

Chemistry Final Exam Study Guide Fall Semester

Name: Answers

Date: _____ Class: _____

Basics of Science

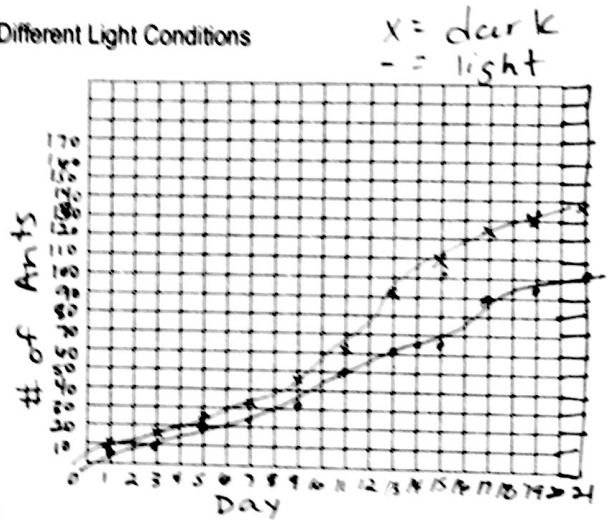
Directions: The following are experimental scenarios. Read the experiments and then identify the components of the scientific method by completing the graphic organizer provided. Graph the data and determine the relationship between the independent and dependent variable.

Experimental Scenario #1

A student investigated whether ants dig more tunnels in the light or in the dark. She thought that ants used the filtered light that penetrated the upper layers of earth and would dig more tunnels during the daytime. Ten ant colonies were set up in commercial ant farms with the same number and type of ants per ant farm. The same amount of food was given to each colony, and the colonies were in the same temperature. Five of the colonies were exposed to normal room light and five were covered with black construction paper so they did not receive light. Every other day for three weeks the length of the tunnels was measured in millimeter using a string and a ruler. Averages for the light and dark groups for each measured were then computed. The averages are listed in the following chart.

Length of Tunnels (mm) Constructed by Ants in Different Light Conditions

Day	Light	Dark
1	5	7
3	10	15
5	20	25
7	26	32
9	32	47
11	50	62
13	61	93
15	66	110
17	90	115
19	95	120
21	103	136



1. Briefly describe what occurs in each step of the scientific method:

1. Problem/Question	Do ants dig more tunnels in light or dark
2. Research	Ant behavior
3. Hypothesis: Independent and Dependent Variables	If the ants are exposed to light then they will dig more tunnels
4. Experiment (identify the control group)	5 colonies were exposed to light, 5 colonies exposed to darkness, same temp, food, soil
5. Results and Conclusion	Ants in the dark dig more tunnels, we must reject our hypothesis.

2. Do the steps of the scientific method always have to be followed in a strict order? Explain your answer

No, sometimes we start by repeating an experiment, sometimes research creates a question

3. Identify the following as qualitative or quantitative data

QL smooth
QN 2.4 g/mL

QL soluble
QN 15 m

QN 150 pounds
QL rainy

4. What is the purpose of a control group in an experiment?

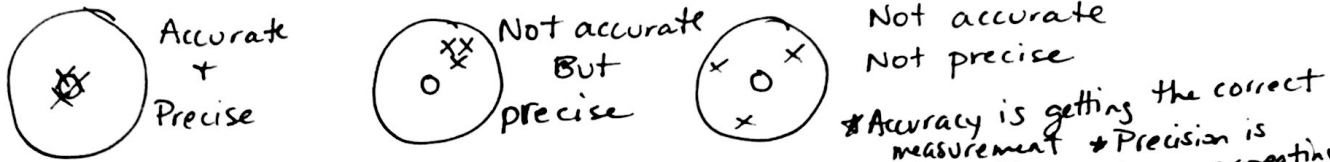
The control group is the group that is compared to the experimental group. The control group should help indicate if the variable being tested is affecting the outcome.

Measurements

1. Fill in the following table with the correct information

Equipment	Measurement	Units	Base or Derived
Balance	Mass	gram	Base
Stop Watch	Time	second	Base
Ruler	Length	meter	Base
graduated cylinder, ruler	Volume $l \times w \times h$	L, cm^3	Derived

2. What type of units are mass and volume? What type of unit is density? Determine the difference between a base unit and a derived unit. Density is a derived unit $D = \frac{M}{V}$
 Mass is a base unit
 Volume is a derived unit
 Derived units are determined by combining more than one measurement
3. Draw 3 targets to explain the difference between accuracy and precision then define accuracy and precision.



