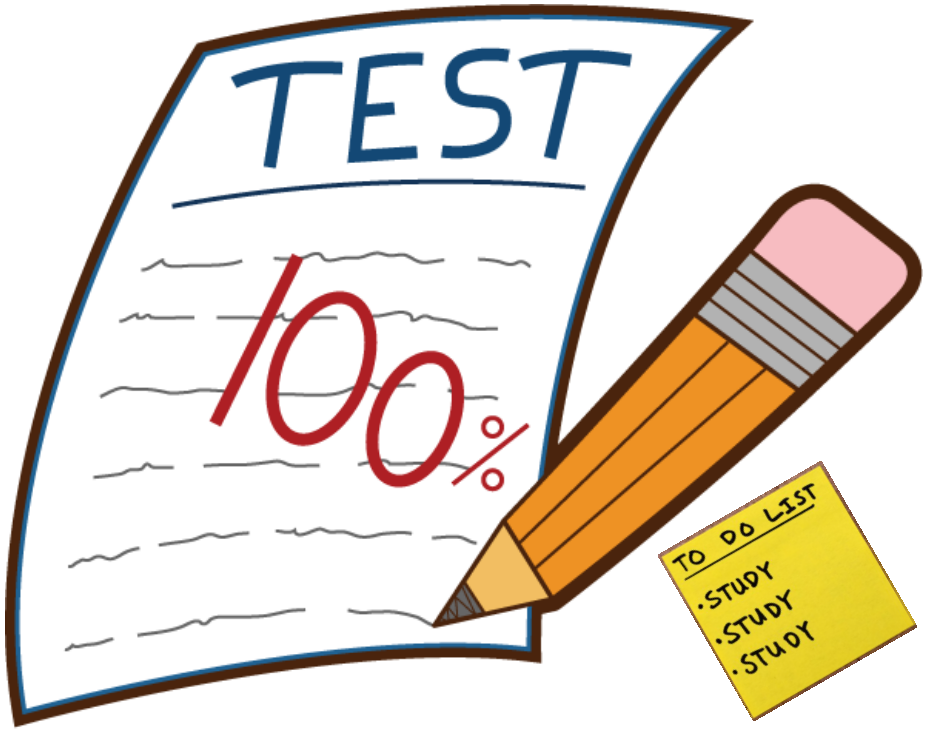
Chemistry 11

Final Exam Review Package

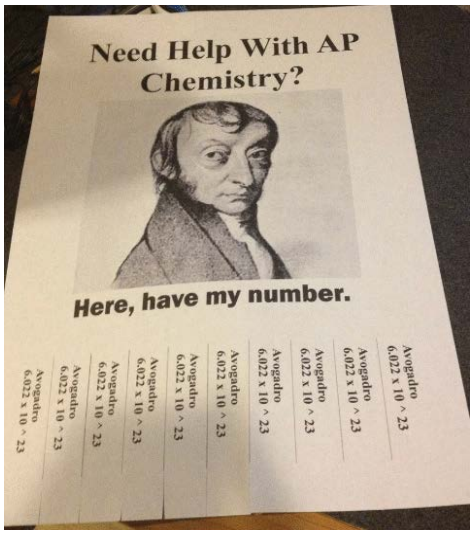


- **Unit 4: Chemical Reactions & Stoichiometry**
- **Unit 5: Atomic Theory & Periodic Trends**

Name:_____ Block:_____

Study Checklist

This review booklet is by no means a "practice final". It is a collection of practice questions on each unit, meant to guide your final exam studying and prepare you for the types of questions you are likely to see. DO NOT treat this booklet as a practice test. If you're stuck on a question, look it up and ask for help! DO NOT go straight to the answer key when you come across a question you cannot remember how to do. Difficult questions SHOULD guide your study! Always look up a concept in your class notes if you are stuck, then attempt the question again.



