

Chemistry 11 – Course Review

Final Exam  
is  
Mon Jan 24  
8:50am!

**Introduction to Chemistry**

1.  $0.0006 \text{ mm} = ? \mu\text{m}$

Answer \_\_\_\_\_

2.  $0.054 \text{ mL} = ? \text{ nL}$

Answer \_\_\_\_\_

3.  $3.5 \mu\text{g/L} = ? \text{ mg/mL}$

Answer \_\_\_\_\_

4. The density of iron is  $7860 \text{ g/L}$ . Calculate the mass of a  $3.2 \text{ mL}$  sample of iron.

Answer \_\_\_\_\_

5. Manganese has a density of  $7.20 \text{ g/mL}$ . Calculate the volume occupied by a  $4.0 \text{ kg}$  piece of manganese.

Answer \_\_\_\_\_

6. A 0.0460 L piece of copper has a mass of 410.32 g. Calculate the density of copper in g/mL.

Answer \_\_\_\_\_

7. Give the number of significant digits in each of the following. Assume they are all measurements.

- a) 0.0023 .....  
b) 3953 000 .....  
c)  $1.0200 \times 10^5$  .....  
d)  $3.2 \times 10^{-4}$  .....  
e) 50020.000 .....  
f) 3450 .....

8. Perform the following calculations and round the answers off to the correct number of significant digits as justified by the data. Assume all numbers are measurements.

- a)  $2.1500 \times 0.31$  .....  
b)  $0.05 + 394.7322$  .....  
c)  $4.905 \times 10^6 \div 4 \times 10^{-2}$  .....  
d)  $(3.33 \times 9.52) + 13.983$  ..  
e)  $3.813 + 98.98 + 2.669$  ..  
f)  $8.90 \times 10^3 \div 4.400 \times 10^{-6}$  .....  
g)  $83.00 \div 1.2300 \times 10^2$  .....  
h)  $98.0076 - 2.195$  .....  
i)  $0.00000200 \times 245.912$  .....  
j)  $5.802 \div 6.21 + 2.41 \div 9.2565$  ...

9. Round the following numbers to 2 significant digits. (4 marks)

- a) 2 000 000 000.....  
b) 106 000 .....  
c)  $3.88945 \times 10^{28}$  .....  
d) 0.000 000 7895 .....



3. Concerning separation techniques...

a) Explain how distillation can be used to separate the substances in a solution.

b) What types of mixtures does paper chromatography work best for?

c) Explain how a centrifuge separates the components of a suspension.

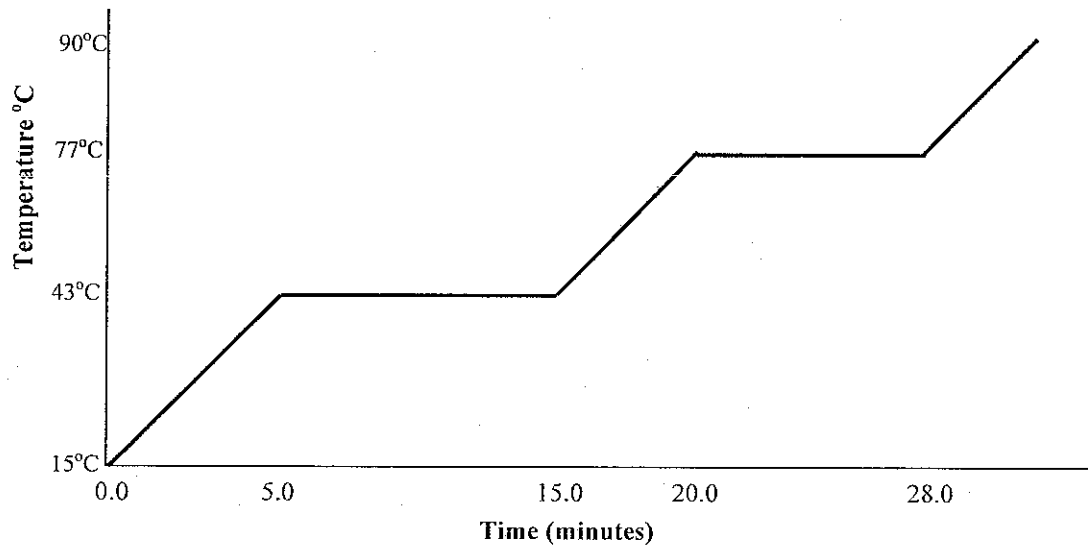
4. Define a physical change –

Give some examples of physical changes.