4. Three students made multiple massings of a copper cylinder, each using a different balance. The correct mass of repeating the cylinder had been previously determined to be 47.32 g. Describe the accuracy and precision of each student's measurements.

47.32g is the Accepted Value

	Lissa	Lamont	Leigh Anne
Measurement #1	47.13	47.37	47.95
Measurement #2	47.94	47.39	47.91
Measurement #3	46.83	47.35	47.89
Measurement #4	47.47	47.38	47.93

Not precise, not accurate precise + accurate precise but not accurate

Based on the above data:

- Which student's data is both accurate and precise?
 Which student's data is precise but not accurate?
 Which student's data is neither precise nor accurate?

Leigh Anne
Lamont
Lissa

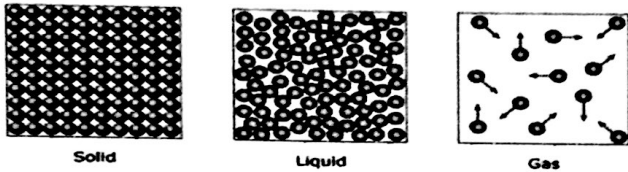
5. A student used water displacement to determine the volume of a metal cube. She filled a graduated cylinder with 20.8 mL of water. When she dropped the metal cube into the water its new volume level was recorded as 25.5 mL. Determine the volume of the metal cube and record the answer to the correct number of significant digits.

25.5
20.8
4.7 mL

6. You calculate that your semester average in chemistry is 97.5. When you get your report card, your average is 96. What was the percent error of your calculations?
 $\frac{97.5 - 96}{96} = 1.5\%$ error $\frac{\text{Actual} - \text{Accepted}}{\text{Accepted}} \times 100$
7. Determine the significant figures in each measurement
- | | |
|-----------------------|-----------------------|
| i. 0.03015 m <u>4</u> | iv. 0.90 sec <u>2</u> |
| ii. 0.1210 L <u>4</u> | v. 5000 dogs <u>∞</u> |
| iii. 1.56 mL <u>3</u> | vi. 5.0 mm <u>2</u> |

8. The following measurements were taken: 2.345 cm x 4.56 cm x 5.1 cm. Calculate the volume to the correct number of significant digits. 55 cm³

Matter and its Properties



Solid: No or little motion, definite volume
 Liquid: slight motion, definite volume
 Gas: lots of motion, no definite volume

© 2007 - 2009 The University of Waikato | www.sciencelearn.org.nz

- Describe the particle motion and shape and volume of the images above.
- Calculate the density of an object that has a mass of 5.2 grams and a volume of 8.2 mL.
 $D = \frac{m}{V} = \frac{5.2g}{8.2ml} = 0.63g/mL$
- Phase Changes. Label the phase changes represented on the diagram below.

$$D = \frac{m}{V} = \frac{5.2g}{8.2ml}$$

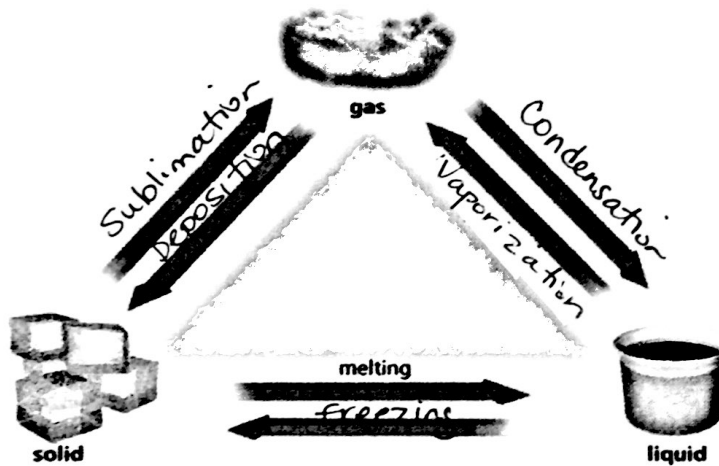


Figure 7.5A Changes of state

4. Determine if the following are physical or chemical properties or changes. Determine if the physical property is an intensive or extensive physical property.

