Name_____ Date_____ Hour_____

Review – Chemistry Final Exam

1) Arrange Li, Sn, Cl, Bi by increasing atomic radius (smallest to largest). Explain how you made your decision.

Li, Cl, Sn, Bi

- # of shells increase as you go down periodic table, leading to a bigger radius

2) Arrange Al, Si, P, S by increasing atomic radius (smallest to largest). Explain how you made your decision.

S, P, Si, Al

- From left to right, the # of protons and electrons increase, leading to and increased +/- attraction and a smaller radius.

3) Describe the octet rule.

Atoms bond with other atoms in order to have a full outer shell, 8 valence electrons.

* Driving force behind bond formation

4) Describe VSEPR.

Valence Shell Electron Pair Repulsion

- Electron Pairs want to be as far away as possible from other electron pairs → this determines molecular geometry

5) How do you decide whether or not a bond is polar?

If the atoms forming the bond have the same electronegativity, then the bond is non-polar (no pull).
If the atoms forming the bond have different electronegativities, Then the bond is polar (there is a pull!).

6) Describe the difference between ionic bonds and covalent bonds.

Ionic Bonds - electrons are transferred
Covalent Bonds - electrons are shared

Electronegativity Difference Scale

0 Covalent 1.7 Ionic 3.3

7) What type of bonding (ionic or covalent) occurs in each of the following?

a) NaCl $3.0 - 0.9 = 2.1$ → Ionic

b) CO $3.5 - 2.5 = 1.0$ → Covalent

c) $BaCl_2$ $3.0 - 0.9 = 2.1$ → Ionic

$PV = nRT$

8) Assuming all other conditions are held constant, what happens to the volume of a gas as pressure increases? $P_1V_1 = P_2V_2$ (inverse)

P↑ V↓

9) Assuming all other conditions are held constant, what happens to the volume of a gas as the number of moles increases? $\frac{V_1}{n_1} = \frac{V_2}{n_2}$ (direct)

n↑ V↑

10) Assuming all other conditions are held constant, what happens to the volume of a gas as the temperature increases? $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ (direct)

T↑ V↑

11) Assuming all other conditions are held constant, what happens to the pressure of a gas as the temperature increases? $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

T↑ P↑

12) (T) or F Gases are compressible. Explain.
Molecules that make up gases are far apart and can be moved closer together.

13) (T) or F Gases have low density. Explain.
$Density = \frac{Mass}{Volume}$ Gases can occupy a large volume with little mass, leading to low density.

14) (T) or F Gases expand to fill a container. Explain.
Gas molecules can go wherever they like, they are independant of one another, and will spread out until the concentration is uniform.

15) Explain each of the following in terms of beginning state (solid, liquid, gas) and ending state.

a) Melting Solid → Liquid
b) Freezing Liquid → Solid
c) Boiling Liquid → Gas
d) Evaporation Liquid → Gas
e) Condensation Gas → Liquid
f) Sublimation Solid → Gas
g) Deposition Gas → Solid

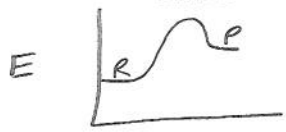
16) Why do we put salt on our roads in the winter? Use colligative properties to explain.
Adding particles of solute to a solvent will lower the overall vapor pressure leading to a depressed freezing point. So, salt (solute) is applied to roads in the winter so that a temperature colder than the normal freezing point is needed to create icy roadways.

17) What is another name for average kinetic energy?

Temperature

18) What is the difference between the graph of an endothermic reaction and an exothermic reaction? Draw pictures to help explain.

