## **Chemistry Final Exam Sample Items**

- 1. Which idea of John Dalton is no longer considered part of the modern view of atoms?
  - a. Atoms are extremely small.
  - b. Atoms of the same element have identical masses.
  - c. Atoms combine in simple whole number ratios to form compounds.
  - d. Atoms of different elements can combine in different ratios to form different compounds.
- 2. Which best describes the current atomic theory?
  - a. Atoms consist of electrons circling in definite orbits around a positive nucleus.
  - b. Atoms are composed of electrons in a cloud around a positive nucleus.
  - c. Atoms can easily be split, at which time they become radioactive.
  - d. An atom's mass is determined by the mass of its neutrons.
- 3. What is the nuclear composition of uranium-235?
  - a. 92 electrons and 143 protons
  - b. 92 protons and 143 electrons
  - c. 143 protons and 92 neutrons
  - d. 92 protons and 143 neutrons

Notice it said nuclear composition and in the nucleus are protons and neutrons Atomic number of uranium = 92 so 92 protons Neutrons = 235-92 = 143

- 4. Which best describes the relationship between subatomic particles in any neutral atom?
  - a. The number of protons equals the number of electrons.
  - b. The number of protons equals the number of neutrons.
  - c. The number of neutrons equals the number of electrons.
  - d. The number of neutrons is greater than the number of protons.In order to be neutral, positives and negatives must equal so protons (+) = electrons (-)
- 5. What is the name of the compound  $PbO_2$ ?
  - a. Lead oxide
  - b. Lead (II) oxide
  - c. Lead oxide (II)
  - d. Lead (IV) oxide

Pb<sup>+4</sup>O<sup>-2</sup> cross cross to give Pb<sub>2</sub>O<sub>4</sub> which can be reduced to PbO<sub>2</sub>

- 6. What is the name of HCl (*aq*)?
  - a. Chloric acid
  - b. Hydrochloric acid
  - c. Hydrogen chloride
  - d. Perchloric acid Starts with H so is an acid, no oxygen so use prefix hydro and change ending to –ic

- 7. What is the chemical formula for calcium nitrate?
  - a. CaNO<sub>3</sub>
  - b.  $Ca(NO_2)_2$
  - c.  $Ca(NO_3)_2$
  - d.  $Ca_3N_2$  $Ca^{+2}NO_3^{-1}$  cross cross to give choice C
- 8. What is the correct formula for dinitrogen pentoxide?
  - a. N<sub>4</sub>O
  - b. NO<sub>2</sub>
  - c.  $N_2O_5$
  - d. NO<sub>4</sub>

Di means 2 and penta means 5

- 9. If the volume of an 18.5 g piece of metal is 2.35 cm<sup>3</sup>, what is the identity of the metal?
  - a. Iron
  - b. Lead
  - c. Nickel
  - d. Zinc

Calculate density by doing mass divided by mass then look up the density on the reference table which shows it must be iron. Remember density is unique for everything.

## 10. Which substance listed in the table is a liquid at 27°C?

	Melting	Boiling		
	Point	Point		
T	<b>2</b> 00 <i>G</i>	1 400 G		
I	28°C	140°C		
II	-10°C	25°C		
III	20°C	140°C		
IV	-90°C	14°C		

# a. I

- b. II
- c. III d. IV

For I, 27°C is below melting point so it would still be a solid. For II and III, 27°C is above boiling point so would be a gas.

- 11. Which will increase the solubility of most solid solutes?
  - a. Decreasing the temperature
  - b. Decreasing the amount of solvent at constant temperature
  - c. Increasing the amount of solute at constant temperature
  - d. Increasing the temperature

Increasing temperature causes particles to move faster so dissolves quicker.

- 12. What happens to the pressure of a constant mass of a gas at constant temperature when the volume is doubled?
  - a. The pressure is doubled
  - b. The pressure remains the same
  - c. The pressure is reduced by  $\frac{1}{2}$
  - d. The pressure is reduced by ¼
     Constant temperature is Boyle's law which is inverse.
- 13. What is the pressure, in atmospheres, exerted by a 0.100 mol sample of oxygen in a 2.00 L container at 273°C?
  - a. 4.48 x 10<sup>-1</sup> atm
  - b. 2.24 x 10<sup>0</sup> atm
  - c.  $1.12 \times 10^3$  atm
  - d.  $2.24 \times 10^3$  atm

Use the equation PV=nRT. Use the R value with atm in the unit and remember that temperature must be in Kelvin.

