

Name: _____

June 14, 2016

Chemical Principles I

Exam 2

Some useful information: $K = (^\circ C + 273.15^\circ C) \left(\frac{1K}{1^\circ C} \right)$ STP = 1.000 atm, 0°C $PV = nRT$ $M = \frac{dRT}{P}$

1 atm = 101325 Pa = 760 torr = 760 mm Hg $R = 0.08206 \frac{L \cdot atm}{mol \cdot K}$ $\chi_a = \frac{n_a}{n_a + n_b + \dots}$ $P_a = \chi_a P_{total}$

1. You are given the balanced chemical equation:



If 1.3618 moles of AsF_3 are allowed to react with 1.000 mole of C_2Cl_6 , what would be the theoretical yield of $AsCl_3$, in moles? (6 pt)

- a. 0.3618 moles b. 0.7343 moles c. 0.7500 moles d. 1.3333 moles
e. 1.3618 moles

$$1.3618 \text{ mol } AsF_3 \times \frac{4 \text{ mol } AsCl_3}{4 \text{ mol } AsF_3} = 1.3618 \text{ mol } AsCl_3$$

$$1.000 \text{ mol } C_2Cl_6 \times \frac{4 \text{ mol } AsCl_3}{3 \text{ mol } C_2Cl_6} = 1.333 \text{ mol } AsCl_3$$

L.R.

2. A solute is

(2 pt)

- a. a solid substance which does not dissolve in water.
b. a solid substance that does not dissolve at a given temperature.
c. a substance containing a solid, liquid, or gas.
d. a substance which dissolves in a solvent.
e. a liquid that does not dissolve in another liquid.

3. A strong electrolyte is one that _____ completely in solution.

(2 pt)

- A) ionizes B) disappears C) decomposes D) reacts

4. A weak electrolyte exists predominantly as _____ in solution.

(2 pt)

- A) an isotope B) ions C) atoms D) electrons E) molecules

5. The *distinguishing* characteristic of all electrolyte solutions is that they

(2 pt)

- A) contain molecules. B) always contain acids. C) conduct heat.
D) conduct electricity. E) react with other solutions.

6. Identify the following as strong electrolytes (strong), weak electrolytes (weak), or nonelectrolytes (non). (10 pt)

HCl	<u>strong</u>	weak	non
C ₁₂ H ₂₂ O ₁₁ , sucrose	strong	weak	<u>non</u>
CaBr ₂	<u>strong</u>	weak	non
KOH	<u>strong</u>	weak	non
CH ₃ COOH, acetic acid	strong	<u>weak</u>	non

7. A neutralization reaction between an acid and a metal hydroxide produces _____. (2 pt)

- A) sodium hydroxide B) hydrogen gas C) oxygen gas D) water and a salt
 E) ammonia

8. Identify the following as strong acids, weak acids, strong bases, or weak bases. (8 pt)

KOH	strong acid	weak acid	<u>strong base</u>	weak base
HNO ₃	<u>strong acid</u>	weak acid	strong base	weak base
NH ₃	strong acid	weak acid	strong base	<u>weak base</u>
HF	strong acid	<u>weak acid</u>	strong base	weak base

9. List the formula of a polyprotic acid. (3 pt)



10. How many mL of 2.0 M HCl solution would need to be diluted to produce 0.250 L of 0.8 M HCl? (4 pt)

- a. 100 mL b. 200 mL c. 0.10 mL d. 160 mL e. 2.5 mL

$$M_1 V_1 = M_2 V_2 \quad V_1 = \frac{M_2 V_2}{M_1} = \frac{(0.8 M)(0.250 L)}{2.0 M} = 0.100 L \text{ or } 100 mL$$

11. A 15.7 mL aliquot of H₂SO₄(aq) of unknown concentration was titrated with 0.0134 M NaOH (aq). It took 23.9 mL of the base to reach the endpoint of the titration. The concentration (M) of the acid was

- A) 0.0102 B) 0.00508 C) 0.0204 D) 0.102 E) 0.227



$$23.9 mL \times \frac{L}{1000 mL} \times \frac{0.0134 mol NaOH}{L} \times \frac{1 mol H_2SO_4}{2 mol NaOH} = \frac{0.160 mol}{1000 mL}$$

$$\frac{0.160 mol \times 10^{-3}}{0.0157 L} = 0.0102$$

12. For problem 11,

a. write the net ionic equation.

(3 pt)



b. identify the spectator ions.

(2 pt)



13. Oxidation is the Loss and reduction is the Gain.

(2 pt)

A) gain of oxygen, loss of electrons

B) loss of oxygen, gain of electrons

C) loss of electrons, gain of electrons

D) gain of oxygen, loss of mass

E) gain of electrons, loss of electrons

14. The oxidation number of Cl in HClO_2 is

(2 pt)

A) +7

B) +5

C) +3

D) +1

E) +8

15. The oxidation number of N in N_2H_4 is

(2 pt)

A) +3

B) -3

C) +2

D) -2

E) 0

16. Which of these properties is/are characteristic(s) of gases?

(2 pt)

A) High compressibility

B) Relatively large distances between molecules

C) Formation of homogeneous mixtures regardless of the nature of gases

D) A and B.