ENDO - gain energy



• Products have more energy than reactants

EXO - lose energy

• Products have less energy than reactants

19) What is produced when you mix the following acids and bases?

a. $HCl + KOH \rightarrow KCl + H_2O$

b. $HBr + LiOH \rightarrow LiBr + H_2O$

c. $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2HOH$

20) Use the given information to determine if the solution is acidic, basic or neutral.

a. pH = 2 Acid

b. pOH = 12 pH = 2 Acid

c. pOH = 7 Neutral

d. pH = 8 Base

21) If 756 mL (V_1) of hydrogen are collected at a pressure of 855 mbar (P_1), what volume (V_2) will the gas occupy if the pressure were changed to 760 mbar (P_2)? $PV = nRT$

$P_1V_1 = P_2V_2$

$$\frac{(855\ mbar)(756\ mL)}{760\ mbar} = \frac{(760\ mbar)(V_2)}{760\ mbar}$$

$V_2 = 850\ mL$

22) If a sample of gas occupies 5.7 L (V_1) at 340 degrees C ($T_1 = 340°C + 273.15 = 613.15K$), what will its volume (V_2) be at 32 degrees C if the pressure does not change?

$T_2 = 32°C + 273.15 = 305.15K$ $PV = nRT$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad \frac{5.7L}{613.15K} = \frac{V_2}{305.15K}$$

$V_2 = 2.8\ L$

$T = 24°C + 273.15 = 297.15\,K$

23) Determine the volume (V) of a gas occupied by 0.759 moles (n) at 24 degrees C and at a pressure of 0.923 atm (P). $\left(R = 0.0821 \frac{L \cdot atm}{K \cdot mol}\right)$

$\frac{PV}{P} = \frac{nRT}{P} \qquad V = \frac{nRT}{P}$

$$V = \frac{(0.759\ mol)\left(0.0821 \frac{L \cdot atm}{K \cdot mol}\right)(297.15\ K)}{0.923\ atm} = \boxed{20\ L}$$

24) Calculate the mass of KBr in a 7.00% solution that has a mass of 956 g.

$$\frac{7.00\ g\ KBr}{100\ g\ Soln} \Big| \frac{956\ g\ Soln}{} = \boxed{66.9\ g\ KBr}$$

25) Calculate the mass of LiOH in a 20.00% solution that has a mass of 450 g.

$$\frac{20.00\ g\ LiOH}{100\ g\ Soln} \Big| \frac{450\ g\ Soln}{} = \boxed{90\ g\ LiOH}$$

26) Calculate the molarity of a 55 L solution that contains 459 g $Al_2(CO_3)_3$.

$$\frac{1\ mol\ Al_2(CO_3)_3}{233.99\ g\ Al_2(CO_3)_3} \Big| \frac{459\ g\ Al_2(CO_3)_3}{55\ L\ Soln} = \boxed{0.036\ M\ Al_2(CO_3)_3}$$

27) Calculate the molarity of a 750 mL solution that contains 260 g $CaCl_2$.

$$\frac{1\ mol\ CaCl_2}{110.98\ g\ CaCl_2} \Big| \frac{260\ g\ CaCl_2}{750\ mL\ Soln} \Big| \frac{1000\ mL\ Soln}{1\ L\ Soln} = \boxed{3.1\ M\ CaCl_2}$$

28) What volume (V_c) of a 1.15 M (M_c) stock solution of potassium nitrate (KNO_3) is needed to make 0.75 L (V_D) of 0.578 M (M_D) potassium nitrate?

$M_c V_c = M_D V_D$

$$\frac{(1.15\ M)(V_c)}{1.15\ M} = \frac{(0.578\ M)(0.75\ L)}{1.15\ M} \qquad \boxed{V_c = 0.38\ L}$$

29) If 55.0 mL (V_c) of a 2.45 M (M_c) stock solution of sucrose is diluted with water to make 168 mL (V_D) of sucrose solution, what is the molarity (M_D) of the final solution?

$M_c V_c = M_D V_D$

$$\frac{(2.45\ M)(55.0\ mL)}{168\ mL} = \frac{M_D(168\ mL)}{168\ mL} \qquad \boxed{M_D = 0.802\ M}$$

30) Josephine's lab results showed that it required 32.5 mL of a 0.04 M KOH to neutralize 58.0 mL of HBr. Calculate the concentration of HBr. → mol HBr / 1 L soln

$HBr + KOH \rightarrow KBr + HOH$

58.0 mL 32.5 mL 0.04 mol KOH / 1 L soln

1 mol HBr / 1 mol KOH	0.04 mol KOH / 1 L KOH soln	1 L KOH soln / 1000 mL KOH soln	32.5 mL KOH / 58.0 mL HBr	1000 mL HBr soln / 1 L HBr soln	= 0.02 M HBr

