Exam 4

# Part 1: Multiple Choice (2 points each)

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

1. What type(s) of intermolecular forces are in formaldehyde, H2CO?
2. London forces
3. dispersion forces
4. hydrogen bonding
5. a & b only
6. all of the above
7. If the heat of vaporization of mercury is 59 kJ/mol, what is the heat of condensation?
	1. 59 kJ/mol
	2. -59 kJ/mol
	3. -0.29 kJ/g
	4. b & c only
	5. none of the above
8. Which of the following pairs would not dissolve in one another?
	1. water and sodium fluoride
	2. methanol, CH3OH, and water
	3. hexane, C6H14, and potassium chloride
	4. all of the above
	5. none of the above
9. Which of the following will increase the rate of dissolving of a solid in a solution?
	1. increase solution temperature
	2. decrease the solid’s particle size
	3. mix the solution
	4. all of the above
	5. none of the above
10. If 75.00 mL is added to 15.00 mL of a 0.75 M KCl solution, what is the new molarity?
	1. 0.125 M
	2. 0.015 M
	3. 0.13 M
	4. 4.5 M
	5. none of the above
11. A mixture of gases consists of helium at a partial pressure of 400. torr, neon at a partial pressure of 300. torr, and argon at a partial pressure of 200. torr. What is the total pressure of the gases?
	1. 760. torr
	2. 300. torr
	3. 900. torr
	4. 1000 torr
	5. 1 atm
12. A solution is considered basic if the [H3O+] \_\_\_\_\_\_ [OH-].
	1. less than
	2. greater than
	3. equal to
	4. 7
	5. none of the above
13. Name the acid: H2S (aq)
	1. hydrosulfuric acid
	2. sulfuric acid
	3. sulfurous acid
	4. dihydrogen monosulfide
	5. hydrogen sulfide
14. What is the conjugate acid of the bisulfate ion, HSO4-?
	1. H2SO4
	2. SO42-
	3. HSO4-
	4. all of the above
	5. none of the above
15. Name the piece of equipment:



# Part 2: 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.

1. A 25.0 g piece of ice at 0.0 °C is added to a sample of water at 6.0 °C. All of the ice melts and the temperature of the water decreases to 0.0 °C. How many grams of water were in the sample? Cice = 2.06 J/g °C, cwater  = 4.184 J/g °C, ∆Hfus = 333 J/g (8 points).

qin = - qout

mice∆Hwater = - mwatercwater∆Twater

(25.0 g)(333 J/g) = - mwater(4.184 J/g °C)(0.0 °C – 6.0 °C)

8.33 × 104 J = - mwater(4.184 J/g °C)(-6.0 °C)

* 1. × 104 J = -mwater(-25 J/g)

8.33 × 103 g = mwater

1. Select the one substance that has the corresponding property (8 points).
	1. Strongest dipole force H2S SCl2 SF2
	2. Highest vapor pressure as solids CO2 (s) SO2 (s) SiO2 (s)
	3. Strongest hydrogen bonding H2O (l) H2S (l)  H3COH (l)
	4. Greatest surface tension as liquids CH3OH (l) C2H5OH (l) C3H7OH (l)
	5. Strongest London forces CH4 SiF4 GeF4
	6. Lowest viscosity as liquids HCl (l) HBr (l) HI (l)
	7. Highest boiling point as liquids AsH3 (l) PH3 (l) NH3 (l)
2. Identify each as metallic, covalent network, ionic, or molecular solid (5 points).
	1. CO2 (s) \_\_\_\_\_\_\_\_\_molecular solid
	2. NaCl (s) \_\_\_\_\_\_\_\_\_ionic solid
	3. Ag (s) \_\_\_\_\_\_\_\_\_metallic solid
	4. C (s), diamond \_\_\_\_\_\_\_\_\_covalent network solid
	5. I2 (s) \_\_\_\_\_\_\_\_\_molecular solid
3. The solubility of potassium chloride at 20 °C is 34.0g/100 g H2O and at 50 °C is 42.6 g/100 g H2O. Determine whether adding 25.0 g potassium chloride, KCl, to 100 g H2O will produce a saturated or unsaturated solution at 20 °C (4 points).

$$\frac{25.0 g KCl}{100 g H\_{2}O}<\frac{34.0 g KCl}{100 g H\_{2}O}, therefore the solution is unsaturated at 20 °C.$$

1. How would the concentration change if a 1.0 L flask of 1.0 M sodium chloride solution were left uncapped on a laboratory bench for several days? Why (4 points)?

