Review Packet for Chemistry Final Exam Name: ANSWER KEY

Matter & Measurement

1. A graduated cylinder is weighed empty and with a liquid. The following data was obtained:

Cylinder with liquid	85.26 g
Empty cylinder	62.55 g
Volume of liquid	25.80 mL

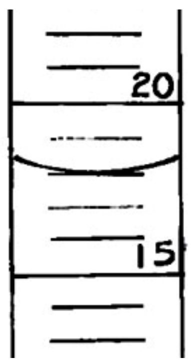
Mass of liquid = mass of cylinder with liquid – mass of empty cylinder
22.71= 85.26 – 62.55 *when you subtract-keep the least # of decimal places*
Density = mass/volume 22.71 g/ 25.80 mL = 0.8802325581 = 0.8802 g/mL
when you divide-keep the least # of sig figs

2. Which instrument would you select to measure the following:

23.20 g balance (mass)

17.5 mL graduated cylinder (volume)

3. Record the volume using the correct number of significant figures.



18.0 mL 73.0 mL

Make sure to always read one digit past the degree of confidence. Ex: You can read that the graduated cylinder on the left is 18, but add one degree of estimation – thus 18.0

Atomic Structure

4. Electrons have a negative charge. When you take away an electron the charge becomes more positive. When you gain an electron the charge becomes more negative.
5. An atom containing 19 protons, 19 electrons, and 21 neutrons has a mass of 40 amu.
6. These are 3 isotopes of He: $^{4}_{2}He$ $^{5}_{2}He$ $^{6}_{2}He$

These isotopes have the same number of electrons, the same number of protons and a different number of neutrons.

7. When most of the alpha particles were not deflected by the gold foil in Rutherford's experiment, he concluded that gold atoms were mainly empty space
8. What is the ground state electron configuration of chlorine gas?

$1s^2 2s^2 2p^6 3s^2 3p^5$

9. What is the ground state electron configuration of krypton gas?

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

10. All noble gases end in this notation: p^6

11. Which atom has the same electron configuration as:

Sb^{-3} Xe Ba^{+2} Xe Al^{+3} Ne

Sb = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^{3+3 \text{ electrons}}$ = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6$
Ba = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^{2-2 \text{ electrons}}$ = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6$
Al = $1s^2 2s^2 2p^6 3s^2 3p^{1-3 \text{ electrons}}$ = $1s^2 2s^2 2p^6$

Add up the superscripts to find the atomic number

Periodic Table

12. Rows on the periodic table are called periods; columns are called groups or families.
13. Fill in the table.

	Group #	# Valence Electrons
Alkali Metals	1A	1
Alkaline Earth Metals	2A	2
Halogens	7A	7
Noble Gases	8A	8

14. Which of these groups of elements would be expected to have similar properties?

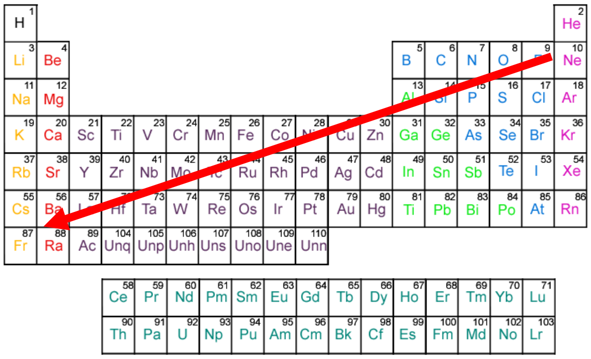
Rb, Zr, Nb As, Bi, Sb P, S, Ar O, Cl, Kr

They are in the same group (5A)

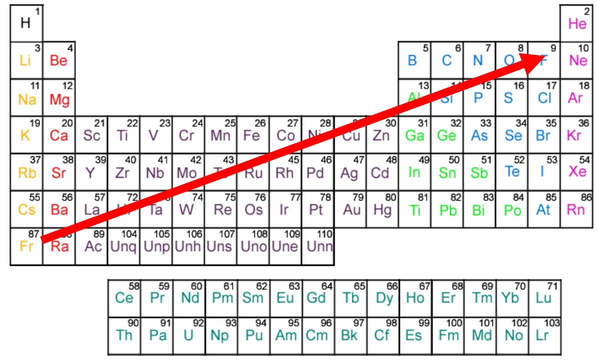
15. If an atom has 2 valence electrons, it belongs in group 2A in the periodic table. If an atom has 2 unpaired electrons it belongs in group 6A in the periodic table *the atom has 6 lone pairs – it needs 2 more to be stable with 8 electrons*.