5. Define a chemical change –

Give some examples of chemical changes.

6. Given the following graph of Temperature vs. Time for warming substance "X" which starts out as a solid, answer the questions below:



- a) During time 0.0 – 5.0 minutes, the added heat energy is being used to \_\_\_\_\_
- b) During time 5.0 – 15.0 minutes, the added heat energy is being used to \_\_\_\_\_
- c) During time 15.0 – 20.0 minutes, the added heat energy is being used to \_\_\_\_\_
- d) During time 20.0 – 28.0 minutes, the added heat energy is being used to \_\_\_\_\_
- e) The melting point of substance "X" is \_\_\_\_\_
- f) The boiling point of substance "X" is \_\_\_\_\_
- g) If a greater amount of substance "X" was used, the melting point would be  
 1. a lower temperature  
 2. a higher temperature  
 3. the same temperature      Answer \_\_\_\_\_
- h) What phase is substance "X" at 90°C? \_\_\_\_\_
- i) Explain WHY the curve levels off between 5.0 min. and 15.0 min.

## Names and Formulas for Compounds

1. Write the correct formula for the following compounds:

- a) ammonium chlorate ..... \_\_\_\_\_
- b) copper (II) sulphite..... \_\_\_\_\_
- c) zinc carbonate tetrahydrate ..... \_\_\_\_\_
- d) nitric acid ..... \_\_\_\_\_
- e) phosphorus pentaiodide ..... \_\_\_\_\_
- f) iron (III) thiocyanate ..... \_\_\_\_\_
- g) sulphuric acid ..... \_\_\_\_\_
- h) dinitrogen tetrafluoride ..... \_\_\_\_\_

2. Write the correct names for the following compounds:

- a)  $\text{Mn}(\text{SO}_4)_2$ ..... \_\_\_\_\_
- b)  $\text{PbCrO}_4 \cdot 6\text{H}_2\text{O}$  ..... \_\_\_\_\_
- c)  $\text{As}_2\text{O}_3$ ..... \_\_\_\_\_
- d)  $\text{CH}_3\text{COOH}$  ..... \_\_\_\_\_ acid
- e)  $\text{Ni}_2(\text{C}_2\text{O}_4)_3$  ..... \_\_\_\_\_
- f)  $\text{NF}_3$  ..... \_\_\_\_\_
- g)  $(\text{NH}_4)_2\text{HPO}_4$  ..... \_\_\_\_\_
- h)  $\text{Ba}(\text{OH})_2 \cdot 10\text{H}_2\text{O}$ ..... \_\_\_\_\_

## The Mole Concept

1. Make the following conversions, clearly showing your steps. Include proper units in all of your work and in your answer.

a) 133.44 grams of  $\text{PCl}_5$  = ? moles

Answer \_\_\_\_\_

b) 0.00256 moles of  $\text{Li}_2\text{Cr}_2\text{O}_7$  = ? grams

Answer \_\_\_\_\_

c) 170.24 L of  $\text{NO}_2$  at STP = ? moles

Answer \_\_\_\_\_

d) 570.625 g of  $\text{PCl}_3$  gas = ? L (STP)

Answer \_\_\_\_\_

e) 1030.4 mL of  $\text{C}_2\text{H}_6$  gas at STP = ? g

Answer \_\_\_\_\_

f) 5.00 kg of nitrogen gas = ? L (STP)

Answer \_\_\_\_\_

g) 0.5696 kg of  $\text{CH}_4(\text{g})$  = ? mL (STP)

Answer \_\_\_\_\_

2. The density of liquid ethanol ( $\text{C}_2\text{H}_5\text{OH}$ ) is 0.790 g/mL. Calculate the number of molecules in a 35.0 mL sample of liquid ethanol. (NOTE: You CAN'T use 22.4 L/mol since this is NOT a gas at STP!)

