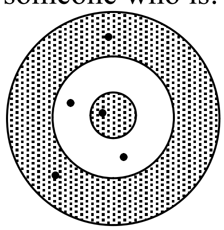
# Toombs 2012 CHEMISTRY 11 FINAL EXAM REVIEW

This is a **GENERAL OVERVIEW** ...it by no means serves as a complete review - it will give you an idea of which sections you need to focus on most! (This does not cover definitions and theory from your class notes)

## INTRODUCTION TO WORKING in the LABORATORY

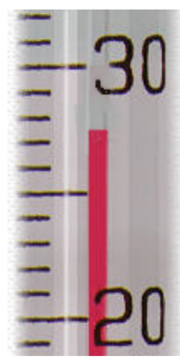
1. The term that refers to the reproducibility of a laboratory measurement is
   a) precision b) repeatability c) accuracy d) exactness

2. The marks on the following target represent someone who is:



   a) accurate, but not precise. b) precise, but not accurate.
   c) both accurate and precise. d) neither accurate nor precise

3. a) Clearly state the temperature in $^{o}$C, read from the thermometer illustrated to the right: ____________________
   b) How many significant digits should be reported in the correct answer? ________________
   c) What is the uncertainty of this measurement?___________
   d) State this temperature in Kelvin ____________




4. The number of significant digits in 0.30500 is
   a) 1 b) 2 c) 3 d) 4 e) 5

5. The result of 2.350 x (4.0 + 6.311) is,
   a) 24 b) 24.2 c) 24.21 d) 24.205

6. Make the following Metric System conversions using "unit analysis" (you may use scientific notation):

a) 825 cm _______________ = _______________ km

b) 19 mL _______________ = _______________ cL

c) 18 cg _______________ = _______________ μg

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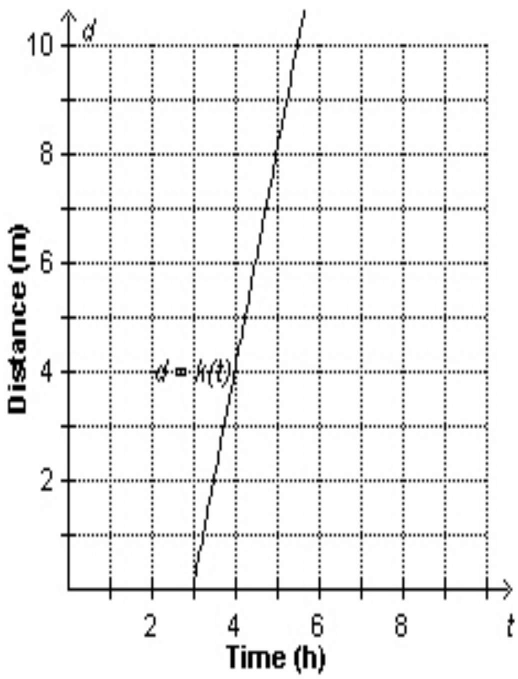
7. The following graph shows distance, *d* metres, as a function of time, *t* hours.
a) Interpolate to determine the time at which the distance is 6.0 m.
b) Extrapolate to determine the distance at 6.0 hours.
c) Can the distance be determined for the 2.0 hour mark?




## ATOMIC THEORY

1. Define each of the following:
   Ionization energy | Ionic radius
   Atomic radius | Electronegativity | Metallic Character

2. As you move down the periodic table… (fill in each blank with "increases" or "decreases")
   Ionization energy _______________ Ionic radius __________________
   Atomic radius _________________ Electronegativity ______________
   Metallic Character _____________

3. Describe the contribution of each of the following scientists to the development of the model of the atom:
   Democritus Aristotle Dalton
   Rutherford Thompson Bohr

4. Define Isotopes. Use Carbon 12 and Carbon 13 to identify the number of electrons, protons, and neutrons and the atomic mass of each of these two isotopes.

5. Describe the development of the modern periodic table.

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## INTRO TO CHEMISTRY

1. Write the combining capacity of each element in:
a) MgS: Mg ________ S _______
b) $Cu_2O$: Cu _______ O _______
c) $Pt(MnO_2)_2$: Pt _______ Mn _______ O ________

2. List two diatomic elements: _______________ ______________
3. List the most metallic element on the periodic table: _________
4. Which of the following is a metalloid? a) As b) Ag c) S d) Pb e) He
5. Which of the following is a transition metal? a) Cl b) Ni c) P d) Ca e) C
6. Which of the following is an alkali metal? a) Mg b) Kr c) K d) Al e) H
7. Which of the following is a lanthanide? a) Xe b) Eu c) Cd d) P e) W
8. Which element has the highest melting point? a) Pb b) Au c) Os d) W e) Hg

9. Define anion and give one example of a monatomic and one example of a polyatomic anion.

10. FILL IN THE FOLLOWING CHART:

| ***Combination*** | ***Bond Type (ionic or covalent)*** | ***Formula*** | ***Name*** |
|---|---|---|---|
| C / Cl | | | |
| | | $Sc_3N_5$ | |
| | | | iron (III) perarsenate |
| | | | triselenium nonaiodide |

11. The melting point of wax is ~30°C. List the freezing point :___________
If the boiling point of wax is ~105°C, Draw a rough sketch of what the temperature time graph (heating curve) would look like for a wax.

