THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

FIRST SEMESTER EXAMINATIONS – 2022

AS 113 – CHEMISTRY I (FORESTRY)

MONDAY 31ST OCTOBER 2022 – 8:20 AM

TIME ALLOWED: 2 HOURS

INFORMATION FOR CANDIDATES: -

1. You will have 10 minutes to read the question paper. You MUST NOT begin writing in the answer book during this time.

2. **ANSWER ALL QUESTIONS.**

3. All answers **MUST** be written on the answer book provided

4. Calculators are permitted in the examination room. Lecture notes, notebooks plain papers and textbooks are **NOT** allowed.

5. Mobile phones are not allowed. **SWITCH OFF THE MOBILE PHONES.**

6. Show all workings and calculations in the answer book.

7. **DRAW** the **STRUCTURES** clear and visible.

8. **DO NOT** over write.

9. Write your name and student **ID number** clearly on the front page of the answer book. **DO IT NOW.**

MARKING SCHEME: TOTAL 100 MARKS
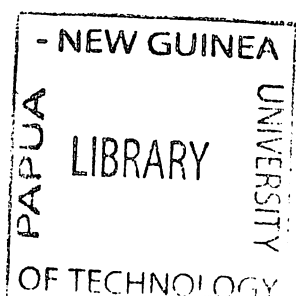
1.   (a)   Name the ions below.   [2 marks]

        (i) I^-

        (ii) Co^{2+}

      (b)   Name the following type-I binary compounds.   [3 marks]

        (i)   LiH

        (ii) H_2S

        (iii) $MgBr_2$

      (c)   Complete and balance the reaction equations below.   [4 marks]

        (i) HCl + $AgNO_3$ $\longrightarrow$

        (ii) $CaCl_2$ + $NaOH$ $\longrightarrow$

      (d)   Heating potassium chlorate, $KClO_3$(s) releases oxygen leaving
             solid potassium chloride. Show the corresponding balanced
             equation.   [2 marks]

      (e)   Sodium carbonate (Na_2CO_3) reacts with HCl to produce sodium
             chloride, carbon dioxide and water. For this reaction, write a
             balance: [4 marks]

        (i)   molecular equation.

        (ii)   ionic equation.

                                              (Total = 15 Marks)

2.   (a)   Find the oxidation state of the atoms of each of the formula below.

            (i) H_2SO_4 [3 marks]

            (ii) H_2O_2.   [2 marks]

     (b)   For the equation below, identify the oxidizing agent and the
            reducing agent.   [2 marks]
            $Cr_2O_7^{2-}$ (aq) + 2OH$^-$ (aq) --------→ $2CrO_4^{2-}$ (aq) + H_2O(l)

     (c)   Arrange the following two half reactions as necessary, so they add up
            to produce a balanced redox equation.   [4 marks]
            Fe^{2+}(aq) + 2e$^-$ ------→ Fe(s);   Al(s) ------→ Al^{3+}(aq) + 3e$^-$

     (d)   Draw Lewis structures for the following molecules.   [4 marks]

            (i) CO_2 (ii) CCl_4

     (e)   Assign formal charges for the two molecules given above (2.d).   [4 marks]

                                                              (Total = 19 marks)

3.   (a)   Calculate the number of atoms in 2.4 grams of zinc (Zn).   [2 marks]
            (Avogadro's number = 6.02×10^{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 100.0 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)

4.   (a)   How many protons, neutrons and electrons are there in ^{197}Au?   [3 marks]

(b)   Write the correct electron configuration of the ions below.   [2 marks]
     (i) Mg^{2+} (ii) Cl^-

(c)   Define:
     (i)   mole.

     (ii)   Chemical stoichiometry.   [2 marks]

(d)   Nitrogen (N_2) reacts with hydrogen (H_2) to form ammonia (NH_3). Write the balanced equation and determine the moles of hydrogen that are required to produce 4.2 moles of ammonia.   [3 marks]

(e)   The natural isotope distribution of magnesium is 78.70% $_{12}^{24}Mg$ at a mass of 23.98504 amu, 10.13% $_{12}^{25}Mg$ at 24.98584 amu and 11.17% $_{12}^{26}Mg$ at 25.98259 amu. Calculate the relative atomic mass of magnesium.   [4 marks]

(Total = 14 marks)

5.   (a)   Define: [2 marks]

        (i)   molar weight.

        (ii)   molarity

     (b)   Calculate the molar weight of calcium fluoride (CaF_2).   [3 marks]

     (c)   15.7 grams of $KMnO_4$ are dissolved in 420 mL of distilled water. Calculate the molarity (M) of $KMnO_4$.   [5 marks]

     (d)   How much 2.0 M HCl would be required to make 200 mL of 0.10 M HCl.   [2 marks]

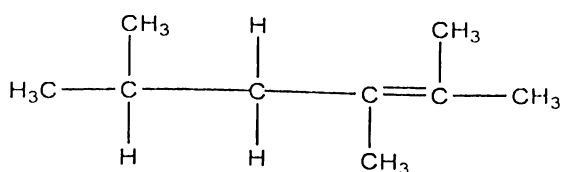(Total = 12 marks)

6.   (a)   For the equation below at equilibrium in a closed vessel, how would
               the concentrations of each product and reactant compare to the original
               concentrations if adjustment is made to one.

$$H_2O(g) + CO(g) \rightleftharpoons H_2(g) + CO_2(g)$$

               (i)   If $CO(g)$ is added.   [2 marks]

               (ii)   If $CO_2(g)$ is removed.   [2 marks]

       (b)   Define the following: [2 marks]
               (i)   chemical kinetics.

               (ii)   activation energy.

       (c) $CaCO_3(s)$ reacts with $HCl(aq)$ to produce $CO_2(g)$. Sketch a graphical
               representation of the production of $CO_2(g)$ at high and low
               temperatures.   [4 marks]

       (d)   (i)   Water has high specific heat index. Explain what this means.   [2 marks]

               (ii)   Show the pH expression of hydrogen ion concentration.   [1 mark]

(iii)   Using the expression for ionic product of water, calculate
        the pH of 2×10^{-3} moles/L of NaOH.   [5 marks]

(Total = 14 marks)

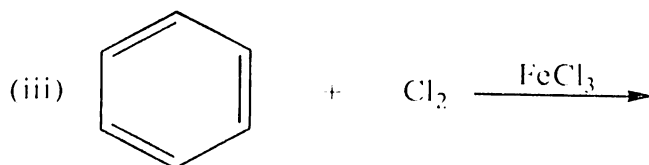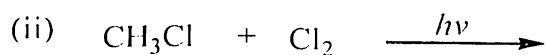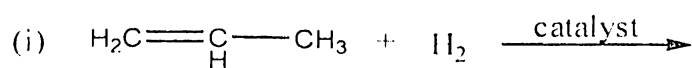7.   (a)   Draw the structures of the following organic compounds;

      (i)   propene   (ii)   2-pentyne   [4 marks]

      (b)   Name the structure below.   [3 marks]

      (c)   Complete the equations below.   [5 marks]

      (i) $H_2C{=}C{-}CH_3$ + H_2 $\xrightarrow{\text{catalyst}}$
                    |
                    H

      (ii) CH_3Cl + Cl_2 $\xrightarrow{hv}$

      (iii)   + Cl_2 $\xrightarrow{FeCl_3}$

d)   (i)   Why is ethanol more soluble in water than pentanol?   [2 marks]

       (ii)   Explain why aldehydes and ketones have higher boiling points
               than comparable molecular weight of non-polar compounds.   [2 marks]

                                                        (Total = 16 marks)