- 14. Which pair of elements would most likely bond to form a covalently bonded compound?
  - a. Sodium and fluorine
  - b. Barium and chlorine
  - c. Phosphorus and oxygen
  - d. Magnesium and sulfur Covalent bonds are between two nonmetals.
- 15. Consider this phase diagram.



At what temperature does the normal boiling point occur?

a. 45°C

- b. 60°C
- c. 100°C
- <mark>d. 110°C</mark>

Normal boiling point occurs at 1 atm. So find 1 atm then go over to the line that separates liquid and gas.

- 16. The compound formed between element X and oxygen has the chemical formula X<sub>2</sub>O. Which element would X most likely represent?
  - a. Fe
  - b. Zn
  - c. Ag
  - d. Sn

Criss cross backwards so oxygen has a -2 charge. The oxygen has no subscript so the X must have a +1 charge. Fe can be +2 or +3, Zn is +2 and Sn can be +2 or +4. Silver is the only one that can have a +1 charge.

- 17. Which electron configuration represents a transition element?
  - a.  $1s^22s^22p^3$
  - b.  $1s^22s^22p^63s^2$
  - c. 1s<sup>2</sup>2s<sup>2</sup>2p<sup>6</sup>3s<sup>2</sup>3p<sup>6</sup>4s<sup>2</sup>3d<sup>7</sup>
  - d. 1s<sup>2</sup>2s<sup>2</sup>2p<sup>6</sup>3s<sup>2</sup>3p<sup>6</sup>4s<sup>2</sup>3d<sup>10</sup>4p<sup>4</sup>
    Transition elements are in groups 3-12. Add up exponents which equal 27 which is cobalt. A is nitrogen, B is magnesium, D is selenium.
- 18. Given the electron configuration of 1s<sup>2</sup>2s<sup>2</sup>2p<sup>4</sup>, how many electrons does this element have in its outer level?
  - a. 2
  - b. 4
  - <mark>c. 6</mark>
  - d. 8

Outer level is number of valence electrons. This element is oxygen which has 6 valence electrons.

19. Which correctly lists four atoms from smallest to largest radii?

- a. I, Br, Cl, F
- b. F, I, Br, Cl
- c. Si, P, S, Cl
- d. Cl, S, P, Si

Atoms get larger as you go down and to the left on the periodic table.

- 20. Which have the lowest electronegativities?
  - a. Alkali metals
  - b. Halogens

- c. Rare earth elements
- d. Transition metals

Electronegativity increases as you go up and to the right on the periodic table so the farther left you go the lower it is. Alkali metals are the first group so farthest left and therefore lowest electronegativity.

- 21. How many moles are in 59.6 grams of BaSO<sub>4</sub>?
  - a. 0.256 mole
  - b. 3.91 moles
  - c. 13.9moles
  - d. 59.6 moles

Grams to moles is a one step problem. Need to calculate formula mass of barium sulfate. 59.6 g x (1 mol/233.33 g)

- 22. What is the volume of two moles of hydrogen gas at STP?
  - <mark>a. 44.8 L</mark>
  - b. 22.4 L
  - c. 11.2 L
  - d. 2.00 L

The volume of a gas at STP is 22.4 L/mol so double that.

- 23. How many molecules are contained in 55.0 g of  $H_2SO_4$ ?
  - a. 0.561 molecule
  - b. 3.93 molecules
  - c.  $3.38 \times 10^{23}$  molecules
  - d. 2.37 x 10<sup>24</sup> molecules Have to convert grams to moles using formula mass and then moles to molecules using Avogadro's number.
    55g x (1 mol/98g) x (6.022x10<sup>23</sup>/1mol)
- 24. If a sample of magnesium has a mass of 60 g, how many moles of magnesium does the sample contain?
  - a. 1.1 moles
  - b. 1.2 moles
  - c. 2.0 moles
  - d. 2.5 moles

Convert grams to moles, just one step. 60g x (1mol/24.3g)

- 25. How many grams of KCl are necessary to prepare 1.5 L of a 0.500 M solution of KCl?
  - a. 224 g
  - b. 74.6 g
  - <mark>c. 56.0 g</mark>

d. 24.9 g

M = molarity which is mol/L. Need to determine moles first. 0.5M = mol/1.5L mol=0.5 x 1.5=0.75 mol Convert moles to grams 0.75 mol x 74.45 g/1 mol