12. Define endothermic reaction and give one example that is a physical change. (You should be able to write a realistic example).

13. Define exothermic reaction and give one example that is a chemical change. (You may use fictitious substances such as $A_2B_{(aq)}$).

14. Fill in the blanks in the table

| Symbol | $^{65}Cu$ | $^{86}Kr$ | $^{195}Pt^{+3}$ | |
|---|---|---|---|---|
| Number of protons | | | 78 | |
| Number of neutrons | | | 117 | 46 |
| Number of electrons | | | 75 | 36 |
| Name of element / ion | | | | |

15. Copper has two stable isotopes, $^{63}Cu$ and $^{65}Cu$, with masses of 62.939598 amu and 64.927793 amu, respectively. Calculate the percent abundances of these isotopes of copper.

## THE MOLE CONCEPT

1. Write Avogadro's number: ____________________

2. What volume will be occupied by 50. g of oxygen gas at STP?

3. Mercury has a density of 13.6 g/ml. How many atoms are present in 10.5 ml of mercury?

4. Determine the number of atoms in 150 g of $Al_2O_3$.

5. State Avogadro's Hypothesis.

6. A container holds 378 g of radon gas at RTP. An identical container at RTP holds 121 g of an unknown gas. Identify the second gas.

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## GAS LAWS

1. Calculate the volume of hydrogen produced if 5 moles of calcium reacts with water at 304 kPa and 19ºC.

2. 3.50 L of a gas at 27ºC are heated to 79ºC. What will its new volume be (assuming constant pressure)?

3. If we took 2.00 liters of gas at 1.00 atm and compressed it to a pressure of $6.00 \times 10^4$ atm, what would the new volume of that gas be?

4. A meteorological balloon occupies 140 litres at 39°C and 95 kPa. What volume will it occupy at 85°C and 121 kPa?

5. What volume will 480 g of ammonia gas occupy at 125 °C and 180 kPa?

## CHEMICAL CHANGE

1. BALANCE THE FOLLOWING:

a) $Mn^{2+}$ + $Al^{3+}$ ---> Al + $Mn^{7+}$

b) KOH + $Cl_2$ ---> KCl + $KClO_3$ + $H_2O$

c) $KMnO_4$ + Cr --->

d) Calcium bicarbonate reacts when heated...

e) $C_3H_8$ + $O_2$ --->

2. A reaction between Lead and Oxygen produced 68.6 g of $Pb_3O_4$. How many grams of oxygen and lead were involved?

3. 57 g of calcium hydroxide is reacted with 91 g of oxalic acid. What are the two products in this reaction, and how many grams of each product are formed?

4. Define molecular formula, structural formula and empirical formula, and give one example of each.

5. An ionic compound contains 29.0% Na, 40.6% S, and 30.4 % O. What is the empirical formula for the compound?

6. Find the percentage composition for sulphuric acid.

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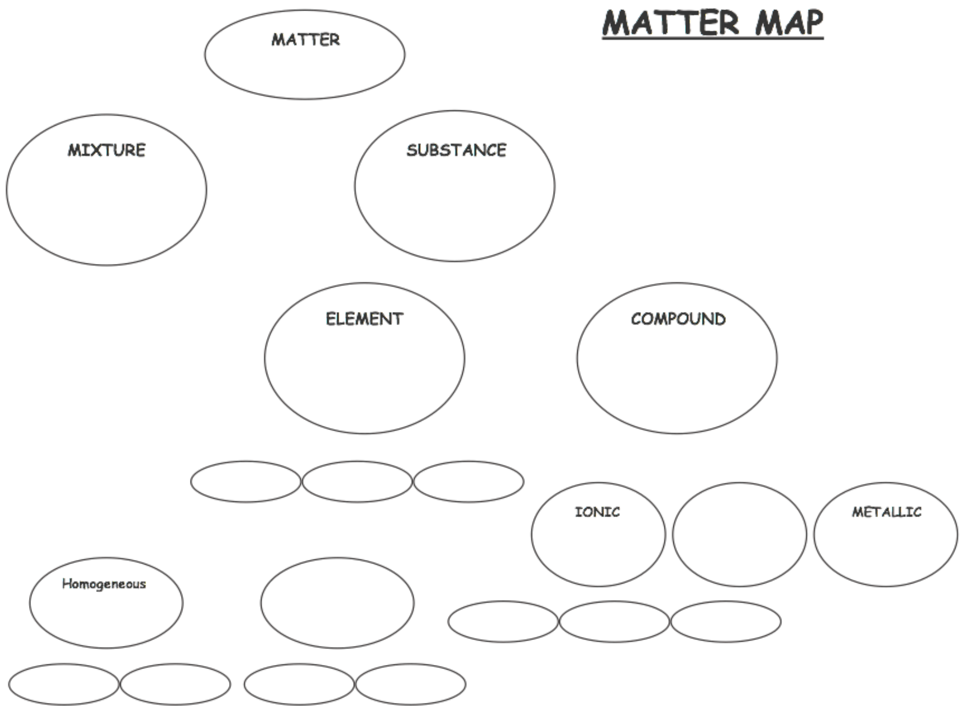
7. Fill in the following table on the classification of matter. Fill in the heading categories AND define each heading. Give an example of each.