Milk sours C
 solubility P, I
 Evaporation P, I

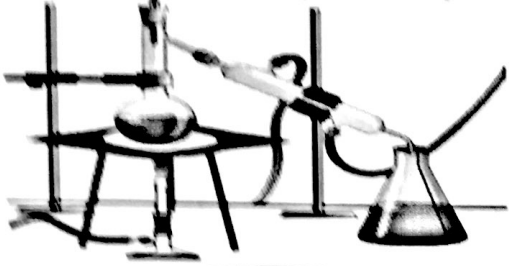
iron rusting C
 Grass growing C
 boiling point P, I

Reacts with acid C
 density P, I
 Luster P, I

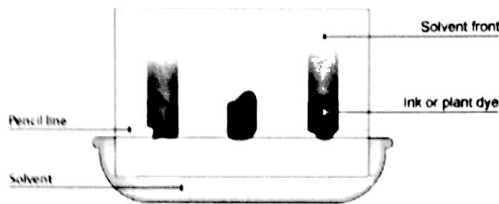
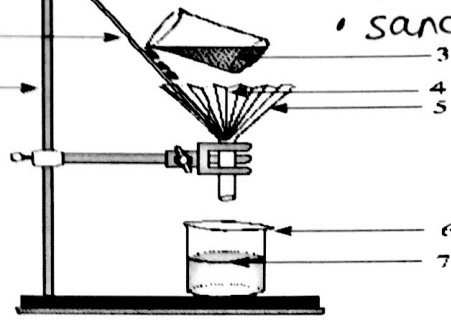
- Explain why orange juice WITH pulp is a different type of mixture from orange juice WITHOUT pulp.
 OJ with pulp is a heterogeneous mixture b/c the pulp will separate from the juice. Regular
- Identify the techniques that could be used with each of the following and describe what is being separated:
 chromatography, distillation, evaporation to dryness, filtration

Next page →

Distillation - liquids with different boiling points
 • water / soda syrup



Filtration - insoluble solid in a liquid
 • sand in water



Evaporation to dryness - soluble solid in H₂O • saltwater

Chromatography - 2 dyes

7. What is the difference between an element, ion, and compound? Give an example of each.

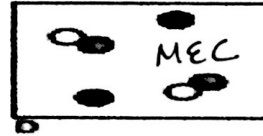
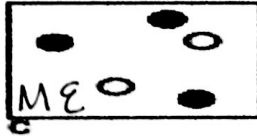
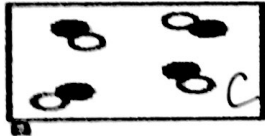
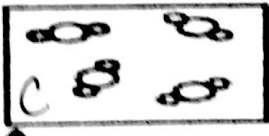
• Element is the simplest unit of matter (atom) → Ca²⁺ ion is an atom with a charge Ca²⁺ (its lost or gained e⁻)
 • compound is 2 or more atoms chemically bonded

Determine if the following are substances (element or compound) or mixtures in the following list and the images

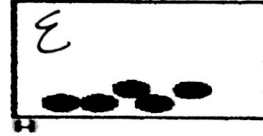
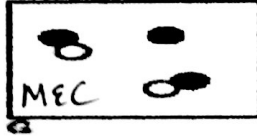
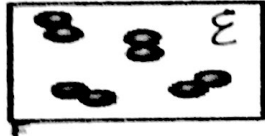
E sulfur
C water

E oxygen
C carbon dioxide

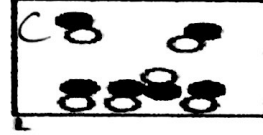
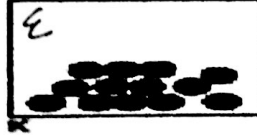
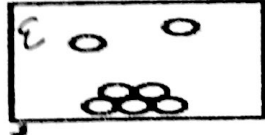
M soil
M sugar water



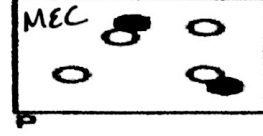
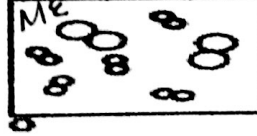
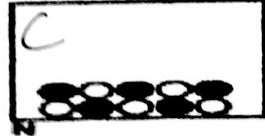
C - Compound
 E - Element