16. Draw the following trends on the periodic tables:

Atomic Radius



Electronegativity & Ionization Energy



Use the following table to answer questions 17-22.

I																	
W	X											A			R	F	B
S																T	
													K			P	N

17. Which element is the most reactive metal?

I W S F

Reactivity of metals = as you go down the group and from right to left, the reactivity of metals increases because it is easier for the atom to give up electrons (lower ionization energy). For nonmetals, the opposite is true because of electronegativity (increases towards the top and to the right – F is the most reactive nonmetal)

18. Which is the least reactive nonmetal?

B F T R I

B is a noble gas

19. Which is the most reactive nonmetal/highest electronegativity?

B F T R I

See the explanation for reactivity of nonmetals in the answer to #17.

20. Which element has the largest atomic radius?

S P N I

Atomic radius increases towards the bottom and to the left

Chemical Bonding

21. Which of the following pairs are most likely to form a covalently bonded molecule?

    W & X   W & F   R & P   R & B

    Covalent bond = 2 nonmetals bonding together
    W & X = 2 metals;   W&F = metal + nonmetal;   R&B=B is a noble gas so it cannot participate in bonding

22. Which of the following pairs are most likely to form an ionic bond?

    W & X   W & F   R & B   W & B

    Ionic bond = metal + nonmetal
    W & X = 2 metals;   R&B=2 nonmetals   W&B= B is a noble gas so it cannot participate in bonding

23. Chemical bonding always involves:

    a) proton sharing   b) nucleus sharing   c) electron sharing   d) outer shell e-

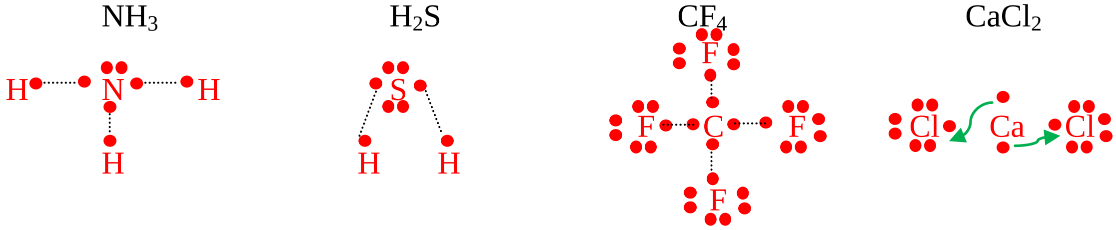
    electron sharing   *electron sharing*   *sometimes, but sometimes there is a transfer of electrons or a sea of electrons*

24. The bond between H and O in water is a(n) hydrogen/polar covalent bond. The unpaired electrons of the oxygen atom gives the water molecule its bent shape.

25. Draw the Lewis dot structures of the following elements:

26. Draw the Lewis dot structures of following molecules and identify their shape:

NH_3 H_2S CF_4 $CaCl_2$



Trigonal pyramidal   bent   tetrahedral   linear

Nomenclature

27. Name the following:

    SO_3 sulfur trioxide   *2 nonmetals = use prefixes*

    $Fe(NO_3)_2$ iron (II) nitrate   *Fe^{2+} NO_3^-*

$CaCl_2$ calcium chloride *Ca^{2+} Cl^-* *all binary (only 2 elements) compounds end in -ide*