- 26. What is the molarity of a solution containing 20.0 g of sodium hydroxide dissolved in 1.0 L of solution?
  - a. 0.5 M b. 0.4 M c. 0.3M d. 0.2 M M = molarity which is mol/L. Convert grams to moles 20g x (1mol/40g) = 0.5molM = 0.5 mol/1L
- 27. Analysis shows a compound to be, by mass, 43.8% N, 6.2% H and 50.0% O. Which is a possible molecular formula for the substance?
  - a. NH<sub>4</sub>NO<sub>2</sub>
  - b. NH<sub>4</sub>NO<sub>3</sub>
  - c. NH<sub>3</sub>OH
  - d. N<sub>2</sub>OH

Need to determine empirical formula first.

Change percents to grams, grams to moles, divide by smallest number of moles, whole numbers become subscripts.

N 43.8g x 1mol/14g = 3.1/3.1 = 1H 6.2g x 1 mol/1g = 6.2/3.1 = 2O 50g x 1mol/16 g = 3.1/3.1 = 1Empirical formula =  $NH_2O$ 

A, which can be written  $N_2H_4O_2$  is the only one that can be reduced down to  $NH_2O_2$ .

- 28. A compound has an empirical formula of CH<sub>2</sub>O and a molecular mass of 180 g. What is the compound's molecular formula?
  - a.  $C_3H_6O_3$
  - b.  $C_6H_{12}O_6$
  - c.  $C_6H_{11}O_7$
  - d. C<sub>12</sub>H<sub>22</sub>O<sub>11</sub>

If the empirical formula is not given then you have to determine it like in the previous question. Once you have it, like in this problem, you then have to determine formula mass of the empirical formula then divide the molecular mass by the mass of the empirical formula. This will be a whole number so you then multiply subscripts by this number. Mass of  $CH_2O = 12 + 2 + 16 = 30$ 

180/30 = 6, so multiply subscripts by 6

29. What is the percent by mass of iron in the compound  $Fe_2O_3$ ?

- a. 70% b. 56%
- c. 48%
- d. 30% Percent is always part/whole x 100. The whole is the formula mass and the part is the mass of that element. 111.6/159.6 x 100 = 70%
- 30. Metallic sodium reacts violently with water to form hydrogen and sodium hydroxide according to the balanced equation:

 $2Na + 2H_2O \rightarrow 2NaOH + H_2$ 

How many moles of hydrogen gas are generated when 4.0 moles of sodium react with excess

water?

- a. 1.0 mole
- b. 2.0 moles
- c. 3.0 moles
- d. 4.0 moles

Mole to moles problems are one step just using coefficients. 4 mol Na x (1 mol  $H_2/2$  mol Na)

31. Consider this reaction:

 $3Ca(s) + 2H_3PO_4(aq) \rightarrow Ca_3(PO_4)_2(s) + 3H_2(g)$ 

How many moles of calcium are required to produce 60 g of calcium phosphate?

- a. 0.145 mole
- b. 0.194 mole
- c. 0.387 mole
- d. 0.581 mole

60g Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub> x (1 mol Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>/310 g Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>) x (3 mol Ca/1mol Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>)

- 32. According to the equation  $2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$ , what mass of water is required to yield 22.4 L of oxygen gas at STP?
  - a. 12 g
  - b. 18 g
  - c. 24 g
  - <mark>d. 36 g</mark>

22.4 L  $O_2 x (1 \text{ mol } O_2/22.4 \text{ L } O_2) x (2 \text{ mol } H_2O/1 \text{ mol } O_2) x (18 \text{ g } H_2O/1 \text{ mol } H_2O)$ 

33. Consider this reaction:

$$3Mg(s) + 2H_3PO_4(aq) \rightarrow Mg_3(PO_4)_2(s) + 3H_2(g)$$

How many grams of magnesium phosphate should be produced if 5.40 g of magnesium react?

a. 1.8 g
b. 19.5 g
c. 58.4 g

d. 175 g

5.4 g Mg x (1 mol Mg/24.3 g Mg) x (1 mol Mg<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>/3 mol Mg) x (262.9g Mg<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>/1 mol Mg<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>

34. Methane (CH<sub>4</sub>) is burned in oxygen according to this balanced chemical equation:

 $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$ 

What volume of carbon dioxide is formed when 9.36 L of methane are burned at STP?

