Exam 3

Part I: Multiple Choice (2 points each)

Directions: Please circle the *best* answer for each of the following questions.

Question 1. In the reaction of hydrogen gas with oxygen gas to produce water, 1.00 mol of oxygen gas can produce \_\_\_ mol of water, given sufficient hydrogen.

1. 0.50 mol
2. 1.00 mol
3. 2.00 mol
4. 3.00 mol
5. 4.00 mol

Question 2. When 1.00 mol of sodium chloride reacts with 0.500 mol of silver nitrate, sodium chloride is the limiting reagent.

NaCl (aq) + AgNO3 (aq) 🡪 NaNO3 (aq) + AgCl (s)

1. 2.00 mol AgCl produced
2. 0.25 mol of AgNO3 left
3. true
4. false
5. none of the above

Question 3. Use VSEPR theory to predict the shape of oxygen difluoride, OF2.

1. Bent with bond angles < 120°
2. Trigonal planar
3. Bent with bond angles <109.5°
4. Tetrahedral
5. Trigonal pyramidal

Question 4. If the electronegativity difference between elements X and Y is 2.1, the bond between the elements X-Y is \_\_\_\_\_\_\_\_\_\_\_\_.

1. nonpolar ionic
2. polar covalent
3. impossible
4. nonpolar covalent
5. ionic

Question 5. Which measurement describes the pressure of a gas?

1. 1.2 g/L
2. 315 K
3. 0.45 moles
4. 2.5 L
5. 96.7 kPa

Question 6. The ability of an atom to attract the shared electrons in a covalent bond is its \_\_\_\_\_\_\_\_\_\_\_\_.

1. ionic character
2. electronegativity
3. polarity
4. nonpolarity
5. bonding ability

Question 7. Which of the following is not part of the kinetic molecular theory of gases?

1. A gas is composed of very small particles.
2. Gas particles move rapidly.
3. Gas particles do not attract/repel one another.
4. Gas particles move faster when the temperature increases.
5. There is very little empty space in a gas.

Question 8. In the reaction of aluminum and iron(III) oxide to form iron and aluminum oxide, energy is given off. This reaction is \_\_\_\_\_\_\_\_.

1. Al (s) + Fe2O3 (s) 🡪 2 Fe (s) + Al2O3 (s)
2. single replacement
3. double replacement
4. catalytic
5. combination
6. decomposition

Question 9. What is the best coefficient for water for the reaction:

C2H2 (g) + O2 (g) 🡪 CO2 (g) + H2O (g)

1. 0.5
2. 1
3. 1.5
4. 2
5. 3

Question 10. Which activity is part of the safety ethic in the chemistry laboratory?

1. Valuing safety
2. Preventing at-risk behavior
3. Reporting incidents immediately
4. Accepting responsibility for safety
5. all of the above

Part II: Short Answer

Directions: Answer each of the following questions. Be sure to use complete sentences where appropriate. For full credit be sure to show all of your work.

Question 1. The four major attractive forces between particles are ionic bonds, dipole-dipole attractions, hydrogen bonds, and dispersion forces (8 points).

* 1. Classify each compound by its predominant attractive or intermolecular force among atoms or molecules of the same type.

MgF2 ionic

HF hydrogen bonding

HBr dipole

N2 dispersion

* 1. Based upon the intermolecular forces present, rank the substances according to the expected boiling point for the substance from highest to lowest boiling point.

MgF2 > HF > HBr > N2

Question 2. Which of these molecules exhibits resonance structures (4 points)?

1. Ozone, O3 resonance structures
2. H2O no resonance structures
3. CO32- resonance structures
4. CCl4 no resonance structures

Question 3. Classify these molecules as polar or nonpolar (6 points).

* 1. CCl4 nonpolar
	2. H2O polar
	3. BCl3 nonpolar
	4. H2 nonpolar
	5. HF polar
	6. CH3Cl polar

Question 4. Classify each process as endothermic or exothermic (5 points).

1. Evaporation endothermic
2. Freezing exothermic
3. Condensation exothermic
4. Melting endothermic
5. Sublimation endothermic

Question 5. Compare and contrast the electron pair geometries, molecular shapes, bond angles, and polarities of carbon tetrabromide, CBr4, and nitrogen tribromide, NBr3 (10 points).