31) Christopher's lab results showed that it required 67.0 ml of a 0.50 M NaOH to neutralize 32.5 mL of H_2SO_4. Calculate the concentration of H_2SO_4. → mol H_2SO_4 / 1 L soln

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2HOH$

32.5 mL 67.0 mL 0.50 mol NaOH / 1 L soln

1 mol H_2SO_4 / 2 mol NaOH	0.50 mol NaOH / 1 L NaOH soln	1 L NaOH soln / 1000 mL NaOH soln	67.0 mL NaOH soln / 32.5 mL H_2SO_4 soln	1000 mL H_2SO_4 soln / 1 L H_2SO_4 soln	= 0.52 M H_2SO_4

32) Calculate the pH of a 3.45×10^{-2} M HCl.

$pH = -\log(3.45\times10^{-2}) = \boxed{1.46}$

33) Calculate the pOH of a 5.67×10^{-2} M H_2SO_4.

$pH = -\log(5.67\times10^{-2}) = 0.945$ (×2) $pOH = 14 - 0.945 = \boxed{13.06}$

34) Calculate the pOH of 0.65 M KOH.

$pOH = -\log(0.65) = \boxed{0.19}$

35) Calculate the pH of a 4.0×10^{-3} M $Ca(OH)_2$.

$pOH = -\log(4.0\times10^{-3}) = 2.10$ (×2) $pH = 14 - 2.10 = \boxed{11.9}$

36) Determine the molarity of HCl with a pH of 1.82.

$[H^+] = 10^{-1.82} = \boxed{0.0151\ M\ HCl}$

37) Determine the molarity of NaOH with a pOH of 13.5.

$[OH^-] = 10^{-13.5} = \boxed{3.16\times10^{-14}\ M\ NaOH}$

38) If the pH of a H_2SO_4 solution is 2.45, what is the $[H^+]$?

$[H^+] = 10^{-2.45} = \boxed{3.55\times10^{-3}\ M\ H_2SO_4}$

39) If the pOH of a NaOH solution is 13.2, what is the $[OH^-]$?

$[OH^-] = 10^{-13.2} = 6.31 \times 10^{-14}\ M$

#43 40) Determine the oxidation state of each element in the following molecules or ions.

a. H_2SO_4 (+1 +6 -2)

b. $Al(OH)_3$ (+3 -2 +1)

c. PO_3^- (+5 -2)

d. AsO_4^{3-} (+5 -2)

#44 41) Balance the following redox reaction in an acidic solution.

a) $Cu + HNO_3 \rightarrow Cu^{+2} + NO$ (Cu: 0 → +2, LEO; N: +5 → +2, GER)

$3[Cu \overset{LEO}{\rightarrow} Cu^{+2} + 2e^-]$

$2[3e^- + 3H^+ + HNO_3 \rightarrow NO + 2H_2O]$

$3Cu \rightarrow 3Cu^{+2} + 6e^-$

$6e^- + 6H^+ + 2HNO_3 \rightarrow 2NO + 4H_2O$

$3Cu + 6H^+ + 2HNO_3 \rightarrow 3Cu^{+2} + 2NO + 4H_2O$

0 +6 0 +6 6 0

+6 = +6 ✓

b) $Cr_2O_7^{-2} + Cl^- \rightarrow Cr^{+3} + Cl_2$ (Cr: +6 → +3, GER; Cl: -1 → 0, LEO)

$6e^- + 14H^+ + Cr_2O_7^{-2} \overset{GER}{\rightarrow} 2Cr^{+3} + 7H_2O$

$3[2Cl^- \overset{LEO}{\rightarrow} Cl_2 + 2e^-]$

$6Cl^- \rightarrow 3Cl_2 + 6e^-$

$14H^+ + Cr_2O_7^{-2} + 6Cl^- \rightarrow 2Cr^{+3} + 7H_2O + 3Cl_2$

+14 −2 −6 +6 0 0

+6 = +6 ✓