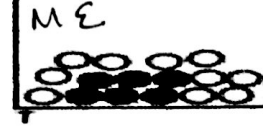
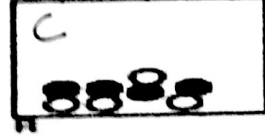
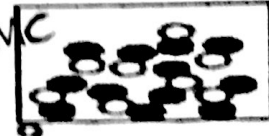
ME - Mixture of elements



MC - Mixture of compounds



MEC - Mixture of E + C



Atoms, Electrons and the Periodic Table

1. What is an isotope? How is the mass number shown on the Periodic Table calculated?
Isotopes are atoms of the same type (same # of protons) but have different
2. Fill in the following table: masses due to different # of neutrons

Particle	Symbol	Location	Relative Charge	Relative Mass
Proton	P^+	nucleus	+1	1 amu
Neutron	n^0	nucleus	0	1 amu
Electron	e^-	electron cloud	-1	$\frac{1}{1800}$ amu

3. Fill in the following table

Isotope Name	Atomic Mass	Atomic Number	# of Protons	# of Neutrons	# of Electrons
Ne-20	20	10	10	10	10
Ne-21	21	10	10	11	10
Ne-22	22	10	10	12	10
Zn-68	68	30	30	38	30
Zn-70	70	30	30	40	30

4. Magnesium has 3 isotopes. Magnesium-24 has a % abundance of 78.99%; Magnesium-26 has a % abundance of 11.01%. What is the percent abundance of Magnesium-25? The average atomic mass would be closest to which isotope? Why?
Mg-25 \rightarrow 10% abundance
Mg-24 b/c the avg mass on the Pt is 24.3 + that is closest to Mg-24
5. What determines the identity of an atom?
of protons (atomic #)
6. What is the name of a negative ion? A positive ion? Did the atom gain or lose an electron to become a negative ion? Is that a metal or a nonmetal?
anions are negative; positive ions are cations;
(gain e^-) \rightarrow nonmetal (lose e^-) metal

Fill in the following Table about ions

Element Name	Type of Element (metal/nonmetal/halogen/noble gas, etc)	Cation/Anion	How many electrons can be given away/received?
Lithium ion	Alkali metal	$Li^+ \rightarrow$ cation	one given away
Sodium ion	Alkali metal	$Na^+ \rightarrow$ Cat	1 given away
Nitrate ion	NO_3^- ; polyatomic ion	$NO_3^- \rightarrow$ anion	gained 1 extra e^-
Sulfide ion	S^{2-} , monatomic ion	$S^{2-} \rightarrow$ anion	gained 2 e^-
Tin (IV) ion	Sn^{4+} , monatomic ion transition metal	$Sn^{4+} \rightarrow$ cation	lost 4 e^-

7. Match the following:

<p><u>D</u> Arranged the Periodic Table by atomic mass</p> <p><u>C</u> Discovered the positively charged nucleus and that the rest of the atom is mostly empty space</p> <p><u>B</u> Based the periodic table on the law of octaves</p> <p><u>E</u> Discovered the electron</p> <p><u>A</u> Arranged the periodic table by increasing atomic number</p>	<p>A. Moseley</p> <p>B. Newland</p> <p>C. Rutherford</p> <p>D. Medeleev</p> <p>E. Thomson</p>
---	---