## ATOMIC STRUCTURE AND BONDING

1. Which elements tend to gain electrons? Give some examples, including their combining capacity. Explain why the examples you chose would gain electrons.

2. Define valence electrons. Give an example, using a transition metal.

3. For each of the following, write the:

   i) full electronic configuration
   ii) core electronic configuration
   iii) orbital representation diagram
   iv) Lewis dot diagram

a) Ca
b) $Rb^{+}$
c) P
d) $Sb^{-3}$
e) U

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4. FILL IN THE FOLLOWING CHART:

| Formula | # of bonds | # of lone pairs | Total # of bond axes | Basic shape | Actual shape | Bond angles | Type of bond | Net dipole Y/N | Is the MOLECULE polar? |
|---|---|---|---|---|---|---|---|---|---|
| HF | | | | | | | | | |
| $SiCl_4$ | | | | | | | | | |
| $ClF_3$ | | | | | | | | | |
| $BrF_5$ | | | | | | | | | |

*(Please note that Type of Bond refers to "polar covalent, non-polar covalent, or ionic)*
*"Net dipole" means "does the molecule have a dipole?*

Draw each of these molecules in the space below

| | |
|---|---|
| HF | $SiCl_4$ |
| $ClF_3$ | $BrF_5$ |

5. Define electronegativity. Which element on the periodic table is the MOST electronegative? How does electronegativity affect bonding?

6. Write the Lewis dot diagram and structural formula (if possible) for eaeh of the following. For each, state the %ionic character, and state which **COVALENT MOLECULES** are polar.

a) HF

b) $SiCl_4$

c) $CO_3^{2-}$

d) $K_3N$

7. Explain how polarity of the molecule relates to its solubility in certain solvents.

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## SOLUTIONS

1. What volume of 3.5 M phosphoric acid solution can be made using 75 g of phosphoric acid?

2. When barium nitrate and lithium sulphate are mixed, the products will be:
a) both aqueous
b) both solid precipitates
c) one aqueous solution and one solid precipitate
d) the reaction will not proceed

3. The following two solutions are mixed:
300. ml of 0.50 M $Al_2S_3$ (aq) and 150 ml of 0.30 M $Sr(OH)_2$ (aq).
a) State the concentrations of each of the ions after mixing.
Include the dissociation equation(s) in your answer.
b) Identify the precipitate that forms.
Write the net ionic equation for this precipitation reaction.
c) State the limiting and excess reagents.
d) Clearly list all ion concentrations AFTER mixing and precipitation is complete.

4. What volume of 0.50 M hydrochloric acid solution will neutralize 30. ml of 0.01 M barium hydroxide (aq). Write the full formula equation for this reaction. If you were to write a net ionic equation, what would it be?

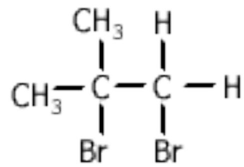
5. If a solution conducts a current, it must contain:
a) an ionic compound
b) a covalent compound
c) an exothermic reaction
d) neutrons

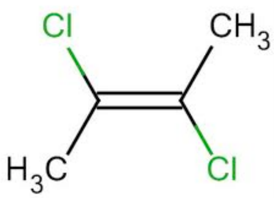
6. State whether each statement is True or False and explain your choice.
a) Ionic compounds which dissociate in solution will conduct electricity
b) Covalent molecules do not dissociate in solution and conduct a current
c) 500. mL of a 2.0 M solution is more concentrated than 150 mL of a 3.5 M solution
d) Adding more water to a solution improves the dissociation of the ionic compound

## ORGANIC CHEMISTRY

1. Name the following:

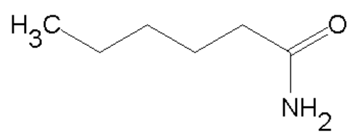
a) $CH_3 - CH_2 - CH_2 - OH$

b) 


c) 


d) $CH_3 - CH_2 - CH_2 - O- CH_2 - CH_3$

e) $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - NH_2$

f) 


2. Show the structural formulas of the following:

a) butanal

b) (2E, 4Z) - 3,4 - dichlorohexa - 2,4-diene

c) butanoic acid

d) 3-pentanone

e) 3, 7 – decadiynol

f) butoxy heptanoate

# Toombs 2012 CHEMISTRY 11 FINAL EXAM REVIEW - ANSWERS

## INTRODUCTION TO WORKING in the LAB ANSWERS:

1A
2D
3a) 27.5 °C
3b) 3 SF (because we can estimate to ± ½ of a reading, so that gives the 1 dec place and thus the 3SF)
3c) ± 0.5 °C
3d) sig fig rules so the answer is 300. K or $3.00 \times 10^2$ K for 3 SF
4E
5B
6a) $8.25 \times 10^{-3}$ km
6b) 1.9 cL
6c) $1.8 \times 10^3$ μg
7a) 4.5 m
7b) The distance would be between 10.5 and 11.0 hours. (redrawing the graph we could provide a more accurate answer)
7c) Since distance = 0.0 m at 3.0 hours, (this is the starting data) the assumption must be made that the graph can not be extrapolated back to a value < 3.0 hours; i.e., this distance value does not exist for this set of data.

