Chem 121 Midterm I 29 Sept. 2006 Name: _____

This exam should be written in ink. Units must be included in answers where necessary and FINAL answers should be expressed to the correct number of sig figs. Show me your work so that I can award part marks. All the goodies you could possibly want are included in the question. Total marks: 34. Use your time wisely!!

1a. Name the following compounds: **[6 marks]**

i. N_2S_5

ii. $(NH_4)_2S_2O_3$

iii. CuF_2

b. Write chemical formulas for the following compounds:

iv. iron(III) sulphate v. rubidium nitrate heptahydrate vi. sulphuric acid

2. Give the number of protons, neutrons and electrons in $^{65}_{29}Cu^{2+}$ **[3 marks]**

protons _____ neutrons _____ electrons _____

3. When lithium metal reacts with the atmosphere a mixture of Li_2O and Li_3N is formed. If 0.459 g of lithium yields 0.952 g of the mixture on oxidation, calculate the percentage by mass of Li_3N in the **mixture**.
Molar masses (g mol^{-1}): Li 6.941, Li_3N 34.83, Li_2O 29.88 **[4 marks]**

4. A 10.00 g sample of a compound, which contains only carbon, hydrogen and oxygen, is burned completely in oxygen. The products of combustion are 19.98 g of CO_2 and 8.18 g of H_2O. The molecular mass as determined by mass spectrometry is 176.2 $g \bullet mol^{-1}$. What are the empirical and molecular formulas of the compound?
Molar masses ($g \bullet mol^{-1}$): C 12.01, H 1.008, O 16.00, CO_2 44.01, H_2O 18.02. **[5 marks]**

5. A 1.450 g piece of limestone rock was ground up and treated with 25.00 mL of 1.052 M HCl. The resulting solution contained excess acid and required 15.85 mL of 0.9850 M NaOH for neutralization. Calculate the percent by mass of calcium carbonate in the rock. The relevant reactions are: **[4 marks]**

$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$

$HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

Molar masses (g mol^{-1}): $CaCO_3$ 100.09; HCl 36.46; NaOH 40.00.

6. The relationship between heat and temperature is: Heat energy (ΔH) = n x C_p x ($T_{final} - T_{initial}$). Calculate the heat energy and its associated error, absorbed by the water in a glass placed in the sun, from the following data:

n = mol water = 14.36 ± 0.04 mol C_p = molar heat capacity of water = 75.3 ± 0.3 J $mol^{-1}K^{-}$

$T_{initial}$ = 9.4 ± 0.2°C T_{final} = 26.1 ± 0.2°C **[4 marks]**

Give your final answer with the correct number of significant figures, and report the error as **absolute** error.

7. Balance the following reaction: **[2 marks]**

_____NO_2 + _____ NH_3 $\rightarrow$ _____ N_2 + _____H_2O

8. Nitrogen gas reacts with silicon according to the following reaction: $3Si + 2N_2 \rightarrow Si_3N_4$

a. What mass of Si_3N_4 will be produced from 1.50 g of Si and 1.30 g of N_2? State which of the two reagents is limiting and show how you came to this conclusion.

b. Calculate the mass of excess reagent that remains at the completion of the reaction.

c. If 2.0 g of Si_3N_4 are obtained, what is the percent yield of the reaction? **[6 marks]**

Molar masses (g mol^{-1}): Si 28.09, N_2 28.01, Si_3N_4 140.3