BEFORE beginning this booklet you should:

- read through your class notes booklet on *each topic*
- make your own "quick summary page" of important formulas & key concepts for the unit
- review quizzes & tests from the unit to recall strengths & weaknesses *(a great study method would be to re-do old quizzes & tests on a separate piece of paper)*

WHILE working through this booklet you should:

- look up concepts & example problems in your class notes when you come across a problem you are stuck on
- make a list of "questions to ask my teacher" so you can come to class and use your time efficiently.

Questions I'm having difficulty with:

Page	Question Number #	Topic

1. Stoichiometry:

A. **Stoichiometry** *(text pgs. 347-364)*
- performing mole calculations based on coefficient ratios in a balanced chemical equation (using the flowchart notes)

B. **Excess and Limiting Reagents** *(text pgs. 365-373)*
- identifying limiting and excess reagents in a chemical reaction
- calculating the amount of excess reactant
- calculating the amount of product formed in a reaction using the limiting reactant

2. Atomic Models and Subatomic Particles:

A. **Subatomic Particles and Average Atomic Mass:**
- Subatomic particles: protons, neutrons and electrons – properties and how to calculate numbers of each
- Atomic mass and atomic number
- Ions
- Isotopes and calculations of average atomic mass

B. **Quantum Molecular Model**
- Electron orbitals
- Electron configurations of neutral atoms and ions
- Significant figures (multiplication, division, adding and subtracting)

C. **History of the Atomic Models**
- Identifying which scientists made which discoveries

3. Elements and the Periodic Table:

A. Organization of the Periodic Table
- The history of the periodic table
- metals, non-metals, and semi-metals
- chemical families; Alkali metals, Alkaline Earth metals, Halogens, Noble Gases

B. Periodic Trends
- Atomic radius, and ionic radius (sizes of atoms versus their ions)
- Ionization energy
- Electronegativity

1. Stoichiometry:

1. Ammonia combines with oxygen gas in the following reaction:

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

a) How many moles of NH_3 are needed to combine with 3.57 moles of O_2 gas?

$$3.57\ mol\ O_2 \times \frac{4\ mol\ NH_3}{5\ mol\ O_2} = 2.86\ mol\ NH_3$$

b) If 1.5 grams of NO is produced in the above reaction, how many grams of NH_3 were reacted?

$$1.5\ g\ NO \times \frac{1\ mol\ NO}{30.0\ g\ NO} \times \frac{4\ mol\ NH_3}{4\ mol\ NO} \times \frac{17.0\ g\ NH_3}{1\ mol\ NH_3} = 0.85\ g\ NH_3$$

2. $3Na_2CO_3 + 2FeCl_3 \rightarrow 6NaCl + Fe_2(CO)_3$

a) How many grams of NaCl will be produced from the reaction of 0.080moles of Na_2CO_3 with excess $FeCl_3$? ↳58.5g/mol

$$0.080\text{mol } Na_2CO_3 \times \frac{6\text{mol NaCl}}{3\text{mol } Na_2CO_3} \times \frac{58.5\text{g NaCl}}{1\text{mol NaCl}} = 9.4\text{g NaCl}$$

b) How many grams of $FeCl_3$ (↳162.3g/mol) would be needed to react with 4.2g of Na_2CO_3? (↳106.0g/mol)

$$4.2\text{g } Na_2CO_3 \times \frac{1\text{mol } Na_2CO_3}{106.0\text{g } Na_2CO_3} \times \frac{2\text{mol } FeCl_3}{3\text{mol } Na_2CO_3} \times \frac{162.3\text{g } FeCl_3}{1\text{mol } FeCl_3} = 4.3\text{g } FeCl_3$$