$FeCl_3$ iron (III) chloride *Fe^{3+} Cl^-*

28. Give the correct formula for the following: *do the criss-cross method*

Chromium (II) Nitrate	$Cr(NO_3)_2$	*Cr^{2+} (from the roman numeral) NO_3^-*
Boron Tetrafluoride	BF_4	*simply write out the symbols and prefixes*
Barium Sulfate	$BaSO_4$	*Ba^{2+} SO_4^{2-} 2+ and 2- cancel out*

29. The formula for the sulfide of a metal is Rh_2S_3. The formula for the chlorine compound is $RhCl_3$. *Reverse criss-cross= $Rh^{3+}S^{2-}$ replace the S with Cl^- and do the criss-cross*

30. Name the seven diatomics: H_2 N_2 O_2 F_2 Cl_2 Br_2 I_2 *Have NO Fear ClBrtson Is here*

Chemical Reactions

31. Balance the equations below:

6 HCl + _____Fe_2O_3 → 2 $FeCl_3$ + 3 H_2O

2 $CuCl_2$ + _____H_2S → 2 HCl + 2 CuCl + _____S

32. Consider the reactants in the equation below and identify the products: *double replacement reaction (you are given 2 compounds)*
1. do the reverse criss-cross for each compound
2. switch partners – metal of compound 1 joins with nonmetal of compound 2
3. do the criss-cross for the new combination of compounds
You need to know your polyatomic ions and the charges for group A elements

Na_2CO_3 + $Mg(NO_3)_2$ → $NaNO_3$ + $MgCO_3$
Na^+ CO_3^{2-} Mg^{2+} NO_3^- Na^+ NO_3^- Mg^{2+} CO_3^{2-}

33. Consider the reactants in the equation below and identify the products: *single replacement reaction (you are given 1 compound and 1 diatomic)*
1. look at what is by itself – in this case it is the chlorine.
2. Chlorine is a nonmetal so it will replace the nonmetal in the compound – it will replace the iodine.
3. Switch partners and do the criss-cross for the new combination of compounds
Because I and Cl are in the same group, you can do a 1-for-1 switch

CaI_2 + Cl_2 → $CaCl_2$ + I_2

34. A student mixes two chemicals together to see if they react. What are three observations that would indicate that a chemical reaction had occurred?

1. color change
2. precipitate/solid forms
3. heat change

35. What are the reactants of combustion? CH (hydrocarbon) + O_2

36. What are the products of combustion? CO_2 + H_2O

37. A chemistry class does 4 experiments. Their results are summarized below.

1. Ashley heats a small amount of a dry powder which was identified as a hydroxide. She notices small water droplets at the top of the test tube.
2. John pours a solution of lead (II) nitrate with a solution of sodium iodide. He notices that a bright yellow solid forms immediately.
3. Tina holds a piece of magnesium ribbon in a Bunsen burner flame. After about 8 seconds the magnesium burns brightly.
4. Nick heats some water in a beaker. Something that looks like smoke rises from the surface when the water boils. When he holds a cool beaker in the "smoke" small droplets of clear liquid collect on the bottom of the beaker.

Which experiment shows a physical change? 4 – boiling, steam = phase change

Which experiment demonstrates a decomposition reaction? 1 XOH $\rightarrow$ H_2O + X

Which experiment demonstrates a double replacement reaction? 2 precipitate is formed

Stoichiometry

38. The total number of atoms in $Al(C_2H_3O_2)_3$ is 22. The number of Oxygen atoms is 6.

Use the following equation to answer questions 39-40. Use correct significant figures.

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$

39. If 22.00g of NH_3 reacts with an excess amount of O_2 what is the mass of water produced?

$$22.00\ g\ NH3 * \frac{1\ mole\ NH3}{17.0\ g\ NH3} * \frac{6\ moles\ H2O}{4\ moles\ NH3} * \frac{18.0\ g\ H2O}{1\ mole\ H2O} = 34.94\ g\ H2O$$

Scheme: grams NH_3 $\rightarrow$ moles NH_3 $\rightarrow$ moles H_2O $\rightarrow$ grams H_2O