Answer \_\_\_\_\_

3. A 100.0 mL sample of liquid mercury contains 6.78 moles. Calculate the density of liquid mercury from this data.

Answer \_\_\_\_\_

4. Calculate the density of  $\text{PCl}_3(\text{g})$  at STP.

Answer \_\_\_\_\_



5. a) The density of a gas at STP is 4.955 g/L. Calculate the molar mass of this gas.

b) The gas is an oxide of selenium. Determine the molecular formula.

Answer \_\_\_\_\_

6. Find the percent composition (% by mass of each element) in the following compound:  
 $\text{Sr}_3(\text{PO}_4)_2$ . Show your work.

Answer \_\_\_\_\_%Sr, \_\_\_\_\_%P, \_\_\_\_\_%O

7. A compound was analyzed and the following results were obtained:

Molar mass: 270.4 g/mol

Mass of sample: 162.24 g

Mass of potassium: 46.92 g

Mass of sulphur: 38.52 g

Mass of oxygen: the remainder of the sample is oxygen

a) Determine the mass of oxygen in the sample.

Answer \_\_\_\_\_

b) Determine the empirical formula for this compound.

Answer: Empirical Formula: \_\_\_\_\_

- c) Determine the molecular formula for this compound.

Answer: Molecular Formula: \_\_\_\_\_

8. 123.11 g of zinc nitrate,  $\text{Zn}(\text{NO}_3)_2$  are dissolved in enough water to form 650.0 mL of solution. Calculate the  $[\text{Zn}(\text{NO}_3)_2]$  Include proper units in your work and in your answers.

Answer \_\_\_\_\_

9. Calculate the mass of potassium sulphite ( $\text{K}_2\text{SO}_3$ ) needed to make 800.0 mL of a 0.200 M solution of  $\text{K}_2\text{SO}_3$ . Include proper units in your work and in your answers.

Answer \_\_\_\_\_

10. What volume of 2.50 M  $\text{Li}_2\text{CO}_3$  would need to be evaporated in order to obtain 47.232 g of solid  $\text{Li}_2\text{CO}_3$ ? Include proper units in your work and in your answers.

Answer \_\_\_\_\_

11. 150.0 mL of water are added to 400.0 mL of 0.45 M  $\text{HNO}_3$ . Calculate the final  $[\text{HNO}_3]$ . Include proper units in your work and in your answers.

Answer \_\_\_\_\_

12. What volume of water needs to be added to 150.0 mL of 4.00 M  $\text{H}_2\text{SO}_4$  in order to bring the concentration down to 2.50 M? Include proper units in your work and in your answers.

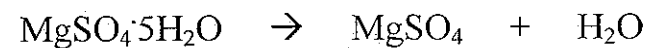
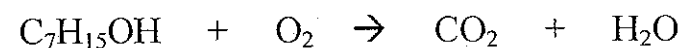
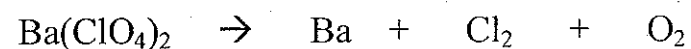
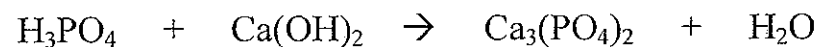
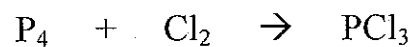
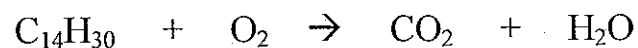
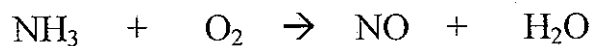
Answer \_\_\_\_\_

13. Give directions on how to make 5.00 L of 0.020 M  $\text{Ca}(\text{ClO})_2$  using solid  $\text{Ca}(\text{ClO})_2$  and water. Include proper units in your work and in your answers.