## ATOMIC THEORY ANSWERS:

#1 and #2 **Trends of the Periodic Table**
**Note:** These are general periodic trends of elements. There are many exceptions to these general rules.

**Atomic Radius** - Atomic radius is simply the radius of the atom, an indication of the atom's volume.
**Period** - atomic radius decreases as you go from left to right across a period.
Why? Stronger attractive forces in atoms (as you go from left to right) between the opposite charges in the nucleus and electron cloud cause the atom to be 'sucked' together a little tighter.
**Group** - atomic radius increases as you go down a group.
Why? There is a significant jump in the size of the nucleus (protons + neutrons) each time you move from period to period down a group. Additionally, new energy levels of elections clouds are added to the atom as you move from period to period down a group, making the each atom significantly more massive, both is mass and volume.

**Electronegativity** - Electronegativity is an atom's 'desire' to grab another atom's electronegativity.
**Period** - electronegativity increases as you go from left to right across a period.
Why? Elements on the left of the period table have 1 -2 valence electrons and would rather give those few valence electrons away (to achieve the octet in a lower energy level) than grab another atom's electrons. As a result, they have low electronegativity. Elements on the right side of the period table only need a few electrons to complete the octet, so they have strong desire to grab another atom's electrons.
**Group** - electronegativity decreases as you go down a group.
Why? Elements near the top of the period table have few electrons to begin with; every electron is a big deal. They have a stronger desire to acquire more electrons. Elements near the bottom of the chart have so many electrons that loosing or acquiring an electron is not as big a deal. This is due to the shielding affect where electrons in lower energy levels shield the positive charge of the nucleus from outer electrons resulting in those outer electrons not being as tightly bound to the atom.

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## ATOMIC THEORY continued ANSWERS:

**Ionization Energy** - Ionization energy is the amount of energy required to remove the outermost electron. It is closely related to electronegativity.
**Period** - ionization energy increases as you go from left to right across a period.
Why? Elements on the right of the chart want to take others atom's electron (not given them up) because they are close to achieving the octet. The means it will require more energy to remove the outer most electron. Elements on the left of the chart would prefer to give up their electrons so it is easy to remove them, requiring less energy (low ionization energy).
**Group** - ionization energy decreases as you go down a group.
Why? The shielding affect makes it easier to remove the outer most electrons from those atoms that have many electrons (those near the bottom of the chart).

**Reactivity** - Reactivity refers to how likely or vigorously an atom is to react with other substances. This is usually determined by how easily electrons can be removed (ionization energy) and how badly they want to take other atom's electrons (electronegativity) because it is the transfer/interaction of electrons that is the basis of chemical reactions.
**Metals**
**Period** - reactivity decreases as you go from left to right across a period.
**Group** - reactivity increases as you go down a group
Why? The farther to the left and down the periodic chart you go, the easier it is for electrons to be given or taken away, resulting in higher reactivity.
**Non-metals**
**Period** - reactivity increases as you go from the left to the right across a period.
**Group** - reactivity decreases as you go down the group.
Why? The farther right and up you go on the periodic table, the higher the electronegativity, resulting in a more vigorous exchange of electron.

**Ionic Radius vs. Atomic Radius**
**Metals** - the atomic radius of a metal is generally larger than the ionic radius of the same element.
Why? Generally, metals loose electrons to achieve the octet. This creates a larger positive charge in the nucleus than the negative charge in the electron cloud, causing the electron cloud to be drawn a little closer to the nucleus as an ion.
**Non-metals** - the atomic radius of a non-metal is generally smaller than the ionic radius of the same element.
Why? Generally, non-metals loose electrons to achieve the octet. This creates a larger negative charge in the electron cloud than positive charge in the nucleus, causing the electron cloud to 'puff out' a little bit as an ion.

**Melting Point**
**Metals** - the melting point for metals generally decreases as you go down a group.
**Non-metals** - the melting point for non-metals generally increases as you go down a group.

#3 and #4 See the next page

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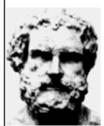
## #3 and #4 ATOMIC THEORY continued ANSWERS:

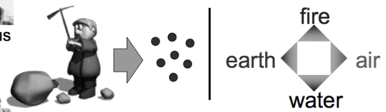
### Models of the Atom: a Historical Perspective

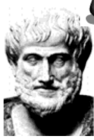
### Early Greek Theories



Democritus

- 400 B.C. - Democritus thought matter could not be divided indefinitely.
- This led to the idea of atoms in a void.