3. $3Mg + 2AlCl_3 \rightarrow 3MgCl_2 + 2Al$

a) How many grams of $MgCl_2$ would be formed if 50.0mL of 0.200M $AlCl_3$ is reacted with excess Mg? ↳95.3g/mol

$$50.0\text{mL} \times \frac{1\text{L}}{10^3\text{mL}} \times \frac{0.200\text{ mol } AlCl_3}{1\text{L}} \times \frac{3\text{mol } MgCl_2}{2\text{mol } AlCl_3} \times \frac{95.3\text{g } MgCl_2}{1\text{mol } MgCl_2}$$

$$= 1.43\text{g } MgCl_2$$

b) How many mL of 0.150M $AlCl_3$ would be needed to react completely with 2.00g of Mg?

$$2.00\text{g Mg} \times \frac{1\text{mol Mg}}{24.3\text{g Mg}} \times \frac{2\text{mol } AlCl_3}{3\text{mol Mg}} \times \frac{1\text{L } AlCl_3}{0.150\text{mol } AlCl_3} \times \frac{10^3\text{mL } AlCl_3}{1\text{L } AlCl_3}$$

$$= 366\text{mL } AlCl_3$$

Excess and Limiting Reagents

1. $2Fe_2S_3 + 9O_2 \rightarrow 2Fe_2O_3 + 6\,SO_2$

In a chemical reaction 6.92g of Fe_2S_3 is combined with 4.54g of oxygen gas.

a) Which reactant is the **LIMITING** reagent?

$$6.92\text{g } Fe_2S_3 \times \frac{1\text{mol } Fe_2S_3}{207.9\text{g}} \times \frac{2\text{mol } Fe_2O_3}{2\text{mol } Fe_2S_3} = 0.0333\text{mol } Fe_2O_3$$

$$4.54\text{g } O_2 \times \frac{1\text{mol } O_2}{32.0\text{g } O_2} \times \frac{2\text{mol } Fe_2O_3}{9\text{mol } O_2} = 0.0315\text{mol } Fe_2O_3$$

∴ O_2 is limiting

b) How many grams of the **EXCESS** reactant will be **left over** after the reaction is complete?

$$4.54\text{g } O_2 \times \frac{1\text{mol } O_2}{32.0\text{g } O_2} \times \frac{2\text{mol } Fe_2S_3}{9\text{mol } O_2} \times \frac{207.9\text{g } Fe_2S_3}{1\text{mol } Fe_2S_3} = 6.55\text{g } Fe_2S_3 \text{ used up}$$

∴ $6.92\text{g} - 6.55\text{g} = 0.37\text{g } Fe_2S_3$ left over

c) How many grams of Fe_2O_3 can be formed in this reaction?

$$0.0315\text{mol } Fe_2O_3 \times \frac{159.6\text{g } Fe_2O_3}{1\text{mol } Fe_2O_3} = 5.03\text{g } Fe_2O_3$$

2. What mass of P_4 will be produced when 41.5g of $Ca_3(PO_4)_2$, 26.3g of SiO_2, and 7.80g of C are reacted according to the following balanced equation?

$$2\ Ca_3(PO_4)_2 + 6\ SiO_2 + 10C \rightarrow P_4 + 6CaSiO_3 + 10CO$$

$41.5g\ Ca_3(PO_4)_2 \times \frac{1mol\ Ca_3(PO_4)_2}{310.3g\ Ca_3(PO_4)_2} \times \frac{1mol\ P_4}{2mol\ Ca_3(PO_4)_2} = 0.0669mol$

$26.3g\ SiO_2 \times \frac{1mol\ SiO_2}{60.1g\ SiO_2} \times \frac{1mol\ P_4}{6mol\ SiO_2} = 0.0729mol$

$7.80g\ C \times \frac{1mol\ C}{12.0g\ C} \times \frac{1mol\ P_4}{10mol\ C} = 0.0650mol \times \frac{124.0g\ P_4}{1mol\ P_4} = \boxed{8.06g\ P_4}$

3. $4Al + 3O_2 \rightarrow 2Al_2O_3$

a) How many grams of aluminum oxide, Al_2O_3, would be expected to form in the reaction of 15.0g Al with 18.43g of oxygen gas?