Whatever is on top is multiplied, whatever is on the bottom is divided

40. If 40.0g of O_2 reacts with an excess amount of NH_3, what is the volume of NO produced at standard conditions?

$$40.0\ g\ O2 * \frac{1\ mole\ O2}{32.0\ g\ O2} * \frac{4\ moles\ NO}{5\ moles\ O2} * \frac{22.4\ L\ NO}{1\ mole\ NO} = 22.4\ L\ NO$$

Scheme: grams O_2 $\rightarrow$ moles O_2 $\rightarrow$ moles NO $\rightarrow$ liters NO

41. How many molecules are there in 99.0 grams of H_2O? (SF)

$$99.0\ g\ H2O * \frac{1\ mole\ H2O}{18.0\ g\ H2O} * \frac{6.02\ x\ 10^{23}\ molecules\ H2O}{1\ mole\ H2O} = 3.31\ x\ 10^{24}\ molecules\ H2O$$

Scheme: grams H_2O → moles H_2O → molecules H_2O

Rodney reacts 35.0g of Na_2CO_3 with an excess amount of HCl to produce NaCl, CO_2, and water.

a. The reaction goes as expected
b. The CO_2 effervesces (bubbles off)
c. The water is evaporated, leaving dry NaCl
d. The theoretical yield was calculated to be 17.2g
e. Rodney's yield was 16.5g

42. What might be the most likely source of error?

A) Incorrect weighing B) Spilling of some of the products

C) Contamination D) Insufficient heating to remove all of the water

43. What is Rodney's percent error?

$$\frac{17.2-16.5}{17.2} * 100 = 4.07\ \%\ error$$

Take the absolute of the theoretical - actual

44. Determine the empirical formula of a compound that contains 36.5% sodium, 25.4% sulfur, and 38.1% oxygen.

Na = 36.5 g / 23.0 g = 1.59 / .791 = 2
S = 25.4 g / 32.1 g = .791 / .791 = 1
O = 38.1 g / 16.0 g = 2.38 / .791 = 3

Na_2SO_3

45. A compound contains 5.9% hydrogen and 94.1% oxygen.

a. What is its empirical formula?

H = 5.9 g / 1.0 g = 5.9 / 5.9 = 1
O = 94.1 g/ 16.0 g = 5.9 / 5.9 = 1

HO

b. If its molecular mass was determined to be 34 what is its molecular formula?

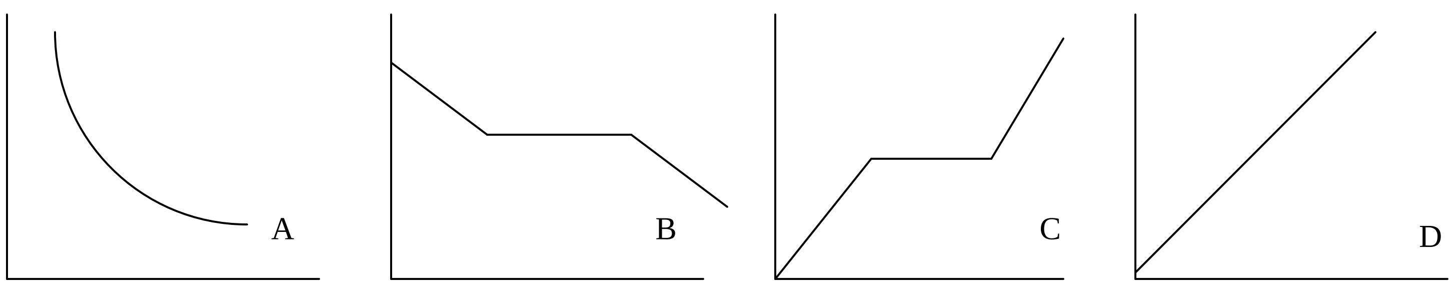
34 grams / 17.0 grams = 2 *(17.0 is the molar mass of HO)*
2(HO) = H_2O_2

Behavior of Gases

46. Respond to the following true/false statements regarding gases.
    - T or F Relatively large distances between molecules, especially compared to solids.
    - T or F The molecules move extremely fast.
    - T or F The molecules energy is directly proportional to the temperature of the gas.
    - T or F The molecules have a random motion pattern.
    - T or F The molecules simply vibrate back and forth in fixed positions.
    - T or F The molecules keep a fixed volume of gas regardless of the pressure on them.