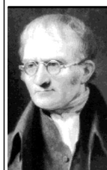



Aristotle

- 350 B.C - Aristotle modified an earlier theory that matter was made of four "elements": earth, fire, water, air.
- Aristotle was wrong. However, his theory persisted for 2000 years.

### John Dalton

- 1800 -Dalton proposed a modern atomic model based on experimentation not on pure reason.

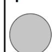


- All matter is made of atoms.
- Atoms of an element are identical.
- Each element has different atoms.
- Atoms of different elements combine in constant ratios to form compounds.
- Atoms are rearranged in reactions.

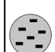
- His ideas account for the law of conservation of mass (atoms are neither created nor destroyed) and the law of constant composition (elements combine in fixed ratios).

### Adding Electrons to the Model

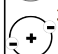
Materials, when rubbed, can develop a charge difference. This electricity is called "cathode rays" when passed through an evacuated tube (demos). These rays have a small mass and are negative. Thompson noted that these <u>negative</u> subatomic particles were a fundamental part of <u>all</u> atoms.



1) <u>Dalton's "Billiard ball" model</u> (1800-1900) Atoms are solid and indivisible.



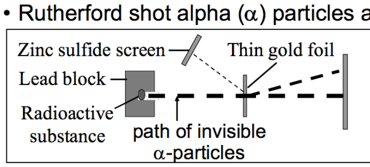
2) <u>Thompson "Plum pudding" model</u> (1900) Negative electrons in a <u>positive</u> framework.

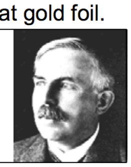


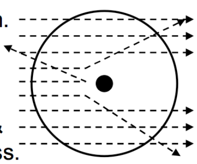

3) <u>The Rutherford model</u> (around 1910) Atoms are mostly empty space. Negative electrons orbit a positive nucleus.

### Ernest Rutherford (movie: 10 min.)

- Rutherford shot alpha (α) particles at gold foil.

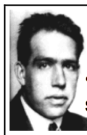


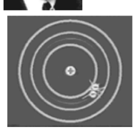


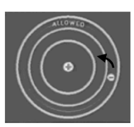
Most particles passed through. So, atoms are mostly empty.
Some positive α-particles deflected or bounced back!
Thus, a "nucleus" is positive & holds most of an atom's mass.

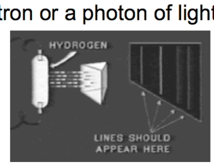
### Bohr's model



- Electrons orbit the nucleus in "shells"
- Electrons can be bumped up to a higher shell if hit by an electron or a photon of light.






There are 2 types of spectra: continuous spectra & line spectra. It's when electrons fall <u>back down</u> that they release a photon. These jumps down from "shell" to "shell" account for the line spectra seen in gas discharge tubes (through spectroscopes).

### Atomic numbers, Mass numbers

- There are 3 types of subatomic particles. We already know about electrons ($e^-$) & protons ($p^+$). Neutrons ($n^0$) were also shown to exist (1930s).
- They have: no charge, a mass similar to protons
- Elements are often symbolized with their mass number and atomic number E.g. Oxygen: $^{16}_{8}O$
- These values are given on the periodic table.
- For now, round the mass # to a whole number.
- These numbers tell you a lot about atoms.
  - # of protons = # of electrons = atomic number
  - # of neutrons = mass number – atomic number
- Calculate # of $e^-$, $n^0$, $p^+$ for Ca, Ar, and Br.

### Bohr - Rutherford diagrams

- Putting all this together, we get B-R diagrams
- To draw them you must know the # of protons, neutrons, and electrons (2,8,8,2 filling order)
- Draw protons ($p^+$), ($n^0$) in circle (i.e. "nucleus")
- Draw electrons around in shells

### Isotopes and Radioisotopes

- Atoms of the same element that have different numbers of neutrons are called isotopes.
- Due to isotopes, mass #s are not round #s.
- Li (6.9) is made up of both $^6$Li and $^7$Li.
- Often, at least one isotope is unstable.
- It breaks down, releasing radioactivity.
- These types of isotopes are called radioisotopes

Q- Sometimes an isotope is written <u>without</u> its atomic number - e.g. $^{35}$S (or S-35). Why?

Q- Draw B-R diagrams for the two Li isotopes.

## #5 ATOMIC THEORY continued ANSWERS:

In Ancient Greece, the influential Greek philosopher Aristotle proposed that there were four main elements: air, fire, earth and water. All of these elements could be reacted to create another one; e.g., earth and fire combined to form lava. However, this theory was dismissed when the real chemical elements started being discovered. Scientists needed an easily accessible, well organized database with which information about the elements could be recorded and accessed. This was to be known as the periodic table.