E) A, B, and C.

17. A sample of gas (24.2 g) initially at 4.00 atm was compressed from 8.00 L to 4.00 L at constant temperature. After the compression, the gas pressure was _____ atm. (4 pt)

A) 4.00

B) 2.00

C) 1.00

D) 8.00

E) 16.0

$$P_1 V_1 = P_2 V_2$$

$$P_2 = \frac{P_1 V_1}{V_2} = \frac{(4 \text{ atm})(8.00 \text{ L})}{4.00 \text{ L}} = 8 \text{ atm}$$

18. A sample of a gas was isolated in a gas containment bulb on a manifold used in this type work. The volume of the bulb was 1.524 liters. The temperature was 28.40 °C, and the manifold pressure was 637.6 torr. What volume would this gas sample occupy at STP? (4 pt)

a. 1.069 L b. 1.158 L c. 1.412 L d. 1.645 L e. 2.006 L

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2} = \frac{(637.6)}{760} \frac{(1.524 \text{ L})(273.15 \text{ K})}{(301.55 \text{ K})(1.000 \text{ atm})} = 1.158 \text{ L}$$

19. A balloon originally had a volume of 4.39 L at 44 °C and a pressure of 729 torr. The balloon must be cooled to _____ °C to reduce its volume to 3.78 L (at constant pressure). (4 pt)

A) 38 B) 0 C) 72.9 D) 273 E) 546

-1 if not in K →

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$T_2 = \frac{V_2 T_1}{V_1} = \frac{(3.78 \text{ L})(317 \text{ K})}{4.39 \text{ L}} = 273 \text{ K or } 0^\circ \text{C}$$

20. A gas sample occupies a volume of 20.13 liters when the temperature is 35.2 °C and the pressure is 735.5 torr. How many moles of gas are in the sample? (4 pt)

a. 0.721 moles b. 0.770 moles c. 1.29 moles d. 5.41 moles e. 6.31 moles

$$n = \frac{PV}{RT} = \frac{(735.5)(20.13)}{(0.08206)(308.35)} = 0.770 \text{ mol}$$

21. A gas sample weighing 5.20 grams occupies a volume of 2.28 L at STP. What is the molecular mass of the sample? (4 pt)

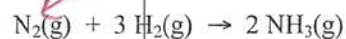
a. 8.54 g mol⁻¹ b. 13.5 g mol⁻¹ c. 37.1 g mol⁻¹ d. 51.1 g mol⁻¹ e. 193 g mol⁻¹

$$M = \frac{(5.20 \text{ g})}{\left(\frac{2.28 \text{ L}}{1.000 \text{ atm}}\right) \left(\frac{1}{273.15 \text{ K}}\right)} = 51.1 \frac{\text{g}}{\text{mol}}$$

22. Which of the following gases will have the greatest density at the same specified temperature and pressure? (3 pt)

a. He b. SF₆ c. CO₂ d. CH₄ e. CFH₃

23. The reaction of 50 mL of N_2 gas with 150 mL of H_2 gas to form ammonia via the equation:



will produce _____ mL of ammonia if pressure and temperature are kept constant. (4 pt)

- A) 250 B) 50 C) 200 D) 150 E) 100

24. The volume of hydrogen gas at 38.0 °C and 763 torr that can be produced by the reaction of 4.33 g of zinc with excess sulfuric acid is _____ L. (6 pt)



- A) 1.68 B) 2.71×10^{-4} C) 3.69×10^4 D) 2.84 E) 0.592

$$4.33 \text{ g Zn} \times \frac{1 \text{ mol Zn}}{65.38 \text{ g Zn}} \times \frac{1 \text{ mol H}_2}{1 \text{ mol Zn}} = 0.0662 \text{ mol H}_2$$

$$V = \frac{nRT}{P} = \frac{(0.0662 \text{ mol})(0.08206)(311.15)}{(763/760)} = 1.68 \text{ L}$$

25. A mixture of 5.00 moles of neon and 3.00 moles of nitrogen occupy a volume of 36.0 L in a vessel where the total pressure is 6.00 atm. The partial pressure of the neon in the container is (4 pt)

- a. 0.375 atm b. 0.625 atm c. 0.833 atm d. 3.75 atm e. 43.2 atm

$$X_{Ne} = \frac{5 \text{ mol}}{8 \text{ mol}} = 0.625$$

$$P_{Ne} = (0.625)(6.00 \text{ atm}) = 3.75 \text{ atm}$$

26. Which one of the following gases would have the highest average molecular speed at 25 °C? (3 pt)

- A) O_2 B) CO_2 C) NH_3 D) Cl_2 E) SF_6

27. The deviation from ideal behavior of a gas is most evident at _____

High pressure

_____ and/or low temperature.

(2 pt)