The concentration would increase over time as the water evaporates from the solution. As the water/solvent in the solution decreases the amount of sodium chloride/solute will remain the same.

1. Answer the following questions for dinitrogen dioxide (6 points):
	1. Draw the Lewis structure; the nitrogens are in the middle.



* 1. Name the intermolecular force(s).

There are London/dispersion forces and dipole-dipole forces.

1. A 2.539 M solution of aluminum chloride has a density of 1.132 g/mL (8 points).
	1. How many grams of aluminum chloride are there in every liter of solution?

$$1 L ×\frac{2.539 mol AlCl\_{3}}{1 L}×\frac{133.341 g AlCl\_{3}}{1 mol AlCl\_{3}}=338.6 g AlCl\_{3}$$

* 1. What is the concentration of chloride ions in the solution?

$$\frac{2.539 mol AlCl\_{3}}{1 L}×\frac{3 mol Cl^{-}}{1 mol AlCl\_{3}}=7.617 M Cl^{-} $$

1. A solution is prepared with 22.0 g sodium hydroxide and 118.0 g water. It has a density of 1.15 g/mL and a total volume of solution of 0.1217 L (10 points).
	1. What is the mass percent of the NaOH solution?

$mass\%=\frac{m\_{solute}}{m\_{solution}}×100\%=\frac{22.0 g NaOH}{22.0 g+118.0 g}×100\%=\frac{22.0 g }{140.0 g}×100\%=15.7\% NaOH$

* 1. What is its molarity (M)?

$$M=\frac{mol solute}{L solution}=\frac{22.00 g NaOH}{0.1217 L}×\frac{1 mol NaOH}{40.00 g NaOH}=4.52 M NaOH$$

1. For each reaction below: (1) identify each reaction below as an Arrhenius acid-base reaction, a Brønsted-Lowry acid-base reaction, or a Lewis acid-base reaction; (2) indicate the acid and conjugate acid if present and the base and conjugate base if present in each reaction (11 points).
2. NH3 (g) + BF3 (g) → BF3NH3 (g)  Lewis

base acid

HNO2 (aq) + PO43- (aq) $⇌$ HPO42- (aq) + NO2- (aq) Brønsted-Lowry

B.L. acid B.L. base c.a. c.b.

1. 2 CsOH(aq) + H2SO4 (aq) → 2 H2O (l) + Cs2SO4 (aq) Arrhenius

 base acid

1. Determine each of the following for a 0.050 M KOH solution (16 points).
	1. What is the hydronium ion concentration, [H3O+]?

$$\left[OH^{-}\right]=\frac{0.050 mol KOH}{1 L soln}×\frac{1 mol OH^{-}}{1 mol KOH}=0.050 mol OH^{-}$$

[H3O+] = ?

$$K\_{w}=\left[H\_{3}O^{+}\right]\left[OH^{-}\right]⟹\left[H\_{3}O^{+}\right]= \frac{K\_{w}}{[OH^{-}]}=\frac{1.0×10^{-14}}{0.050}=2.0×10^{-13} M$$

or

[H3O+] = 10-pH = 10-12.70 = 2.0 × 10-13 M

* 1. What is the pH of the solution?

pH = - log[H3O+] = -log(2.0 × 10-13) = 12.70

or

pH + pOH = 14.000 → pH = 14.000 - pOH = 14.00 – 1.30 = 12.70

* 1. What is the pOH of the solution?

pH + pOH = 14.000 → pOH = 14.000 - pH = 14.00 – 12.70 = 1.30

or

pOH = - log[OH-] = -log(0.050) = 1.30

* 1. Is the solution acidic, basic, or neutral? \_\_\_\_\_\_\_\_\_basic
	2. How many mL is required to neutralize 40.0 mL of 0.035 M sulfuric acid, H2SO4? Hint: write the reaction first.

2 KOH (aq) + H2SO4 (aq) → 2 H2O (l) + K2SO4 (aq)

$$40.0 mL H\_{2}SO\_{4} soln×\frac{0.035 mmol H\_{2}SO\_{4} }{1 mL H\_{2}SO\_{4} soln}×\frac{2 mmol KOH}{1 mmol H\_{2}SO\_{4}}×\frac{1 mL KOH soln}{0.050 mmol KOH}=56 mL KOH soln$$