The original table was created before the discovery of subatomic particles or the formulation of current quantum mechanical theories of atomic structure. If one orders the elements by atomic mass, and then plots certain other properties against atomic mass, one sees an undulation or periodicity to these properties as a function of atomic mass.
In 1829 Döbereiner proposed the Law of Triads: The middle element in the triad had atomic weight that was the average of the other two members. The densities of some triads followed a similar pattern. Soon other scientists found chemical relationships extended beyond triads. Fluorine was added to Cl/Br/I group; sulfur, oxygen, selenium and tellurium were grouped into a family; nitrogen, phosphorus, arsenic, antimony, and bismuth were classified as another group.

This was followed by the English chemist John Newlands, who noticed in 1865 that when placed in order of increasing atomic weight, elements of similar physical and chemical properties recurred at intervals of eight, which he likened to the octaves of music, though his law of octaves was ridiculed by his contemporaries.[3] However, while successful for some elements, Newlands' law of octaves failed for two reasons:

1. It was not valid for elements that had atomic masses higher than Ca.
2. When further elements were discovered, such as the noble gases (He, Ne, Ar), they could not be accommodated in his table.

Dmitri Mendeleev, father of the periodic table
Finally, in 1869 the Russian chemistry professor Dmitri Ivanovich Mendeleev and four months later the German Julius Lothar Meyer independently developed the first periodic table, arranging the elements by mass. However, Mendeleev plotted a few elements out of strict mass sequence in order to make a better match to the properties of their neighbors in the table, corrected mistakes in the values of several atomic masses, and predicted the existence and properties of a few new elements in the empty cells of his table. Mendeleev was later vindicated by the discovery of the electronic structure of the elements in the late 19th and early 20th century.

Earlier attempts to list the elements to show the relationships between them (for example by Newlands) had usually involved putting them in order of atomic mass. Mendeleev's key insight in devising the periodic table was to lay out the elements to illustrate recurring ("periodic") chemical properties (even if this meant some of them were not in mass order), and to leave gaps for "missing" elements. Mendeleev used his table to predict the properties of these "missing elements", and many of them were indeed discovered and fit the predictions well.

With the development of theories of atomic structure (for instance by Henry Moseley) it became apparent that Mendeleev had listed the elements in order of increasing atomic number (i.e. the net amount of positive charge on the atomic nucleus). This sequence is nearly identical to that resulting from ascending atomic mass.

In order to illustrate recurring properties, Mendeleev began new rows in his table so that elements with similar properties fell into the same vertical columns ("groups").

With the development of modern quantum mechanical theories of electron configuration within atoms, it became apparent that each horizontal row ("period") in the table corresponded to the filling of a quantum shell of electrons. In Mendeleev's original table, each period was the same length. Modern tables have progressively longer periods further down the table, and group the elements into s-, p-, d- and f-blocks to reflect our understanding of their electron configuration.

In the 1940s Glenn T. Seaborg identified the transuranic lanthanides and the actinides, which may be placed within the table, or below (as shown above).

# Toombs 2012 CHEMISTRY 11 FINAL EXAM REVIEW

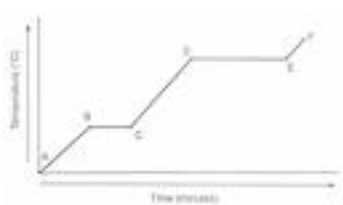
## INTRO TO CHEMISTRY ANSWERS:

1. Write the combining capacity of each element in:
a) MgS: Mg = +2 S = -2
b) $Cu_2O$: Cu = +1 O = -2
c) $Pt(MnO_2)_2$: Pt +2 since $MnO_2$ = -1 and O = -2 then Mn = +3
2. List two diatomic elements: N, O, F, Cl, Br, I, At
3. List the most metallic element on the periodic table: Fr
4 a 5 b 6 c 7 b 8 d
9. An anion is an element that has gained electrons in its valence shell, or a group of elements that has gained electron(s). Monatomic examples: $F^{-1}$ and $N^{-3}$ and a polyatomic example is $PO_4^{-3}$

10. FILL IN THE FOLLOWING CHART:

| ***Combination*** | ***Bond Type (ionic or covalent)*** | ***Formula*** | ***Name*** |
|---|---|---|---|
| C / Cl | Covalent | $CCl_4$ | Carbon tetrachloride |
| $Sc^5$ / $N^3$ | ionic | $Sc_3N_5$ | Scandium (V) nitride |
| $Fe^3$ / $AsO_5^3$ | Ionic | $FeAsO_5$ | iron (III) perarsenate |
| Se / I | Covalent | $Se_3I_9$ | triselenium nonaiodide |

11. The melting point of wax is ~30°C. List the freezing point : ~30°C
The temperature time graph (heating curve) :



12. In an endothermic reaction, heat is absorbed by the reactants in order to make products.
For example: $H_2O$ (l) + heat → $H_2O$ (g) is a physical change.
13. In an exothermic reaction the reactants combine to form products, and energy in the form of heat or light is also produced and given off to the surroundings.
For example: $A_2B_{(aq)} + CD_2 (aq) \rightarrow 2AD_{(aq)} + BC (aq) + 450$ kJ
This is a chemical change. 450 kJ of energy is released.
14.

