THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

FIRST SEMESTER EXAMINATION – 2021

FOOD TECHNOLOGY

FIRST YEAR DEGREE

AS113 – CHEMISTRY FOR NATURAL RESOURCES

FRIDAY 04TH JUNE, 2021   8:20 AM

TIME ALLOWED: 3 HOURS

NAME: ....

STUDENT NO: ....

COURSE: ....

SIGNATURE: ....

INFORMATION FOR CANTIDATES

1. You have 10 minutes to read the paper. You **MUST NOT** answer any question during this time.

2. **ANSWER ALL QUESTIONS.**

3. Answers must be written on the spaces provided. Show all workings and calculations where required.

4. Write your name, student number and course clearly on this page above where indicated. **Do that now.**

5. Calculators are permitted in the examination room. Notes, textbooks, bags, MOBILE PHONES and other electronic devices are **NOT** allowed.

TOTAL [100 MARKS]
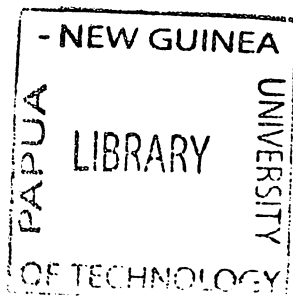
1.   (a)   Explain the rule for naming monatomic anions.   [1 mark]

      (b)   Write the formula for each ion whose name is given, and the name
             where the formula is given.

             (i)   Barium ion   (ii)   Aluminium ion

             (iii) I^- (iv) Cr^{3+} [4 marks]

      (c)   A chemical equation is a qualitative and a quantitative representation.
             Explain what this means.   [2 marks]

      (d)   Octane is a component of gasoline that ignites and powers
             petrol engine vehicles. Show the chemical equation that
             describes this reaction.   [3 marks]

                                              (Total = 10 marks)

2.   (a)   Calculate the number of atoms in 2.2 grams of lithium (Li).   [2 marks]
             (Avogadro's number = 6.02 $\times 10^{23}$)

      (b)   How many moles of O_2 are required to burn 2.4 moles of
             methanol (CH_3OH) to produce carbon dioxide and water?   [4 marks]

(c)   Consider 100.00 gram each of the following samples: H_2O, N_2O, $C_3H_6O_2$, CO_2. Which of the compound would have most number of oxygen atoms and which would have the least number of oxygen atoms?   [4 marks]
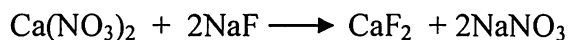
(Total = 10 marks)

3.   (a)   From a litre of 1.0 M H_2SO_4 solution, show how you can prepare 0.2 M H_2SO_4 solution in a 200 mL volumetric flask.   [2 marks]

(b)   A solution containing 29.0 grams of calcium nitrate is added to a solution containing 33.0 grams of sodium fluoride. Calcium fluoride precipitates as shown by the equation:

$$Ca(NO_3)_2 + 2NaF \longrightarrow CaF_2 + 2NaNO_3$$

How many grams of calcium fluoride will precipitate? How many grams of which reactant are in excess?   [8 marks]

(Total = 10 marks)

4.   (a)   State the oxidation number of nitrogen (N) in the molecules below.

      (i) NH_4^+ ....

      (ii)   HCN ....

      (iii) HNO_3 ....

      (iv) NO_2 ....   [4 marks]

      (b)   Give the oxidation state of each of the atoms of the chemical species
             Below:

      (i) K_2CrO_4 K: .... Cr: .... O: ....

      (ii) $KMnO_4$ K: .... Mn:.............. O: ....   [6 marks]

                                              (Total = 10 marks)

5.   (a)   From the equation below, determine which species is oxidized and
             which species is reduced.   [2 marks]

             $$CO_3^{2-} + 2H^+ \longrightarrow CO_2 + H_2O$$
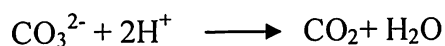
      (b)   Preparation of bromine by bubbling chlorine gas through a solution
             of NaBr is a redox reaction. Write the balance equation by using
             redox half-reaction equations.   [4 marks]

      (c)   (i)   What is meant by the term chemical bond?

             (ii)   Why do atoms bond with each other to form molecules?

(iii)   How do atoms bond with each other to form molecules?

(iv)   What is meant by the term octet rule?   [4 marks]

(Total = 10 marks)

6.   (a)   Draw Lewis structure of the following compounds: [4 marks]
        (i) H_2CO_3 (ii) $CHCl_3$

   (b)   Assign formal charges of the two compounds below.   [6 marks]
        (i) H_2CO_3 (ii) $CHCl_3$

(Total = 10 marks)

7.   How many KJ are required to convert 50 grams of water, initially
    at $20°C$ to steam at $120°C$. The latent heat of water (l) is 2.26 KJ/g and
    specific heat of water (l) is 4.18 J/g $°C$.

(Total = 8 marks)

8.   (a)   If you burn two moles of ethane, C_2H_6, 3080 KJ of head energy is released. Express the balanced chemical reaction in two different forms. [4 marks]

      (b)   What mass of hexane, $C_6H_{14}(l)$, must be burnt in order to provide 7×10^3 KJ of heat? ($\Delta H = 8280$ KJ).   [4 marks]

      (c)   For the equation below at equilibrium, how would the concentrations of each product and reactant compare to the original concentrations when adjustment is made by adding H_2?   [3 marks]

             $H_2O(g) + CO(g) \longleftrightarrow H_2(g) + CO_2(g)$
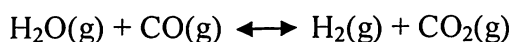
                                                        (Total = 11 marks)

9.   (a)   Specific conductance is a measure of what property of water?   [1 mark]

      (b)   Explain why soaps do not perform well as cleaning agents in hard water. [1 mark]
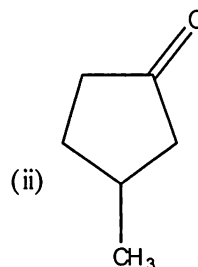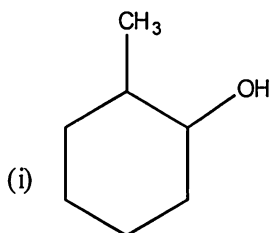
      (c)   Why is it not good for water to have high load of organic matter?   [1 mark]

      (d)   Calculate the pH of 0.10 mol/L CH_3CO_2H given that $K_a = 1.8 \times 10^{-5}$ [3 marks]

                                                        (Total = 6 marks)

10.   (a)   A hydrocarbon of molecular formula, C_5H_{12} has three structural
            isomers. Draw these three isomers and give their respective IUPAC
            names.   [6 marks]

      (b)   Give the IUPAC name for the structures given below.   [4 marks]

      (c)   Define the following:

            (i)   Biochemistry.

            (ii)   Metabolism.

            (iii) Lipids.   [3 marks]

      (d)   Proteins and starch are two biological polymers. Name the
            monomeric units that constitute these polymers.   [2 marks]

            (i) Proteins:................................. (ii) Starch:..................................

                                                          (Total = 15 marks)