47. Respond to the following true/false statements. A capped bottle of air is allowed to sit in the sun on a hot summer day. The statements refer to the molecules of gas inside the bottle.
    - T or F The pressure increases because the molecules of gas expand.
    - T or F As the gas heats the molecules move further apart, increasing the pressure on the walls.
    - T or F Pressure inside the bottle decreases because the molecules are moving faster.
    - T or F Pressure increases because the molecules are hitting the walls harder and faster.
    - T or F The possible pressure changes outside the bottle have no affect on what is going on inside.

Use the graphs below to answer questions 48-50:



48. Which graph represents "volume vs temperature" for a gas at constant pressure? D

    The relationship between volume and temperature can be explained by Charles' Law which is a direct relationship. A direct relationship produces a linear graph.

49. Which graph represents "temperature vs time" for the melting of a pure substance? C

    C is a heating curve; B is a cooling curve. Melting requires heat.

50. Which graph represents "pressure vs volume" for a gas at constant temperature? A

    The relationship between volume and pressure can be explained by Boyles' Law which is an inverse relationship. An inverse relationship produces a curve.

51. A lawnmower exhausts 50.0 liters of CO at a pressure of 100.0 kPa and a temperature of 550 K. What would be the volume of this gas 325 K?

The combined gas law should be used to solve this problem. The pressure stays the same throughout the process.

Do not forget to convert Celsius temperatures to Kelvin by adding 273! This one is already done for you.

$$\frac{100.0\,kPa * 50.0\,L}{550\,K} = \frac{100.0\,kPa * V_2}{325\,K}$$

*Cross multiply = 100 * 50 * 325 = 100 * 550 * V_2* *V_2= 29.5 L*

Acids and Bases

52. What is the pH of each solution?

.1 M HCl 1	1.0 M NaOH 14	.001 M HCl 3
-log[.1]	*-log[1.0] = 0*	*-log[.001]*
	14-0 = 14	

53. The pH of tomato juice is approximately 4.2. This means that the tomato juice is (weakly, strongly) (acidic, basic).

54. NaOH, NaF, NH_3, HCl

c. Identify the acid(s) from the list: HCl *starts with "H"*

d. Identify the base(s) from the list: NaOH *ends with "OH"*

e. Identity the salt(s) from the list: NaF *any ionic compound NaF looks like NaCl but with F.*

55. What are the two reactants for neutralization? Acid + Base

56. What are the two products for neutralization? Salt (ionic compound) + water

57. A) C_2H_5OH ethanol B) HCl hydrochloric acid
C) $Ca(OH)_2$ calcium hydroxide D) $CaCl_2$ calcium chloride

In aqueous solutions, which would react with phenolphthalein? C

C is a base. Phenolphthalein has a pKa around 8.

Which could be the product of neutralization? D

D is an ionic compound (metal + nonmetal). It is a salt, like NaCl but with Ca.

58. What volume of a 4.0 M NaOH solution is required to neutralize 250.0ML of a 2.0 M HCl solution?

$1H^+ * 2.0\ M * 0.250\ L = 4.0 * V_B * 1$

$V_B = 0.125$ L NaOH (or 125 mL NaOH)

Solutions

59. Describe how you would make a saturated sugar solution.

Add enough sugar until no more sugar can dissolve. Only a small amount of crystals should be present at the bottom of the container.

60. Describe how you would know you have an unsaturated solution in your cup.

You add solute and it disappears (dissolves in the solvent). More solute can still be added without reaching saturation.

61. Describe how you would know you have a supersaturated solution in your cup.

There is a large amount of crystals/un-dissolved solute at the bottom of the cup.

