**Eastern Mediterranean University**
Department of Chemistry

**CHEM 101 General Chemistry**
Fall 2006-2007 Final Exam
19/01/2007 - 9:00 - 11:00, 120 mins

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<td>Name &amp; Surname:</td>
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<td>Group:</td>
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<td>Signature:</td>
<td>Q4</td>
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Total:............100

**INSTRUCTIONS:**
1. Write your name, surname and group no on the question booklet.
2. Students who do not write their group number or those who write their group number wrong will lose 3 points.
3. The exam consists of 8 questions. In order to get full marks you must answer all questions. Show your steps in answering the questions.
4. The following information and Periodic Table provided may be necessary to answer some of the questions.
5. Use of mobile phones, exchange of calculators, pencils or rubbers is not allowed.

**Periodic Table of Elements**

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**Constants:**
- \( R = 0.0821 \) (L atm)/(mol K)
- \( \Delta H_f = 8314 \) J/mol K
- \( \Delta G_m = -2.3 \) kJ/mol
- \( N_A = 6.022 \times 10^{23} \) atoms/mol
- \( d_v = 1.00 \) g/mL
- 1 mi = 5280 ft; 1 ft = 12 in; 1 in = 2.54 cm; 1 lb = 453.59 g; 1 yd = 36 in
Question 1 (9 points)

a) Carbon nanotubes are now used in products ranging from tennis rackets to X-Ray tubes. Calculate how many carbon nanotubes can be produced using 1.00 g sample of carbon if one nanotube is composed of $5.012 \times 10^{10}$ carbon atoms.

b) The density of copper is $8.93 \text{ g/cm}^3$, and the mass of a single copper atom is $1.06 \times 10^{-22}$ g. How many copper atoms are present in a copper bar whose dimensions are $2.00 \text{ cm} \times 3.00 \text{ cm} \times 5.00 \text{ cm}$.
Question 2 (17 points)

a) Using the periodic table provided, determine the symbol of the lowest atomic numbered element
   i) that is a nonmetal
   ii) that is a noble gas
   iii) whose electron configuration contains more p-electrons than s-electrons
   iv) whose electrons are all paired

b) Boron has two isotopes: $^{10}B$ and $^{11}B$. Which isotope is more abundant? Why?

c) Write the electron configuration for the period-4 element in the same group as $^{5}B$?

d) Draw the orbital diagram for $^{15}P$.

Question 3 (8 points)

a) Classify each of the following bonds as nonpolar covalent, polar covalent or ionic:
   Cs—F, H—H, Si—O

b) Show the direction of polarity on the polar covalent bond in part a).

c) Show the Lewis structure for the formation of the ionic compound Li$_2$O.
Question 4  

(16 points)

a) Write the formula and the name of a binary variable charge ionic compound.

b) Write the formula of ammonium sulfate and the name of HClO₄.

c) Nicotine which has the formula C₁₀H₁₄N₂ is present in tobacco leaves.
   i) Calculate the mass of carbon that is deposited in the lungs of a student who smokes 1 packet (20 cigarettes) a day if each cigarette contains 0.0015 g nicotine.

   ii) How many nicotine molecules enter the lungs of this student per day? (Assume all the nicotine in a cigarette enters the lungs.)
Question 5  
(18 points)

a) Concentrated nitric acid reacts with copper metal to produce copper (II) nitrate, nitrogen oxide (NO) gas, and water. Write a balanced chemical equation for this reaction.

b) Verify the law of conservation of mass by using the following equation:

\[ \text{BaCl}_2 + 2\text{AgNO}_3 \rightarrow \text{Ba(NO}_3)_2 + 2 \text{AgCl} \]

c) Magnesium nitride can be made by the reaction of magnesium and nitrogen gas:

\[ 3 \text{Mg (s)} + \text{N}_2 \text{(g)} \rightarrow \text{Mg}_3\text{N}_2 \text{(s)} \]

i) Calculate the mass of magnesium nitride formed by the reaction of 35.0 g of magnesium with 15.0 g of nitrogen gas.

ii) How many grams of excess reactant will remain at the end of the reaction.
Question 6 (10 points)

a) The vaporization of 0.868 mol of ethyl alcohol (C\textsubscript{2}H\textsubscript{6}O) at its boiling point requires 33.48 kJ of heat energy. Using this information, calculate the heat of vaporization, in joules per gram, of ethyl alcohol.

b) Heat energy required to increase the temperature of 1 kg liquid water from 0 °C to 100 °C is 418.0 kJ. What will be the temperature of a 1.0 kg copper rod initially at 20 °C if it absorbs the same amount of energy (418.0 kJ)? (specific heat of copper is 0.382 J/g °C) (Assume that copper does not melt within the range studied)

Question 7 (6 points)

A given steam (gaseous water) tank resists pressures up to 5.0 atm. What is the maximum temperature limit (in °C) for this tank? (Normal boiling point of water is 100 °C. Also assume that the amount of gaseous water and the volume of the tank are constant at all temperatures)

Question 8 (16 points)

a) What is the partial pressure, in mmHg, of H\textsubscript{2} gas collected over liquid water at a total pressure of 0.978 atm at 28.0 °C? (Vapor pressure of water at 28.0 °C is 28.3 mmHg)

b) What is the mole fraction of water in the above gaseous mixture?