| Symbol | $^{65}Cu$ | $^{86}Kr$ | $^{195}Pt^{+3}$ | $^{82}Kr$ |
|---|---|---|---|---|
| Number of protons | 29 | 36 | 78 | 36 |
| Number of neutrons | 36 | 50 | 117 | 46 |
| Number of electrons | 29 | 36 | 75 | 36 |
| Name | Copper | Krypton | Platinum ion | Krypton |

15. 69.50% $^{63}Cu$ and 30.50% $^{65}Cu$

# Toombs 2012 CHEMISTRY 11 FINAL EXAM REVIEW

## THE MOLE CONCEPT — ANSWERS:

1. $6.02 \times 10^{23}$
2. 35 L
3. $4.29 \times 10^{23}$ atoms
4. $4.4 \times 10^{24}$ atoms
5. Equal moles of two gases at the same temperature and pressure conditions will occupy the same volume.
6. 71.2 g/mole. Gas # 2 = $Cl_2$ (g)

## GAS LAWS — ANSWERS:

1. PV = nRT  V = 40 L
2. $V_1/T_1 = V_2/T_2$  $V_2$ = 4.22 L
3. $V_1P_1 = V_2P_2$  $V_2 = 3.33 \times 10^{-5}$ L
4. V = 130 L
5. V = 520 L

## CHEMICAL CHANGE — ANSWERS:

1. a) $3Mn^{2+} + 5Al^{3+} \rightarrow 5Al + 3Mn^{7+}$
b) $6KOH + 3Cl_2 \rightarrow 5KCl + 1KClO_3 + 3H_2O$
c) $2KMnO_4 + Cr \rightarrow Cr(MnO_4)_2 + 2K$
d) $Ca(HCO_3)_2 \rightarrow Ca(s) + H_2(g) + 2C(s) + 3O_2(g)$
e) $C_3H_8 + 5O_2 \rightarrow 3CO_2(g) + 4H_2O(l)$

2. 6.40 g

3a. 13.9 g $H_2O$ and 98.6 g $CaC_2O_4$
3b. $Ca(OH)_2$
3c. $H_2C_2O_4$
3d. 0.24 moles of excess $H_2C_2O_4$
3e. The L of C of M applies to all reactions and therefore all calculation questions.

4. refer to your notes or text
5. $Na_2S_2O_3$
6. 2.06%H 32.7%S 65.2%O
7. refer to your notes or text.

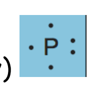
## ATOMIC STRUCTURE AND BONDING — ANSWERS:

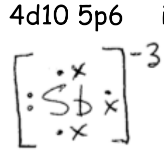
1. Elements in Family 17, 16, and 15 tend to gain electrons. Example: N would gain 3 electrons to become $N^{3-}$, the same electronic configuration as the noble gas, Ne. O gains 2 electrons to have the same electronic configuration as Ne and F gains 1 electron to have the same electronic configuration as Ne (i.e. the outermost shell is filled with 8 electrons).

2. Valence electrons are the outermost s and p electrons that an element has. These are the electrons that are most often involved in bonding and in determining combining capacity. For example, Fe has 2 outermost s electrons, the 4s electrons. It also has 6 "d" electrons, notated as 3d6. But these d electrons are not considered valence electrons.

3. a) Ca  i) 1s2 2s2 2p6 3s2 3p6 4s2  ii) [Ar] 4s2  iii) X X XXX X XXX X  iv) Ca:

b) $Rb^+$  i) 1s2 2s2 2p6 3s2 3p6 4s2 3d10 4p6  ii) [Ar] 4s2 3d10 4p6 or [Kr]
iii) [Ar] X XXXXX XXX  iv) $[Rb^{+1}]$

c) P  i) 1s2 2s2 2p6 3s2 3p3  ii) [Ne] 3s2 3p3  iii) [Ne] X \\\  iv) 

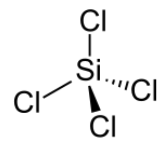
d) $Sb^{-3}$  i) 1s2 2s2 2p6 3s2 3p6 4s2 3d10 4p6 5s2 4d10 5p6  ii) [Kr] 5s2 4d10 5p6
iii) [Kr] X XXXXX XXX  iv)   $Sb^{-3}$ has the same lewis dot diagram as Xe

e) U  i) 1s2 2s2 2p6 3s2 3p6 4s2 3d10 4p6 5s2 4d10 5p6 6s2 4f14 5d10 6p6 7s2 5f4
ii) [Rn] 7s2 5f4  iii) [Rn] X \\\\  iv) U :

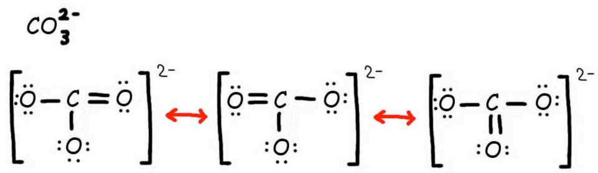
**ATOMIC STRUCTURE AND BONDING continued ANSWERS:**