- a. 9.36 L
- b. 15.0 L
- c. 18.7 L
- d. 22.4 L

Mole to mole, volume to volume, molecule to molecule can all be done in one step using coefficients.

 $9.36 L CH_4 x (1 L CO_2/1 L CH_4)$ 

OR 9.36 L CH<sub>4</sub> x (1 mol CH<sub>4</sub>/22.4 L CH<sub>4</sub>) x (1 mol CO<sub>2</sub>/1 mol CH<sub>4</sub>) x (22.4 L CO<sub>2</sub>/1mol CO<sub>2</sub>)

#### 35. Consider the spectrum for the hydrogen atom. In which situation will light be produced?

- a. Electrons absorb energy as they move to an excited state.
- b. Electrons release energy as they move to an excited state.
- c. Electrons absorb energy as they return to the ground state.
- d. Electrons release energy as they return to the ground state.
   Remember that light/energy is absorbed causing an electron to jump up but then released as it falls back down.
- 36. Which statement regarding red and green visible light is correct?
  - a. The speed of green light is greater than that of red light.
  - b. The wavelength of green light is longer than that of red light.
  - c. The energy of green light is lower than that of red light.
  - d. The frequency of green light is higher than that of red light.

Use the last page of the reference table to notice that green light has a shorter wavelength than red light. Wavelength and frequency are inverse. So, shorter wavelength means higher frequency.

37. Which color of light would a hydrogen atom emit when an electron changes from the n=5 level to the n=2 level?

- a. Red
- b. Yellow
- c. Green
- d. Blue

Use the last page of the reference table and determine what wavelength is released when an electron falls from n=5 to n=2 then look at the visible spectrum to find which color corresponds to that wavelength.

- 38. What energy level transition is indicated when the light emitted by a hydrogen atom has a wavelength of 103 nm?
  - a. n=2 to n=1
  - b. n=3 to n=1
  - c. n=4 to n=2
  - d. n=5 to n=2

Again, use the last page of the reference table.

- 39. A piece of metal is heated then placed in a beaker of cool water. Which statement best describes the effect of the temperature changes on the kinetic energy of the particles?
  - a. Kinetic energy of metal atoms decreases when it was heated.
  - b. Kinetic energy of water molecules increases when the hot metal is placed in it.
  - c. Kinetic energy of water molecules decreases when the hot metal is placed in it.
  - d. Kinetic energy of metal atoms increases when placed in the cool water. Heat always moves from hot to cold so the metal would heat the water. When temperature increase, kinetic energy increase because temperature is a measure of kinetic energy.
- 40. The gases helium, neon, and argon are in separate containers at 55°C. Which is true about the kinetic energy of the gases?
  - a. Helium has the lowest mass and therefore greatest kinetic energy.
  - b. They each have a different kinetic energy.
  - c. Argon has the greatest mass and therefore the greatest kinetic energy.
  - d. They all have the same average kinetic energy.

Again, temperature is a measure of average kinetic energy, so if they are at the same temperature they must have the same kinetic energy.

41. This is a heating curve for a substance.



Between points X and Y, which would be observed?

- a. Solid and liquid will be present.
- b. Only vapor will be present.
- c. Liquid and vapor will be present.
- d. Only liquid will be present. On this diagram, the diagonals are the states of matter and the horizontal lines are the phase changes. Vaporization and condensation occur at X and Y so both liquid and gas will be present.
- 42. An open container of water is brought to a boil and heated until all of the water is converted to water vapor. Which describes the changes in the water molecules?
  - a. The molecules speed up and move farther apart.
  - b. The molecules speed up and move closer together.
  - c. The molecules slow down and move farther apart.
  - d. The molecules slow down and move closer together.As temperature increases, so does kinetic energy as well as distance between molecules.Boiling turns it into a gas and gases have the fastest molecules that are the farthest apart.

### 43. Six grams of gold was heated from 20°C to 22°C. How much heat was applied to the gold?

- <mark>a. 1.55 J</mark>
- b. 15.5 J
- c. 17.0 J
- d. 32.5 J

Use the equation  $Q = m c \Delta T$  and solve for Q. You have to look up the specific heat of gold using the reference table.

Q=6 x 0.129 x 2

44. An 18.0 g piece of unidentified metal was heated from21.5°C to 89.0°C. If 292 J of heat energy was absorbed by the metal in the heating process, what was the identity of the metal?