$15.0g\ Al \times \frac{1mol\ Al}{27.0g\ Al} \times \frac{2mol\ Al_2O_3}{4mol\ Al} \times \frac{102.0g\ Al_2O_3}{1mol\ Al_2O_3} = 28.3g\ Al_2O_3$ ← limiting, so this much is made!

$18.43g\ O_2 \times \frac{1mol\ O_2}{32.0g\ O_2} \times \frac{2mol\ Al_2O_3}{3mol\ O_2} \times \frac{102.0g\ Al_2O_3}{1mol\ Al_2O_3} = 39.2g\ Al_2O_3$

b) If the actual yield of Al_2O_3 produced in the reaction was only 22.4g Al_2O_3, what would the PERCENT YIELD of the reaction be?

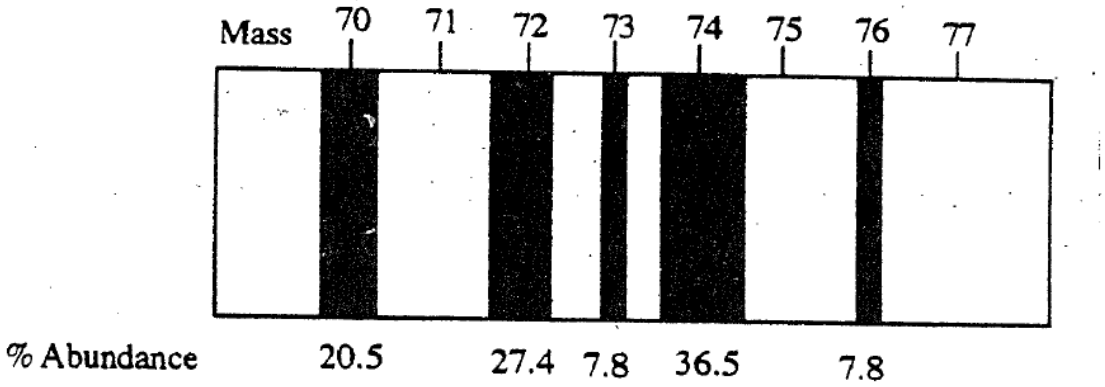
$\%\ yield = \frac{actual}{theoretical} \times 100\% = \frac{22.4g}{28.3g} \times 100\% = 79.2\%\ yield$

3. Atomic Models and Subatomic Particles:

1. Complete the following table.

Symbol	Atomic Mass	Atomic Number	Number of Protons	Number of Neutrons	Number of Electrons
Cr	52	24	24	28	24
P	32	15	15	17	15
Te^{2-}	127	52	52	75	54
Fe^{3+}	56	26	26	30	23
Ca	41	20	20	21	20
Hg^{2+}	201	80	80	121	78
Kr	83	36	36	47	36
Br^-	78	35	35	43	36
Ga^{3+}	70	31	31	39	28
N^{3-}	14	7	7	7	10

2. An element is analyzed by a mass spectrometer and the following spectrum resulted for the naturally occurring isotopes.



a) Calculate the average atomic mass for this element.

70 × 0.205 = 14.35
72 × 0.274 = 19.728
73 × 0.078 = 5.694
74 × 0.365 = 27.01
76 × 0.078 = 5.928

} = 72.71 g/mol

b) What element was analyzed?

Germanium (Ge)

c) Write the symbol for the most abundant isotope of this element, including the atomic mass, and the atomic number.