Directions:

## Chemical Reactions

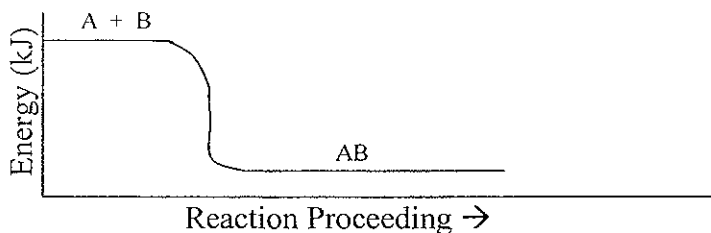
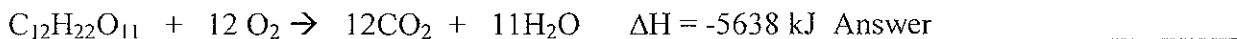
1. Balance the following equations



2. Write a balanced chemical equation for each of the following, and classify each as synthesis, decomposition, single replacement, double replacement, neutralization or combustion.

- potassium sulphate is mixed with cobalt (III) nitrate
- liquid propanol ( $C_3H_7OH$ ) is burned in air
- ammonium nitrate is decomposed into its elements
- a piece of zinc is placed in a test-tube containing a solution of silver nitrate
- bromine reacts with sodium iodide
- bromine reacts with aluminum
- rubidium reacts with chlorine gas
- hydrochloric acid reacts with strontium hydroxide

3. State whether each of the following are *exothermic* or *endothermic*.



Answer \_\_\_\_\_



4. Given the equation:  $C_{12}H_{22}O_{11} + 12O_2 \rightarrow 12CO_2 + 11H_2O + 5638 \text{ kJ}$

a. How much heat is released during the formation of 880.0 g of  $CO_2$ ?

Answer \_\_\_\_\_

b. How much heat is released during the formation of 5.6 moles of  $H_2O$ ?

Answer \_\_\_\_\_

c. If 179.2 L of  $O_2$  (STP) are consumed, how much heat is released?

Answer \_\_\_\_\_

## Stoichiometry

1. Given the following balanced equation, answer the questions following it:



- a) If 5.5 moles of  $\text{H}_2$  are reacted, how many moles of  $\text{NF}_3$  will be consumed?

Answer \_\_\_\_\_

- b) In order to produce 0.47 moles of  $\text{HF}$ , how many moles of  $\text{NF}_3$  would be consumed?

Answer \_\_\_\_\_

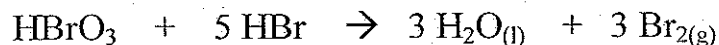
- c) If you needed to produce 180.6 g of  $\text{N}_2$ , how many moles of  $\text{H}_2$  would you need to start with?

Answer \_\_\_\_\_

- d) If you completely react 17.04 g of  $\text{NF}_3$ , what mass of  $\text{HF}$  will be produced?

Answer \_\_\_\_\_

2. Given the following balanced equation, answer the questions following it:



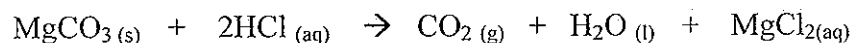
- a) If 3.56 moles of HBr are reacted, how many Litres of Br<sub>2</sub> will be formed at STP?

Answer \_\_\_\_\_

- b) In order to produce  $3.311 \times 10^{24}$  molecules of Br<sub>2</sub>, what mass of HBr is needed?

Answer \_\_\_\_\_

3. Given the following balanced chemical equation, answer the question below it.



- a) What mass of MgCO<sub>3</sub> will react completely with 15.0 mL of 1.5 M HCl?

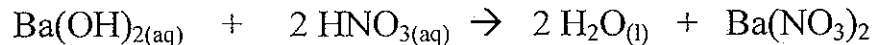
Answer \_\_\_\_\_

- b) Calculate the volume of 2.0 M HCl which would be needed to react completely with 37.935 grams of magnesium carbonate.

Answer \_\_\_\_\_



4. Given the following balanced equation, answer the questions below it.



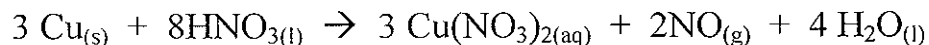
- a) In a titration, 18.20 mL of 0.300 M  $\text{Ba(OH)}_2$  is required to react completely with a 25.0 mL sample of a solution of  $\text{HNO}_3$ . Find the  $[\text{HNO}_3]$ .