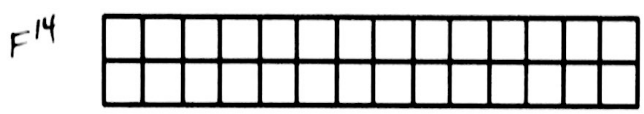
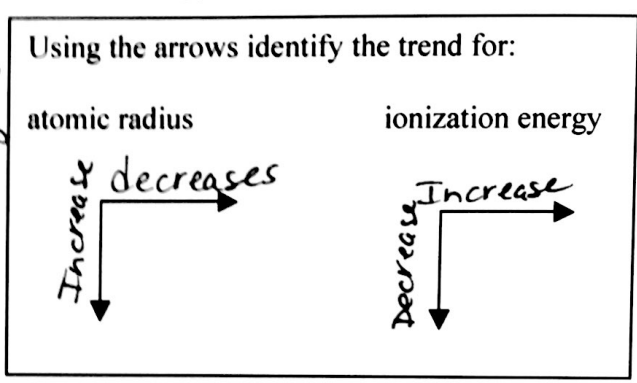
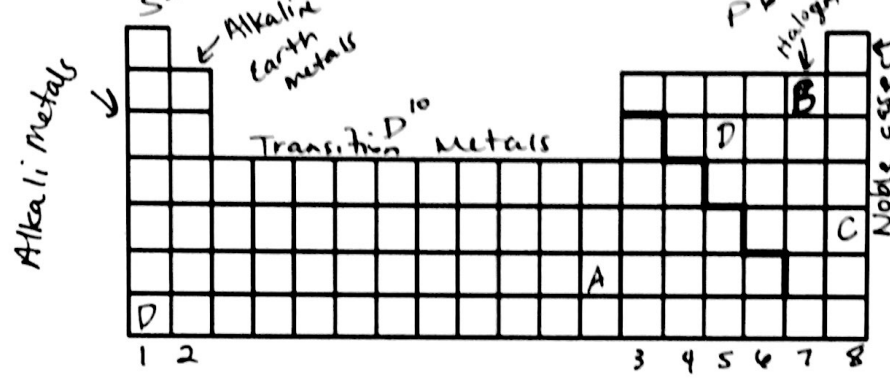
8. Draw the orbital diagram for the element Calcium $1s^2 2s^2 2p^6 3s^2 3p^4 4s^2$

9. Write the electron configuration for the element Fe. $1s^2 2s^2 2p^6 3s^2 3p^4 4s^2 3d^6$

10. Draw the Bohr model of Bromine.
 Br $P=35$ $N=45$

11. Write the electron dot notation for the following elements:
 C K O Br B

12. What is the maximum number of valence electrons possible for any atom? $8 \text{ valence } e^-$
 13. Explain what occurs (in terms of energy) when electrons move from their ground state to an excited state. gain energy
 14. Identify the following element based in the Noble gas notation $[Ar]4s^2 3d^{10} 4p^2$ Ge



- Label the s, p, d and f blocks on the periodic table above. How many electrons can fit in each sublevel?
- Label the Alkali Metals, Alkaline Earth Metals, Halogens, Metalloids, transition metals and Noble Gases

F is the most electronegative element

17. What element is located on period 3, group 17

- A- Place the letter "A" in the box of the only metal that is a liquid at room temperature. Hg
- B- Place the letter "B" in the box that contains the most reactive nonmetal. F
- C- Place the letter "C" in the box that contains a nonreactive (inert) element having 5 energy levels. Xe
- D- Place the letter "D" in the box of the element which has the largest atomic radius. Fr
- E- Place the letter "E" in the box containing the element in period 3 and Group 5A. P

- What type of element is copper? What are 3 properties of this type of element?
 Transition Metal malleable, ductile, good conductor of heat & electricity, lustrous
- What type of element is chlorine? What are 3 properties of this type of element?
 Nonmetal; Halogen Dull, insulators, brittle
- What are 2 characteristics of metalloids?
 conduct electric currents; solids at room temp
- What is the most reactive nonmetal?
 Fluorine

Bonding

1. What type of bond is formed when electrons are transferred from one atom to another atom? This type of bonding would occur between a metal ^{Fonic} and a nonmetal.
cation anion
2. What type of bond is formed when electrons are shared between two atoms? This type of bonding would occur between a nonmetal and a nonmetal. ^{covalent}

3. A single bond contains how many electrons? 2 (-) How many electrons are in a double bond? 4 (=)

4. List 3 characteristics of compounds with ionic bonding. High melting points, soluble in water, + solids @ room temp conduct an electric current when dissolved

5. List 3 characteristics of compounds with covalent bonding.

Low melting points; solids, liquids or gases @ room temp
Do not conduct electric currents, can be polar or nonpolar