Substance	Specific Heat		
Aluminum	0.90 J/g°C		
Calcium	0.65 J/g°C		
Copper	0.39 J/g°C		
Gold	0.13 J/g°C		
Iron	0.46 J/g°C		
Mercury	0.14 J/g°C		
Silver	0.24 J/g°C		

#### **Specific Heat Table**

a. Calcium

b. Copper

c. Iron

d. Silver

Use  $Q = m c \Delta T$  and solve for c then look it up on the above table.

45. This graph represents the change in energy for two laboratory trials of the same reaction.



Which factor could explain the energy difference between the trials?

- a. Heat was added to trial #2.
- b. A catalyst was added to trial #2.
- c. Trial #1 was stirred.
- d. Trial #1 was cooled.A catalyst speeds up a reaction by lowering the activation energy.
- 46. When a chemical cold pack is activated, it becomes cool to the touch. What is happening in terms of energy?
  - a. An exothermic reaction is occurring, absorbing cold from its surroundings.
  - b. An exothermic reaction is occurring, releasing heat to its surroundings.
  - c. An endothermic reaction is occurring, releasing cold to its surroundings.
  - An endothermic reaction is occurring, absorbing heat from its surroundings.
     An exothermic reaction has heat being released into the surroundings making it hot.
     An endothermic reaction has heat being absorbed from the surroundings making it cold.
- 47. Consider this phase diagram.

Phase Diagram



What process is occurring when a substance changes from point X to point Y?

- a. Boiling
- b. Freezing
- c. Melting
- d. Sublimation

X is a solid and Y is a liquid so going from X to Y would be melting.

48. Consider this diagram:





paper wood

Which of the three types of radiation will penetrate the paper and wood?

- a. Alpha, beta and gamma
- b. Alpha and beta only
- c. Gamma only
- d. Beta only

Alpha can be stopped by paper, Beta can be stopped by aluminum and Gamma can only be stopped by thick concrete or several inches of lead.

49. The half-life of phosphorus-32 is 14.30 days. How many milligrams of a 20 mg sample will remain after 85.8 days?

a.	3.333 mg	t <sub>1/2</sub>	t	mass
b.	0.6250 mg	0	0	20 mg
c.	0.3125 mg	1	14.3d	10
d.	0.1563 mg	2	28.6	5
		3	42.9	2.5
		4	57.2	1.25
		5	71.5	0.625
		6	85.8	0.3125

50. In the figure below, what type of nuclear activity is represented?



- a. Fission
- b. Fusion
- c. Alpha emission
- d. Beta emission

Fission is splitting apart and fusion is coming together.

- 51. Which particle will complete this reaction?  ${}^{59}\text{Co} + \underline{?} \rightarrow {}^{60}\text{Co}$ 
  - a. Electron
  - b. Neutron
  - c. Nucleus
  - d. Proton

Notice the only number that changes from the left to right sides of the arrow is the top number. The bottom number is the atomic number (# of protons). The top number is the mass number (protons + neutrons). Since the atomic number didn't change the # of protons didn't change which means the only thing that did change was the neutrons.

27

27

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52. Which will complete this equation? ^{238}U \rightarrow ^{234}Th + \_
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a.  ${}^{0}e$  92 90 -1 b.  ${}^{0}\gamma$ c.  ${}^{1}H$ 1 d.  ${}^{4}He$ 2

The top and bottom numbers have to equal on both sides of the arrow. Choice A is a beta particle, B is gamma, C is a proton and D is alpha particle.

53. Consider this reaction:

 $NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$ 

Which type of reaction does this equation represent?

- a. Combustion
- b. Decomposition
- c. Single replacement
- d. Synthesis

Synthesis always produces just one product. If you forget the types of reactions, use your reference table.

- 54. Which equation represents a single replacement reaction that can occur?
  - a.  $F_2 + 2NaCl \rightarrow 2NaF + Cl_2$
  - b.  $Cl_2 + 2NaF \rightarrow 2NaCl + F_2$
  - c.  $Cu + 2NaCl \rightarrow CuCl_2 + 2Na$
  - d.  $Zn + 2NaF \rightarrow ZnF_2 + 2Na$

For a single replacement reaction, the single element has to be higher on the activation series (see your reference table). Fluorine is higher than chlorine so it would happen while B would not. C would not happen because Cu is not higher than Na and D would not happen because Zn is not higher than Na.