Answer \_\_\_\_\_

- b) In a titration, 11.06 mL of 0.200 M  $\text{HNO}_3$  is required to react completely with a sample of 0.250M  $\text{Ba(OH)}_2$ . Find the volume of the  $\text{Ba(OH)}_2$  sample.

Answer \_\_\_\_\_

5. Given the following balanced equation, answer the questions below it.



- a) If 317.5 grams of Cu are placed into 756.0 grams of  $\text{HNO}_3$ , determine which reactant is in excess.

Answer \_\_\_\_\_

- b) If the reaction in (a) is carried out, what mass of NO will be formed?

Answer \_\_\_\_\_

6. Given the balanced equation:  $2\text{BN} + 3\text{F}_2 \rightarrow 2\text{BF}_3 + \text{N}_2$

When 161.2 grams of BN are added to an excess of  $\text{F}_2$ , a reaction occurs in which 326.118 grams of  $\text{BF}_3$  are formed.

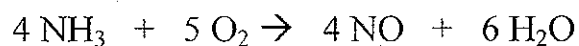
a) Calculate the *theoretical* yield of  $\text{BF}_3$  in grams.

Answer \_\_\_\_\_

b) Calculate the *percentage* yield of  $\text{BF}_3$ .

Answer \_\_\_\_\_

7. When reacting  $\text{NH}_3$  with  $\text{O}_2$  according to the reaction:



Using 163.2 grams of  $\text{NH}_3$  with an excess of  $\text{O}_2$  produces a 67% yield of NO.

a) Calculate the *theoretical yield* of NO in grams.

Answer \_\_\_\_\_

b) Calculate the *actual yield* of NO in grams.

Answer \_\_\_\_\_

## Atoms, Periodic Table and Bonding

2. Consider the following ideas:
- Compounds are made up of molecules which are combinations of atoms
  - All atoms of an element are the same
  - Atoms of different elements are different
  - Atoms are indivisible particles

Who came up with these ideas? \_\_\_\_\_ He called the ideas, the \_\_\_\_\_ Theory.

3. \_\_\_\_\_ measured the charge/mass ratio of an electron and came up with the so-called "plum pudding" model of the atom.
4. \_\_\_\_\_ devised the Scattering Experiment, which showed that all atoms had a small dense \_\_\_\_\_.
5. Bohr came up with an atomic model to explain the spectrum of \_\_\_\_\_.

He said that the atom has certain \_\_\_\_\_ levels which are allowed. These levels corresponded to \_\_\_\_\_ in which electrons move. If an electron absorbs a certain photon of energy, it will jump to a \_\_\_\_\_ level. It will release this energy (in the form of \_\_\_\_\_) when it jumps back to a \_\_\_\_\_ level.

What were two limitations of Bohr's atomic model?

6. Give the number of protons, neutrons and electrons in the following:

Isotope	Protons	Neutrons	Electrons
$^{194}_{\text{Ir}}^{3+}$			
$^{202}_{\text{Hg}}^{2+}$			
$^{125}_{\text{Te}}^{2-}$			
$^{263}_{\text{Sg}}$			
$^2\text{H}^+$			

7. Give the nuclear notation of the following:

Isotope	Protons	Neutrons	Electrons
	105	157	103
	51	72	48
	33	42	36
	54	79	54
	94	150	91

8. Element "X" is composed of the following naturally occurring isotopes:

Isotope	% Abundance
$^{79}\text{X}$	50.69
$^{81}\text{X}$	49.31

Calculate the average atomic mass of element "X" to 3 decimal places.

Element "X" is actually the real element

9. Regions in space occupied by electrons are called \_\_\_\_\_
10. The principal quantum number is given the letter \_\_\_\_\_ and refers to the \_\_\_\_\_ level.

11. Write the ground state electron configurations (eg.  $1s^2 2s^2 2p^6$ ) for the following atoms or ions. You may use the core notation.