62. A student finds a bottle of a solution on a shelf in the chemistry prep room. The label says: 2.5M NaCl.

The solute is NaCl, the solvent is water, M tells you the concentration

63. A solution is made by dissolving 100g of $CuSO_4$ in enough water to make 1.000 L of solution. What is the molarity of the solution that was made?

$$100\ g\ CuSO4 * \frac{1\ mole\ CuSO4}{159.6\ g\ CuSO4} = 0.627\ moles = \frac{0.627\ moles}{1\ L} = 0.627\ M$$

64. When RbCl is dissolved in water, the solution conducts electricity. Write a complete explanation for this observation.

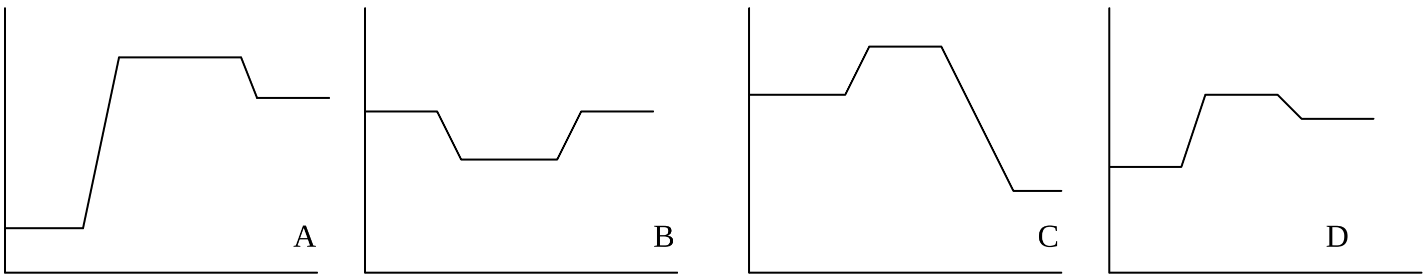
RbCl is an e lectrolyte dissolving as ions.

Thermochemistry

65. Describe the role of a catalyst.

To speed up the rate of the reaction by lowing the activation energy/barrier.

Look at the energy diagrams below to answer questions 66-67.



66. The exothermic reaction is represented by C *the energy of the products (at the end) is lower than the energy of the reactants (at the beginning)*

67. The endothermic reaction is represented by A *the energy of the products (at the end) is greater than the energy of the reactants (at the beginning)*

Application

68. A student puts a balloon that is blown up to almost popping in the warm sunlight. After 10 minutes it pops. Explain what happened. Use the words temperature, energy, pressure, and volume in your answer.

The temperature increases the kinetic energy of the gas particles inside the balloon.

There are more collisions which increase the pressure at a fixed volume.

69. Explain how knowledge of chemistry can help your read the nutritional information on a box of cereal.

Calories = Energy

You can use calorimetry to determine the enthalpy change in a reaction. This helps you determine the amount of energy that is released in a food product through digestion and metabolism.

70. Recall the process for balancing a skeleton equation. Explain why this must be done before we can call it an equation.

Matter cannot be created or destroyed in a chemical reaction so there must be the same number of atoms of each element on the reactant and product side of the equation arrow.

71. Explain the mass change, if there is one, for each of the following:

    a. An ice cube is melted by putting it in a warm pot.

       No change - *just a phase change*

    b. An Alka Seltzer tablet and glass of water is weighed and the mass is totaled. The tablet is dropped into the water and is weighed 2 minutes later.
       Weighs less – *CO_2 leaves through effervescence/bubbling*

    c. A car filter is weighed new and then weighed after the car has been driven for 2 years.
       Weighs more – *particles from the air are trapped by the filter*

    d. Two chemical solutions are weighed. They are poured together, a precipitate forms immediately and then weighed again.
       No change – *just a change in the form of matter*

72. An element has the following electron level configuration: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$

    a. What is the symbol for this element? Se – *add up the superscripts to get 34, identify the element on the periodic table with the atomic number 34*

    b. Is the element a representative metal, a transition metal, a nonmetal, a metalloid, or an inert gas? Nonmetal – *it is to the right of the metalloid line*

    c. What is the Lewis dot structure for this element?

