Name **KEY** _____

Last 5 digits of Student Number: XXX – X ___ – ___ ___ ___ ___
(may be the same as your social security number)

Chem 103
Sample Examination #1

This exam consists of eight (8) pages, including this cover page. Be sure your copy is complete before beginning your work. If this test packet is defective, ask for another one.

A copy of the Periodic Table will be distributed with the exam on a separate piece of paper. You may use the back side of the Periodic Table as scratch paper. No work on scratch paper will be graded or collected.

DO NOT WRITE BELOW THIS LINE

Part 1 (out of 51):

Part 2. Problem 1 (out of 16):

Disclaimer:
This is a copy of a typical Exam 1 given in Chem 103 during the academic year. Your test will be different. This test is being posted to give you a sense of the format, style, scope and level of a typical test on this material. This test may have questions on topics that may not be covered on your exam. Moreover, your test may have questions on topics not covered in this practice exam. Posting this test in no way limits the format, style, scope and level of the test that you will take. Do not limit your preparation to the material in this practice exam.

Part 2. Problem 2 (out of 16):

Part 2. Problem 3 (out of 16):

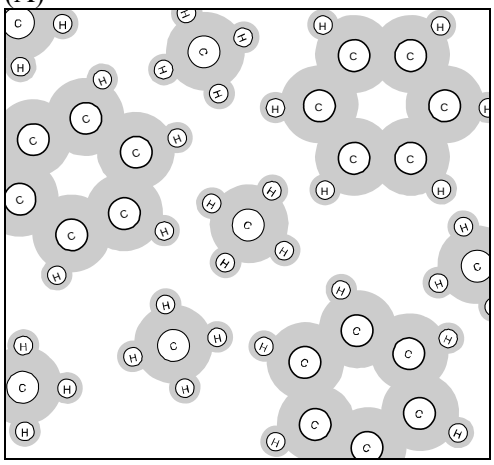
TOTAL (out of 100):

Part 1. Multiple Choice and Short Response (each question is worth 3 points)

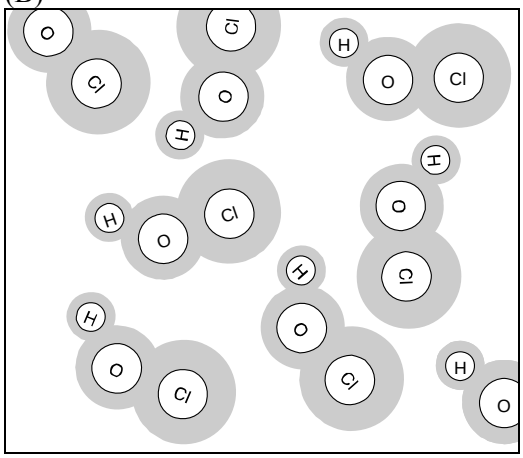
1. Identify which of the following diagrams represents an element, and explain why it is not a compound or a mixture.

(D) is an element. [1 pt]
It is not a compound because there is only one kind of element in it. [1 pt]
It is not a mixture because there is only one kind of unit in it (N_2), unlike (A) and (C). [1 pt]

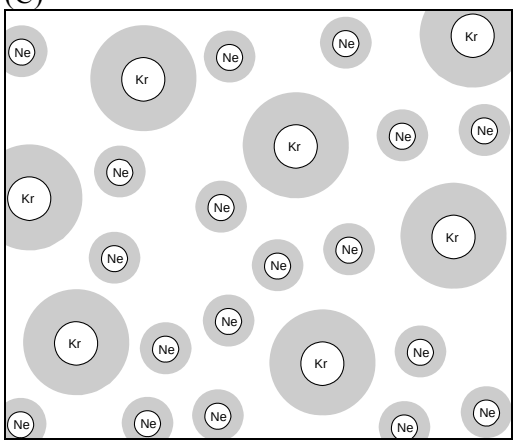
(A)



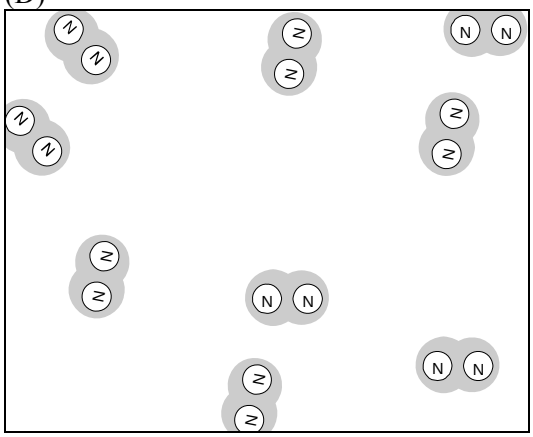
(B)



(C)



(D)



2. Which of the following properties is extensive, and therefore could not be used in determining the identity of a material?
(A) density
(B) shape
(C) color
(D) boiling point

A given material could assume many shapes depending on the amount of material, among other things, and the shape would not be useful evidence to judge the identity of the material. Density, color and boiling point all don't depend on how much of the material you have, just on its identity. So they do provide useful evidence for determining the identity of the material.