- 55. What products are formed when the metal potassium is added to water?
  - a. K and  $H_2O$
  - b. KOH and H<sub>2</sub>O

c.  $K_2O$  and  $H_2$ 

## d. KOH and $H_2$

Use the reference table page with the reaction types on it. Potassium is a metal so you have a metal reacting with water. Look this up and you will see that it produces a metal hydroxide and hydrogen gas.

 $M + HOH \rightarrow MOH + H_2$  the M stands for the metal, which in this case is potassium 56. When Na<sub>2</sub>O reacts with water, what is produced?

- a. HNaO<sub>2</sub>
- b.  $Na + H_2O$
- c.  $NaO + H_2$
- d. NaOH

 $Na_2O$  is a metal oxide so look up on the reference table a metal oxide reacting with water. It tells you that this will produce a base. Bases end in OH.

- 57. Which equation is correctly balanced?
  - a.  $Cu + H_2SO_4 \rightarrow CuSO_4 + H_2O + SO_2$
  - b.  $2Na + 2H_2O \rightarrow 2NaOH + H_2$
  - c.  $2Fe + 3O_2 \rightarrow Fe_2O_3$
  - d.  $4Cu + S_8 \rightarrow 8Cu_2S$

Just check to make sure that you have the same number of each element on both sides of the arrow. Coefficients multiply the subscripts.

58. What coefficients are required to balance this equation?

 $Fe_2O_3 + CO \rightarrow Fe + CO_2$ 

- a. 2, 6, 3,6
- b. 1, 3, 2, 3
- c. 1, 1, 2, 2
- d. 1, 1, 2, 1

59. Which example indicates that a chemical change has occurred?

- a. When two aqueous solutions are mixed, a precipitate is formed.
- b. As ammonium nitrate dissolves in water, it causes the temperature of the water to decrease.
- c. Alcohol evaporates when left in an open container.
- d. Water is added to blue copper (II) chloride solution. The resulting mixture is lighter blue in color.

Indicators of a chemical change are color change, temperature change, gas produced or precipitate (solid) produced. Remember a new substance is produced when a chemical change occurs.

60. Consider this chemical equations:

 $NH_3(aq) + HCl(aq) \rightarrow NH_4^{+1}(aq) + Cl^{-1}$ 

In this reaction, why is the ammonia considered a base?

- a. NH<sub>3</sub> increases the hydronium ion concentration.
- b. NH<sub>3</sub> decreases the hydroxide ion concentration.

- c. NH<sub>3</sub> accepts a proton (hydrogen).
- NH<sub>3</sub> donates a proton (hydrogen).
   Acids donate a proton (hydrogen) while bases accept protons.
   Acids also increase hydronium ion concentration while bases increase hydroxide concentration.
- 61. Phenolphthalein is an indicator that turns pink when added to a basic solution. In which solution would phenolphthalein turn pink?
  - a. NaOH
  - b. HCl
  - c. H<sub>2</sub>O
  - d. NaCl

Acids start with hydrogen, bases end in hydroxide.

- 62. A water sample was found to have a pH of 6 at 25°C. What is the hydroxide concentration in the water sample?
  - a. 1 x 10<sup>-8</sup> M
  - b. 6 x 10<sup>-8</sup> M
  - c. 1 x 10<sup>-6</sup> M
  - d. 6 x 10<sup>-6</sup> M
    - pH + pOH = 14 $[OH^{-}] = 1 \times 10^{-pOH}$
    - 6 + pOH = 14 so pOH = 8
    - $[OH^{-}]$  then must = 1 x 10<sup>-8</sup>
- 63. What is the pH of a solution of KOH with a hydroxide concentration of  $[OH^{-1}] = 1 \times 10^{-4} M$ ?
  - a. -10
  - b. -4
  - c. 4
  - <mark>d. 10</mark>

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pOH = -log[OH^{-}] and pH + pOH = 14
pOH = -log (1 \times 10^{-4} M) = 4
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- pH + 4 = 14 so pH = 10
- 64. In a titration experiment, if 30 mL of an HCl solution reacts with 24.6 mL of a 0.5 M NaOH solution, what is the concentration of the HCl solution?
  - <mark>a. 0.41 M</mark>
  - b. 0.61 M
  - c. 1.5 M
  - d. 370 M

 $M_a V_a = M_b V_b\;$  where M is molarity and a is acid and b is base M x 30 = 24.6 x 0.5

65. Consider this balanced chemical equation:  $2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2$ 

Which of the following will increase the rate of the reaction?