Question 6. A container of variable volume contains oxygen gas at a pressure of 550.0 kPa. At 25.0 °C, what is the new pressure inside the container if the container is allowed to expand from an initial volume of 5.20 L to a final volume of 7.25 L (6 points)?

P1 = 550.0 kPa

T = 25.0 °C

V1 = 5.20 L

V2 = 7.25 L

P2 = ?

$$PV=nRT⇒PV=contant⇒P\_{1}V\_{1}=P\_{2}V\_{2}⇒P\_{2}=P\_{1}\frac{V\_{1}}{V\_{2}}$$

$$P\_{2}=\left(550.0 kPa\right)\left(\frac{5.20 L}{7.25 L}\right)=394 kPa$$

Question 7. How many grams of chlorine gas are present in a 150. liter cylinder of chlorine held at a pressure of 1.00 atm and 0. °C (8 points)?

V = 150. L

P = 1.00 atm

T = 0. °C + 273 = 273 K

m = ?

$$PV=nRT⇒n=\frac{PV}{RT}=\frac{\left(1.00 atm\right)(150.L)}{\left(0.0821 \frac{L atm}{mol K}\right)(273 K)}×\frac{70.90 g Cl\_{2}}{1 mol Cl\_{2}}=474 g Cl\_{2}$$

$$STP conditions: 150.L×\frac{1 mol }{22.4 L}×\frac{70.90 g Cl\_{2}}{1 mol Cl\_{2}}=475 g Cl\_{2}$$

Question 8. Zinc metal, Zn, was allowed to react with hydrochloric acid, HCl, to produce hydrogen gas, H2, and aqueous zinc chloride, ZnCl2, and gave a total of 555 mL of gas collected over water at 20 °C and a pressure of 747 mm Hg (15 points).

1. Write the balanced chemical equation.

Zn (s) + 2 HCl (aq) 🡪 ZnCl2 (aq) + H2 (g)

1. What is the pressure of the dry hydrogen gas in atm, if the vapor pressure of water at 20 °C is 18 mm Hg?

$$P\_{total}=P\_{H\_{2}}+P\_{H\_{2}O}⇒P\_{H\_{2}}=P\_{total}-P\_{H\_{2}O}$$

$$P\_{H\_{2}}=747 mm Hg-18 mm Hg=729 mm Hg×\frac{1 atm}{760 mm Hg}=0.959 atm$$

1. How many moles of hydrogen gas were collected (hint use your pressure of hydrogen from part b)?

Phydrogen gas = 0.959 atm

V = 555 mL

T = 20 °C + 273 = 293 K

n = ?

$$PV=nRT⇒n=\frac{PV}{RT}=\frac{\left(0.959 atm\right)(555 mL)}{\left(0.0821 \frac{L atm}{mol K}\right)(293K)}×\frac{1 L}{1000 mL}=0.0221 mol H\_{2}$$

Question 9. The first step in the production of nitric acid is the formation of nitric oxide, NO, according to the following balanced equation (8 points):

 4 NH3 (g) + 5 O2 (g) 🡪 4 NO (g) + 6 H2O (g) + 906 kJ

1. Is this reaction exothermic or endothermic? \_\_\_\_exothermic\_\_\_\_\_\_\_\_
2. How many kJ are given off by the conversion of 34.0 g of ammonia?

$$34.0 g NH\_{3}×\frac{1 mol NH\_{3}}{17.04 g NH\_{3}}×\frac{906 kJ}{4 mol NH\_{3}}=452 kJ released or-452 kJ $$

Question 10. A student carried out this reaction with methane as the limiting reagent. A 12.0 g quantity of methane was used, and the student collected 22.0 g of carbon dioxide (12 points).

1. Balance the reaction:

CH4 (g) + 2 O2 (g) 🡪 CO2 (g) + 2 H2O (l)

1. What is the theoretical yield of carbon dioxide?

$$12.0 g CH\_{4}×\frac{1 mol CH\_{4}}{16.04 g CH\_{4}}×\frac{1 mol CO\_{2}}{1 mol CH\_{4}}×\frac{44.01 g CO\_{2} }{1 mol CO\_{2}}=32.9 g CO\_{2}$$

1. What is the percent yield of carbon dioxide?

$$\% yield=\frac{actual yield}{theoretical yield}×100=\frac{22.0 g CO\_{2}}{32.9 g CO\_{2}}×100=66.8\% $$