4. a) HAt 0.5% ionic

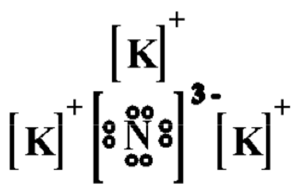

b) $SiCl_4$ 30% ionic




c) $CO_3^{2-}$ 22% ionic




d) $K_3N$ 70% ionic




5. Electronegativity is an atom's attraction to gaining and keeping electrons. F is the MOST electronegative. Elements with a higher electronegativity want to gain electrons to completely fill their valence shell (eg. Halogens) and elements with a lower electronegativity want to lose electrons (eg. Alkali metals) to look like the previous noble gas, that has a filled valence shell in a lower orbital level. The further down a group that you go, the lower (generally) the electronegativity is, as the size of the atom with increasing numbers of orbitals around the nucleus makes it harder for the nucleus to hold on and be attracted to those outermost electrons. Electronegativity affects bonding in that the difference in electronegativity between the two atoms in the compound will dictate whether the bond is ionic or covalent.

**6.**

| Formula | # of Bonds | # of lone pairs | Total # of bond axes | Basic shape | Actual shape | Bond angles | Type of bond | Net dipole | MOLECULE polar? |
|---|---|---|---|---|---|---|---|---|---|
| HAt | 1 | 0 | 1 | Linear | Linear | 180° | Non polar covalent | Not really | "At" has a slightly higher electroneg. |
| $SiCl_4$ | 4 | 0 | 4 | tetrahedral | tetrahedral | 109.5° | polar covalent | No | NO. (Symmetry) |
| $ClF_3$ | 3 | 2 | 5 | Trigonal bipyramidal | T-shape | <90° | polar covalent | YES | YES. (asymmetry) |
| $BrF_5$ | 5 | 1 | 6 | octahedral | Square pyramid | <90° | polar covalent | YES | YES. (asymmetry) |

7. "Like dissolves like". That is why a polar molecule, such as NaCl, dissolves in a polar solvent such as water, whereas a nonpolar molecule like oil does not dissolve in the polar water.

# Toombs 2012 CHEMISTRY 11 FINAL EXAM REVIEW

## SOLUTIONS ANSWERS:

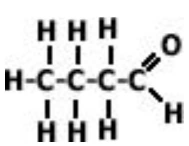
1. 0.22 L
2 c) one aqueous solution and one solid precipitate
3 a) After mixing (dilution and dissociation), but BEFORE precipitation, the ion concentrations are:
$[Sr^{+2}]$ = 0.10 M $[S^{-2}]$ = 0.99 M $[Al^{+3}]$ = 0.66M $[OH^{-}]$ = 0.20M
b) $Al^{+3}$+ $3OH^{-}$ → $Al(OH)_3$ (s) ↓
c) limiting reagent: $[OH^{-}]$ and excess reagent: $[Al^{+3}]$
d) After precipitation, the ion concentrations are: $[Sr^{+2}]$ = 0.10 M $[Al^{+3}]$ = 0.59 M $[S^{-2}]$ = 0.99 M $[OH^{-}]$ = ZERO
4. 1.2 mL Net ionic equation of all neutraliazation reactions: $H^{+}(aq) + OH^{-}(aq) \rightarrow H_20\ (l)$
5. a) an ionic compound
6a) TRUE. When ions dissociate as they dissolve in aqueous solution, a current can be conducted.
6b) TRUE. Covalent molecules do not do not dissociate in solution and therefore no electrical conductivity
6c) FALSE. 3.5 M (or moles per litre) > 2.0M regardless of the 'sample size' (how many mL you have)
6d) FALSE . Diluting the solution means there is a higher volume of solution in the ratio of moles of solute: Litres of solution. The solution becomes less concentrated, less saturated, and the MOLARITY of each of the ions in solution decreases. Adding more water to the solution, does not, however, improve the ability of the substance to dissolve and dissociate.

## ORGANIC CHEMISTRY ANSWERS:

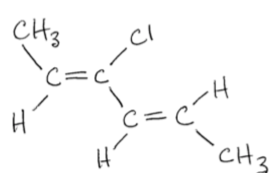
1. a) 1-propanol
b) 1,1 – dibromopropane
c) (E) – 2,3 – dichloro – 2 – butene
c) ethylpropylether OR ethoxypropane
e) pentylamine or 1 – aminopentane
f) hexanamide

**DIAGRAMS:**

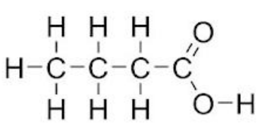
2. a) butanal



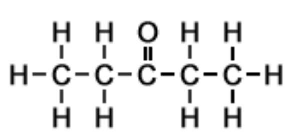
b) (2E, 4Z) - 3,4 - dichlorohexa - 2,4-diene



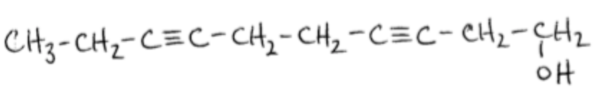
c) butanoic acid



d) 3-pentanone



e) 3, 7 – decadiynol



f) butoxy heptanoate