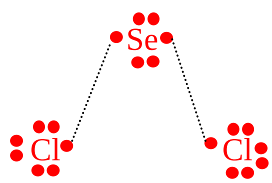
d. What is the ion that this element would most likely form? Se^{2-} *Se has 6 valence electrons and would like to gain 2 more to become stable. Electrons are negatively charged so the charge is a -2.*

e. What is the electron configuration for the ion that this would form?

Se normal electron configuration: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^4$

Se + 2 electrons = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^6$

f. Draw the Lewis dot structure for the compound that will form between chlorine and this element.



g. What is the formula of this compound? $SeCl_2$

h. Is the compound that forms ionic or covalent (molecular)? Explain.

Covalent/molecular – 2 nonmetals

i. What is the shape of this molecule? Bent; bond angles are 109.5° *like water*

73. Imagine that you are the head operator of a JIFFY POP POPCORN making machine. The first step in the operation is to make sure that the corn has the correct amount of moisture (water). This is done by drying the corn as it comes from the farmers. The best popcorn is made from corn that has 60% moisture content.

When this corn is put in the hot oil the kernels explode and make great popcorn. You decide to test the corn that has been drying to see if it is dry enough to use. You get an empty beaker and mass it, add some corn to the breaker and mass it again. You then heat it at 85°C for 30 minutes, cool it for an hour, mass it and repeat this process two more times. As the corn is heated it loses some water. You are doing this procedure to see if the starting moisture content was 60%.

You get the data in the table below:

Mass of the empty beaker	125.0g
Mass of the container + corn before heating	180.0g
Mass of the container + corn after 1st heating	170.0g
Mass of the container + corn after 2nd heating	141.0g
Mass of the container + corn after 3rd heating	141.0g

a. Calculate the percent of water in the corn after the 1st heating.

$$\frac{amount\ lost}{starting\ mass} = \frac{mass\ before\ heating - mass\ after\ 1st\ heating}{mass\ of\ container\ and\ corn\ before - mass\ of\ container} = \frac{180-170}{180-125} = \frac{10}{55}$$

$$\frac{10\ g}{55\ g} * 100 = 18.00\%$$

i. Should you use the corn based on the results of this 1st heating? no

ii. Give a reason for your answer. It is not up to the 60% standard, it is only at 18% right now.

b. Calculate the percent of water in the corn after the 3rd heating.

$$\frac{amount\ lost}{starting\ mass} = \frac{mass\ before\ heating - mass\ after\ 3rd\ heating}{mass\ of\ container\ and\ corn\ before - mass\ of\ container} = \frac{180-141}{180-125} = \frac{39}{55}$$

$$\frac{39\ g}{55\ g} * 100 = 70.91\ \%$$

iii. Should you use the corn based on the results of this 3rd heating? yes

iv. Give a reason for your answer. It meets the 60% standard

c. Why did the farmer perform the second and third heatings?

To ensure a constant mass

74. Silver sulfide (Ag_2S) is the common tarnish on silver objects. The reaction of formation of silver sulfide is given below:

$$4Ag(s) + 2H_2S(g) + O_2(g) \rightarrow 2Ag_2S(s) + 2H_2O(l)$$

a. What weight of silver sulfide can be made from 1.13 x 10^2 g of hydrogen sulfide (H_2S) obtained from a rotten egg? (SF)

$$113\ g\ H2S * \frac{1\ mole\ H2S}{34.1\ g\ H2S} * \frac{2\ mole\ Ag2S}{2\ mole\ H2S} * \frac{247.9\ g\ Ag2S}{1\ mole\ Ag2S} = 821\ g\ Ag2S$$

b. How many molecules of oxygen are required for this reaction? (SF)

$$113\ g\ H2S * \frac{1\ mole\ H2S}{34.1\ g\ H2S} * \frac{1\ mole\ O2}{2\ mole\ H2S} * \frac{6.02\ x\ 10^{23} molecules\ O2}{1\ mole\ O2}$$

$$= 9.97\ x\ 10^{23}\ molecules\ O2$$