THE UNIVERSITY OF ZAMBIA
SCHOOL OF NATURAL SCIENCES
DEPARTMENT OF CHEMISTRY
ACADEMIC YEAR 2020
TERM 1
CHE 1000: INTRODUCTORY CHEMISTRY

15th March 2021

TUTORIAL SHEET 2

1. Complete the following table.

Symbol	# Protons	# Neutrons	# Electrons	Net Charge
^{206}Pb				
	31	38		3^+
	52	75	54	
Mn^{2+}		30		2^+

2. Naturally occurring copper exists in two isotopic forms: ^{63}Cu and ^{65}Cu. The atomic mass of copper is 63.55 amu. What is the approximate natural abundance of ^{63}Cu?

3. A sample of chemical X is found to contain 5.0 grams of oxygen, 10.0 grams of carbon, and 20.0 grams of nitrogen. The law of definite proportion would predict that a 67 gram sample of chemical X should contain how many grams of carbon?

4. A hypothetical element consists of two isotopes of masses 86.95 amu and 88.95 amu with abundances of 35.5% and 64.5%, respectively. What is the average atomic mass of this element?

5. Iron is biologically important in the transport of oxygen by red blood cells from the lungs to the various organs of the body. In the blood of an adult human, there are approximately 2.69×10^{13} red blood cells with a total of 2.90 g of iron. On the average, how many iron atoms are present in each red blood cell? (molar mass Fe = 55.85 g/mol)

6. Roundup, an herbicide manufactured by Monsanto, has the formula $C_3H_8NO_5P$. How many moles of molecules are there in a 304.3-g sample of Roundup?

7. Phosphorus has the molecular formula P4, and sulfur has the molecular formula S8. How many grams of phosphorus contain the same number of molecules as 7.88 g of sulfur?

8. One of the major commercial uses of sulfuric acid is in the production of phosphoric acid and calcium sulfate. The phosphoric acid is used for fertilizer. The reaction is

$Ca_3(PO_4)_2 + 3H_2SO_4 \rightarrow 3CaSO_4 + 2H_3PO_4$.

What mass of concentrated H_2SO_4 (98% by mass) must be used to react completely with 100.00 g of calcium phosphate?

9. The characteristic odour of pineapple is due to ethyl butanoate, a compound containing carbon, hydrogen, and oxygen. Combustion of 2.78 g of ethyl butanoate leads to formation of 6.32 g of CO_2 and 2.58 g of H_2O. The properties of the compound suggest that the molar mass should be between 100 and 150 g/mol. What is the molecular formula?

10. Hydrocortisone valerate is an ingredient in hydrocortisone cream, prescribed for skin problems. Its molecular formula is $C_{26}H_{38}O_6$. What is the percent by mass of carbon in hydrocortisone valerate?

11. Ammonia can be made by reaction of water with magnesium nitride as shown by the following unbalanced equation:

    $Mg_3N_2(s) + H_2O(l) \rightarrow Mg(OH)_2(s) + NH_3(g)$

    If this process is 71% efficient, what mass of ammonia can be prepared from 24.5 kg magnesium nitride?

12. The following equation describes the oxidation of ethanol to acetic acid by potassium permanganate:

    $$3C_2H_5OH + 4KMnO_4 \rightarrow 3HC_2H_3O_2 + 4MnO_2 + 4KOH + H_2O$$

    5.00 g of ethanol and an excess of aqueous $KMnO_4$ are reacted, and 5.98 g of $HC_2H_3O_2$ result. What is the percent yield?

13. A 0.5242-g sample of a compound known to contain only carbon, hydrogen, and oxygen was burned in oxygen to yield 0.9740 g of CO_2 and 0.1994 g of H_2O. What is the empirical formula of the compound?

14. Consider the following reaction:
    $2A + B \rightarrow 3C + D$
    3.0 mol A and 2.0 mol B react to form 4.0 mol C. What is the percent yield of this reaction?