- a. Increasing pressure on the reaction
- b. Decreasing concentration of the reactants
- c. Adding a catalyst to the reaction

d. Decreasing the temperature of the reaction

A catalyst speeds up a reaction without taking part in the reaction.

- 66. For a reaction, increasing the temperature increases the rate of reaction. Which is the best explanation for this happening?
  - a. The pressure increases, which in turn increases the production of products.
  - b. The concentration of reactants increases with an increase in temperature.
  - c. The average kinetic energy increases, so the likelihood of more effective collisions between ions increases.
  - d. Systems are more stable at high temperatures. Temperature is a direct measure of kinetic energy. So increasing temperature increase kinetic energy making the particles move faster with more energy and therefore more likely to react.
- 67. Which statement explains why the speed of some reactions is increased when the surface area of one or all of the reactants is increased?
  - a. Increasing surface area changes the electronegativity of the reactant particles
  - b. Increasing surface area changes the concentration of the reactant particles
  - c. Increasing surface area changes the conductivity of reactant particles
  - d. Increasing surface area enables more reactant particles to collide Increasing surface area basically gives you more particles so more collisions, which are needed for a reaction to occur.
- 68. The shape of the CH4 molecule is most similar to the shape of a molecule of
  - a. H2Ob. N2H4c. SiH4d. C2H4CH4 would be tetrahedral (center atom with four things bonded to it with no lone pairs on the
  - center atom). The only other one like this is C.
- 69. Which molecule is nonpolar?
  - a. H<sub>2</sub>O
     b. HF
     c. NF<sub>3</sub>
     d. CF<sub>4</sub>
     Nonpolar covalent compounds are symmetrical and share electrons equally.
     Polar covalent compounds are not symmetrical and share electrons unequally.

## 70. The arrangement of atoms in a water molecule, H<sub>2</sub>O, is best described as

- a. ring b. bent c. linear d. spherical
- 71. In which pair do *both* compounds exhibit ionic bonding?
  - a. SO<sub>2</sub>, HCl
  - b. KNO3, CH4
  - c. NaF, KBr
  - d. KCl, CO<sub>2</sub>
  - e. NaCl, H<sub>2</sub>O

Ionic bonding is between a metal (or hydrogen) and nonmetal. Covalent is between nonmetals only.

- 72. Covalent bonds are most likely to be found in the compound represented by the formula
  - a. NaCl b. KBr c. CH4 d. HI e. CaF2

73. Which molecule is essentially nonpolar?

a. CH4 b. HCl c. HBr d. H2O e. NH3

74. Identify the equilibrium constant expression for the reaction

$$CO_2(g) + C(s) \rightleftharpoons 2CO(g)$$

a.  $K_{eq} = eq \F([CO]^2, [CO_2] [C])$ b.  $K_{eq} = eq \F([CO_2] [C], [CO]^2)$ c.  $K_{eq} = eq \F([CO_2]^2, [CO_2])$ d.  $K_{eq} = eq \F(1, [C])$ 

 $K_{eq}$  = concentrations of products divided by concentrations of reactants all raised to their coefficients. Solids and liquids are not included in the equilibrium constant expression.

75. How does an increase in pressure at constant temperature affect this equilibrium?

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + heat$$

- a. produces no noticeable effect
- b. increases the concentration of  $N_2$
- c. increases the concentration of NH3
- d. shifts the equilibrium to the left
- e. causes the reaction to become endothermic

Increasing pressure makes the reaction want to shift in the direction with the least number of moles. The reactant side in this reaction has a total of 4 moles (add up coefficients) while the product side only has 2. The reaction therefore shifts to the right making more ammonia.

76. In the equilibrium reaction

$$AgCl(s) + 2NH_3(aq) \rightleftharpoons Ag(NH_3)^{2+}(aq) + Cl^{-}(aq)$$

an increase in the concentration of  $Cl^{-}(aq)$  causes

- a. AgCl(s) to decompose.
- b.  $Ag(NH3)^{2+}(aq)$  to form.
- c. AgCl(s) to precipitate.
- d. the NH3(aq) concentration to decrease.

Adding more Cl<sup>-</sup> makes the reaction want to use up the extra chlorine by shifting to the left and making more reactants.