THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

FIRST SEMESTER EXAMINATIONS – 2022

CH413 – INDUSTRIAL CHEMISTRY

WEDNESDAY 8TH JUNE 2022 – 12:50 PM

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 60 MARKS

1.   (a)   As related to fuel, define Calorific Value.   [2marks]

      (b)   Explain the difference between Gross Calorific Value and
             net CalorificValue.   [4 marks]

      (c)   Listed below are two characteristics of a good fuel. Briefly
             explain their significance.

             (i)   Moderate ignition temperature.   [2marks]

             (ii)   Low moisture content.   [2 marks]

                                                        (Total = 10 Marks)

2.   (a)   Name six characteristics of a good fuel.   [3marks]

      (b)   A fuel has Carbon 84%; Sulphur 1.5%; Nitrogen 0.6%;
             Hydrogen 5.5%; Oxygen 8.4%.and latent heat of steam is
             587 kcal/kg.Given HCV of carbon = 8080kcal/kg,
             hydrogen = 34500kcal/kg and sulphur = 2240kcal/kg. useDulong's
             Formula to:

             (i)   Find the gross calorific value.   [4 marks]

             (ii)   Findthe net calorific.   [3 marks]

                                                        (Total = 10 Marks)
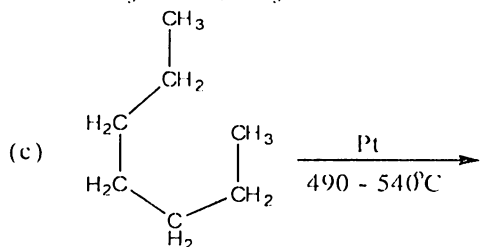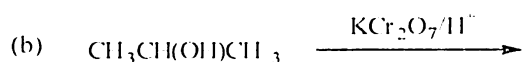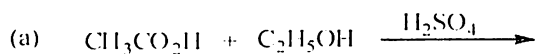
3.   (a)   The two theories regarding the formation of coal are the *in-setu*
             and the drift theory. Explain what these theories are including the
             supporting evidences.   [5 marks]

      (b)   Show the equation for determining the oxygen content of coal.   [2 marks]

      (c)   What is the significance of the analysis of oxygen content in coal?   [1 mark]

      (d)   Explain the two disadvantages of the high level of sulphur in coal.   [2 marks]

                                                        (Total = 10 Marks)

4. (a) (i) Name the three most important liquid fuels and explain their constituent hydrocarbons. [6 marks]

(ii) Differentiate between octane number and cetane number and the significance of these numbers. [4 marks]

(Total = 10 marks)

5. Complete the following reactions. [6 marks]

(a) $CH_3CO_2H + C_2H_5OH \xrightarrow{H_2SO_4}$

(b) $CH_3CH(OH)CH_3 \xrightarrow{KCr_2O_7/H^+}$

(c) $\xrightarrow[490 - 540°C]{Pt}$

(d) (i) Nitro-benzene can be produced via electrophilic substitution reaction. Show the respective balanced equation.

(ii) Friedel Craft alkylation reaction can be used to produce toluene. Show the corresponding chemical equation. [4 marks]

(Total = 10 Marks)