3. A sample of an unknown gray metal has a mass of 3.16 g and a volume of 0.550 cm^3. Which of the following is a possible identity of the material?

(A) Magnesium, density 1.74 g/cm^3
(B) Tin, density 5.75 g/cm^3
(C) Gold, density 19.32 g/cm^3
(D) Platinum, density 21.45 g/cm^3

Density = mass / volume

4. Fill in the missing information in the following table.

	number of protons	number of neutrons	number of electrons
^{18}O atom	**8**	**10**	**8**
$^{40}Ca^{2+}$ ion	**20**	**20**	**18**

5. Calculate the molar mass of $CuSO_4 \bullet 5H_2O$.

63.55 + 32.07 + 4(16.00) + 5(18.02) = 249.72 g/mol

6. Identify these compounds as ionic or molecular.

a) $Ca(OH)_2$ ionic

b) P_2O_5 molecular

c) $(NH_4)_2S$ ionic

7. Name the following compounds:

$Ca(OH)_2$ calcium hydroxide

P_2O_5 diphosphorus pentoxide

HNO_3 nitric acid

8. Write formulas for the following compounds:

hypochlorous acid HOCl or HClO (must have capital and lower case letters correct)

dinitrogen monoxide N_2O

copper (II) phosphate $Cu_3(PO_4)_2$

9. Write in the correct stoichiometric coefficients to balance the following chemical equation.

_2__ Na_3PO_4 + _3__ $NiCl_2$ → _6__ NaCl + ____ $Ni_3(PO_4)_2$

ok to write 1 here since there was a blank written

10. Write and balance the chemical equation for the combustion of cyclohexane (C_6H_{12}).

answer is: $C_6H_{12} + 9\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$

how to figure this out:
start with general form of a combustion of a hydrocarbon
cyclohexane + oxygen gas → carbon dioxide + water
then translate to chemical formulas, remembering that oxygen gas in its pure form is a diatomic
then balance

11. Answer these questions. Be sure to use correct significant figures.

a) 76.0 cm^3 = ? mL $\quad 76.0cm^3 \times \frac{1mL}{1cm^3} = 76.0mL$

b) 76.0 mm = ? m $\quad 76.0mm \times \frac{1m}{1000mm} = 0.0760m$

c) The answer to the problem $\frac{85.2 - 65.21}{0.005991}$ should have __3___ significant figure(s).

12. How many molecules of N_2 are in a 22.8 g sample of N_2? Show your work. Make sure to express your answer with the correct significant figures.

$$22.8\ g\ N_2 \times \frac{1\ mol\ N_2}{28.02\ g\ N_2} \times \frac{6.022 \times 10^{23}\ molecules}{1\ mol} = 4.90 \times 10^{23}\ molecules$$ (note: 3 sig figs)

13. Write the <u>symbol</u> of the element that corresponds to each description.

a) The halogen in period 4 of the Periodic Table is __Br___

b) The alkali earth metal in period 3 of the Periodic Table is ___Mg__

c) The noble gas element that has the same electron configuration as the K^+ ion is __Ar___

14. What charge does each of these elements have when it becomes an ion?

a) The ion of chlorine has charge __-1___

b) The ion of sulfur has charge __-2___

c) The ion of magnesium has charge __+2___

15. What is the percentage by mass of chlorine in $KClO_3$?

$$\frac{35.45}{39.10+35.45+3(16.00)}\times 100\% = \frac{35.45}{122.55}\times 100\% = 28.93\% \quad \text{(note: 4 sig figs)}$$

16. A certain hydrocarbon is 92.26% carbon and 7.74% hydrogen. Which of the following is a possible molecular formula for this hydrocarbon?

(A) C_6H_6
(B) C_2H_6
(C) CH_4
(D) C_3H_8O

Change mass (grams) to moles, then get simplest ratio of moles, which is 1:1 of C:H. Only one of the answers that works with this empirical formula is A.

