. A
- 26. B
- 27. A
- 28. B
- 29. E
- 30. C