$^{74}_{32}Ge$

3. Write the core-notation electron configuration for the elements listed below.

Be	$[He]2s^2$	Ar	$[Ne]3s^2 3p^6$
C	$[He]2s^2 2p^2$	V	$[Ar]4s^2 3d^3$
N	$[He]2s^2 2p^3$	Cu	$[Ar]4s^1 3d^{10}$
Na	$[Ne]3s^1$	Ge	$[Ar]4s^2 3d^{10} 4p^2$
S	$[Ne]3s^2 3p^4$	Br	$[Ar]4s^2 3d^{10} 4p^5$

4. Complete the following table.

Symbol	Number of Protons	Number of Neutrons	Number of Electrons	Electron Configuration
$^{70}_{31}Ga^{3+}$	31	39	28	$[Ar]3d^{10}$
$^{37}_{17}Cl^{-}$	17	20	18	$[Ne]3s^2 3p^6$
$^{39}_{19}K^{+}$	19	20	18	$[Ne]3s^2 3p^6$
$^{65}_{29}Cu^{2+}$	29	36	27	$[Ar]3d^9$
$^{32}_{16}S^{2-}$	16	16	18	$[Ne]3s^2 3p^6$
$^{30}_{15}P^{3-}$	15	15	18	$[Ne]3s^2 3p^6$
$^{87}_{38}Sr^{2+}$	38	49	36	$[Ar]4s^2 3d^{10} 4p^6$
$^{59}_{27}Co^{2+}$	27	32	25	$[Ar]3d^7$

5. In the table below briefly summarize the MAJOR contribution(s) the scientist made to our understanding of the atom.

Scientist	Major Contribution(s)
Dalton	-atomic theory (atom) -3 laws
Bohr	-electrons in quantized orbitals
Thompson	-"plum pudding" → protons + electrons
Chadwick	-neutrons
Rutherford	-nucleus

4. Elements and the Periodic Table:

1. What is a period of the periodic table? _____

1. What is a period of the periodic table? - a horizontal row of elements

2. What is a group or family of the periodic table? - a vertical column of elements.

3. Complete the following table, stating the name of the family (if we named it), the number of valence electrons and the charge on the ions that are usually produced from the elements in the group.

Family Members	Family Name	Number of Valence Electrons	Charge on the Ions Usually Formed
Li, Na, K, Rb, Cs, Fr	Alkali metals	1	+1
B, Al, Ga, In, Tl		3	+3
F, Cl. Br, I, At	Halogens	7	-1
Be, Mg, Ca, Sr, Ba, Ra	Alkaline-Earth Metals	2	+2
N, P, As, Sb, Bi		5	-3
He, Ne, Ar, Kr, Xe, Rn	Noble gases	8	0
O, S, Se Te, Po		6	-2

4. Define the following terms:

a) Atomic Radius:

- distance from the centre of the nucleus to the outer most electrons

b) Ionization Energy:

- energy required to remove an electron

c) Electronegativity:

- ability to attract an electron in a chemical bond

5. Correctly fill in the blanks below with either "increases" or "decreases"

a) As you move from left to right across the periodic table:

Atomic radius decreases

Ionization Energy Increases

Electronegativity Increases

b) As you move down the periodic table:

Atomic radius Increases

Ionization Energy decreases

Electronegativity decreases

6. a) Which of the following has the LARGEST atomic radius?

i) Li, Na, K, Rb Rb

ii) Na, Mg, Al, Si Na

iii) Mg, Os, Cl Os

iv) Na^+, Mg^{2+}, Al^{3+} Na^+

v) P^{3-}, S^{2-}, Cl^- P^{3-}

vi) N, O, F, Cl Cl

b) Which of the following has the LARGEST ionization energy?

i) Li, Na, K, Rb Li

ii) Na, Mg, Al, Si Si

iii) Mg, Os, Cl Cl

iv) Na^+, Mg^{2+}, Al^{3+} Al^{3+}

v) P^{3-}, S^{2-}, Cl^- Cl^-

vi) N, O, F, Cl F

c) Which of the following has the SMALLEST electronegativity value?

i) Li, Na, K, Rb Rb

ii) Na, Mg, Al, Si Na

iii) Mg, Os, Cl Os

vi) N, O, F, Cl N/Cl

have same