6. What type of bond is formed when two electrons are not shared equally between two atoms?

Polar covalent bond $H-\ddot{C}l:$

7. Identify the charge of an ion formed from the following groups

Group 1 +1

Group 2 +2

Group 13 +3

Group 14 +4

Group 15 -3

Group 16 -2

Group 17 -1

Group 18 0

8. If an ion has a charge of 2-, what type of ion is this? Did this ion gain or lose electrons?

Anion; gained 2 e⁻

9. If an ion has a charge of 3+, what type of ion is this? Did this ion gain or lose electrons?

Cation; lost 3 e⁻

Use the compound $Al_2(SO_4)_3$ to answer question 10-12

10. How many atoms of aluminum, sulfur, and oxygen are present in?

$$Al - 2 \text{ atoms} \times 27g = \frac{54g}{342} \times 100 = 16\%$$

$$S - 3 \text{ atoms} \times 32g = \frac{96g}{342} = 28\%$$

$$O - 12 \text{ atoms} \times 16g = \frac{192g}{342g} = 56\%$$

11. What is the name of this compound?

Aluminum sulfate

12. Calculate the percent composition of each element in this compound.

13. How many moles of $CaBr_2$ are in a 39.25g sample.

$$\frac{39.25g}{200g} = 0.19625 \text{ mol } CaBr_2$$

14. You have 1.64 moles of Li_2O . How many formula units of Li_2O are present in this sample.

$$1.64 \text{ moles } Li_2O \left| \frac{6.02 \times 10^{23}}{1 \text{ mol}} \right| = 9.87 \times 10^{23} \text{ formula units } Li_2O$$

15. Find the empirical formula for the following: 37.8% Carbon, 6.4% Hydrogen, and 55.8% Chlorine.

$$\frac{37.8g \text{ C}}{12g} = 3.15 \text{ mol}$$

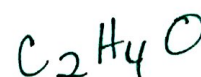
$$\frac{3.15 \text{ mol}}{1.59} = 2$$

$$\frac{6.4g \text{ H}}{1g} = 6.4 \text{ mol}$$

$$\frac{6.4 \text{ mol}}{1.6} = 4$$

$$\frac{55.8g \text{ Cl}}{35g} = 1.59 \text{ mol}$$

$$\frac{1.59 \text{ mol}}{1.59} = 1$$

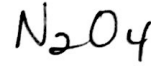


16. A gaseous compound is found to have the following composition: 30.5% Nitrogen and 69.5% Oxygen. The molecular mass of the gas is 91.8. What is the molecular formula?

$$\frac{30.5 \text{ g N}}{14} = \frac{2.1786 \text{ mol}}{2.18} \quad \frac{69.5 \text{ g O}}{16} = \frac{4.34375 \text{ mol}}{2.18}$$



$$\frac{91.8}{46} = 2$$



17. Write the correct formula or name for the following compounds. Calculate the molar mass of each compound

a. Ca_3As_2 Calcium Arsenide

b. $\text{Co}(\text{OH})_2$ Cobalt (II) hydroxide

c. Cu_2O Copper (I) oxide

d. Na_3P Sodium phosphide

e. Magnesium sulfide MgS

f. Barium Iodide ~~BaI₂~~

g. Potassium Carbonate ~~K₂CO₃~~

h. Iron (III) Chloride FeCl₃

Fill in the following table:

Compound Formula	Compound Name	Lewis Structure	Molecular shape	# of bonds	# of lone pairs on the central atom	Polar or nonpolar
CO_2	Carbon dioxide	$:\ddot{\text{O}}=\text{C}=\ddot{\text{O}}:$	linear	4	0	nonpolar
Cl_2	Chlorine	$:\ddot{\text{Cl}}-\ddot{\text{Cl}}:$	linear	-	-	nonpolar
CF_4	Carbon Tetrafluoride	$\begin{array}{c} \text{F} \\ \\ :\text{F}-\text{C}-\text{F}: \\ \\ \text{F} \end{array}$	tetrahedral	4	0	nonpolar
PCl_3	phosphorus trichloride	$\begin{array}{c} \text{Cl} \\ \\ :\text{Cl}-\text{P}-\text{Cl}: \\ \\ \text{Cl} \end{array}$	Trigonal pyramidal	3	1	polar
H_2O	dihydrogen monoxide	$\begin{array}{c} \text{O} \\ \diagup \quad \diagdown \\ \text{H} \quad \quad \text{H} \end{array}$	Bent	2	2	polar