- a) P
- b) Mo
- c) Se
- d) Rb
- e)  $\text{Cl}^-$
- f)  $\text{Al}^{3+}$
- g)  $\text{K}^+$
- h)  $\text{S}^{2-}$

12. In order to become stable,

an atom of Sr will \_\_\_\_\_ electrons and become the ion \_\_\_\_\_

an atom of As will \_\_\_\_\_ electrons and become the ion \_\_\_\_\_

an atom of Al will \_\_\_\_\_ electrons and become the ion \_\_\_\_\_

an atom of Se will \_\_\_\_\_ electrons and become the ion \_\_\_\_\_

an atom of N will \_\_\_\_\_ electrons and become the ion \_\_\_\_\_

an atom of I will \_\_\_\_\_ electrons and become the ion \_\_\_\_\_

an atom of Cs will \_\_\_\_\_ electrons and become the ion \_\_\_\_\_

an atom of Te will \_\_\_\_\_ electrons and become the ion \_\_\_\_\_

13. Circle the metalloid: Be Rb Os Ge Pb Al

14. Circle the most reactive element in the following: Na Mg Si Al Ar

15. Circle the most reactive element in the following: Na K Rb Cs Li

16. Circle the most reactive element in the following: Cl Br I At Ne

17. Circle the element with the largest atomic radius of these: Na Mg Si Al Ar

18. Circle the element with the largest atomic radius of these: N P As Sb Bi

19. Circle the element with the largest ionization energy of these: K Ca Ga As Kr
20. Circle the element with the largest ionization energy of these: C Si Ge Sn Pb
21. What is meant by ionization energy?
22. Circle the element with the largest density of these: C Si Ge Sn Pb
23. Circle the element with the largest density of these: Na K Rb Cs Li
24. Circle the element with the highest electronegativity of these: Mg Sr Ba Ra
25. Circle the element with the highest electronegativity of these: Mg Si S Cl
26. Circle the element with the highest electronegativity of these: F Cl Br I
27. What is meant by electronegativity?
28. Circle the most metallic element of these: Be Mg Ca Sr Ba
29. Circle the most metallic element of these: B Al Ga In Tl
30. Circle the most metallic element of these: Ga Ge Se Br Kr
31. In an ionic bond, electrons are
- a. shared equally by two atoms
  - b. shared unequally by two atoms
  - c. transferred from a metal to a non-metal
  - d. transferred from a non-metal to a metal
  - e. closer to one end of a molecule, forming a temporary dipole
- Answer \_\_\_\_\_
32. In a covalent bond, electrons are
- f. shared equally by two atoms
  - g. shared unequally by two atoms
  - h. transferred from a metal to a non-metal
  - i. transferred from a non-metal to a metal
  - j. closer to one end of a molecule, forming a temporary dipole
- Answer \_\_\_\_\_
33. In a polar covalent bond, electrons are
- k. shared equally by two atoms
  - l. shared unequally by two atoms
  - m. transferred from a metal to a non-metal
  - n. transferred from a non-metal to a metal
  - o. closer to one end of a molecule, forming a temporary dipole
- Answer \_\_\_\_\_

34. In London forces, electrons are
- p. shared equally by two atoms
  - q. shared unequally by two atoms
  - r. transferred from a metal to a non-metal
  - s. transferred from a non-metal to a metal
  - t. closer to one end of a molecule, forming a temporary dipole
- Answer \_\_\_\_\_

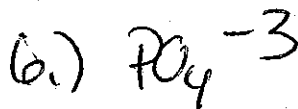
35. What evidence do we have that ionic bonds are very strong?

36. Write electron-dot diagrams for:
- MgCl<sub>2</sub> (ionic)      PBr<sub>3</sub>(covalent)      SeF<sub>2</sub>(covalent)      CH<sub>3</sub>CH<sub>2</sub>I(covalent)

## Yet More Lewis Structures

For those of you that enjoy such things, some more Lewis structures to draw:

1)  $\text{BSF}$



2)  $\text{HBr}$



3)  $\text{C}_2\text{H}_5\text{OH}$  (ethanol)

4)  $\text{N}_2\text{F}_4$

5)  $\text{SF}_6$