17. Consider the two isotopes of chlorine: ^{35}Cl and ^{37}Cl.

a) Name two things that are the same about the two isotopes.

any two of:
- atomic number
- symbol
- element name
- number of protons
- number of electrons

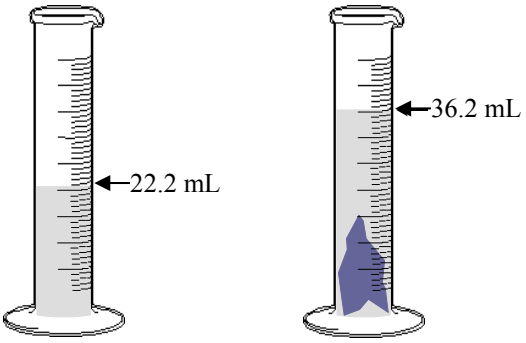
b) Name one thing that is different about the two isotopes.

one of:
- mass number
- number of neutrons

Part 2. Problems (16 points per problem)

Make sure to report answers to the proper significant figures. Show all work. Partial credit is possible even if your final answers are incorrect. No credit will be given, even for a correct answer, if no work is shown.

1. Tin has a density of 5.749 g/mL. The water displacement method is used to measure the volume of a blob of tin (diagram with volume measurements shown below). What should the mass be of the tin blob?



volume = 36.2 – 22.2 mL = 14.0 mL (note: 3 sig figs)

$$14.0 mL \times \frac{5.749\ g}{mL} = 80.5\ g$$ (note: 3 sig figs)

2. A solution containing calcium nitrate, $Ca(NO_3)_2$, is mixed with a solution containing sodium phosphate, Na_3PO_4. White calcium phosphate crystals, $Ca_3(PO_4)_2$, precipitate from solution, and the remaining solution contains sodium nitrate, $NaNO_3$.

a) Write and balance the reaction that occurs. Indicate correct phases of each substance, e.g., (*aq*).

$3\ Ca(NO_3)_2\ (aq)\ +\ 2\ Na_3PO_4\ (aq)\ \rightarrow\ Ca_3(PO_4)_2\ (s)\ +\ 6\ NaNO_3\ (aq)$

to get full credit, needed to have reactants and products correctly identified with proper capital/lowercase letters in symbols, correct phases identified and noted, and correct stoichiometric coefficients

b) If 4.923 g of calcium nitrate were in the first solution, what mass of calcium phosphate crystals could be produced?

$$4.923\ g\ Ca(NO_3)_2 \times \frac{1 mol\ Ca(NO_3)_2}{164.1 g\ Ca(NO_3)_2} \times \frac{1 mol\ Ca_3(PO_4)_2}{3 mol\ Ca(NO_3)_2} \times \frac{310.18\ g\ Ca_3(PO_4)_2}{1 mol\ Ca_3(PO_4)_2} = 3.102\ g\ Ca_3(PO_4)_2$$

note: 4 sig figs

Extra credit (maximum 5 points)

If 3.123 g of sodium phosphate were in the second solution, which chemical (calcium nitrate or sodium phosphate) is the limiting reactant? Show work to receive credit.

up to 5 points extra credit on the exam for correct calculations leading to the conclusion that Na_3PO_4 is the limiting reagent

3. The combustion of 1.205 g of a certain hydrocarbon (which does not contain any oxygen) produces 3.874 g of carbon dioxide and 1.322 g of water.

a) Determine the empirical formula of the hydrocarbon.

$$3.874 \text{ g } CO_2 \times \frac{1 \text{ mol } CO_2}{44.01 \text{ g } CO_2} \times \frac{1 \text{ mol C}}{1 \text{ mol } CO_2} = 0.08803 \text{ mol C} \quad (2\text{pts})$$

$$1.322 \text{ g } H_2O \times \frac{1 \text{ mol } H_2O}{18.02 \text{ g } H_2O} \times \frac{2 \text{ mol H}}{1 \text{ mol } H_2O} = 0.1467 \text{ mol H} \quad (2\text{pts})$$

$$\text{ratio of C:H} = \frac{0.08803}{0.08803} : \frac{0.1467}{0.08803} = (1 : 1.67) \times 3 = 3:5$$

3pts.

C_3H_5 (1pt)

b) In a separate analysis, it was determined that the original sample of the hydrocarbon represents 0.01467 mol. What is the molecular formula of the hydrocarbon?

$$\text{molec. wt.} = \frac{1.205 \text{ g}}{0.01467 \text{ mol}} = 82.14 \text{ g/mol} \quad (2\text{pts.})$$

	empirical		molecular	
formula	C_3H_5	→ ×2	C_6H_{10}	← (2pts.)
weight	41.07 (2pts.)	→ ×2 (2 pts.)	82.14	