

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

SECOND SEMESTER EXAMINATION

CH352 – PETROLEUM CHEMISTRY

MONDAY 26<sup>th</sup> OCTOBER 2020 – 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 number clearly on the front page. **DO IT NOW**

**MARKING SCHEME:** Total 60 marks

1. A fuel has carbon 70%; sulphur 2.0%; nitrogen 0.8%; hydrogen 4.4% and oxygen 6.4%. Write the formula and calculate the gross and net calorific values using the Dulong's formula. [ given : HCV of carbon = 8080 kcal/kg, hydrogen = 34500 kcal/kg and sulphur = 2240 kcal/kg ] (5 marks)
2. Explain how you determine the percentage of moisture and volatile matter present in a given sample of a fuel by proximate analysis? (5 marks)
3. Give reasons for the following:
  - (a) Lesser the moisture content, better the quality of coal as a fuel.
  - (b) Lesser the volatile matter, better the rank of the coal.(5 marks)
4. In an ultimate analysis, 4g of coal was analyzed and found that an increase in weight of calcium chloride and potassium hydroxide tubes are 3.0 and 4.5 respectively.
  - (a) Write the formula and calculate the percentage of hydrogen.
  - (b) Write the formula and calculate the percentage of carbon.(5 marks)
5. Answer the following:
  - (a) Derive the formula to calculate the percentage of nitrogen present in a coal sample by Kjeldahl's method.
  - (b) A sample of 1.5g of coal was treated according to Kjeldahl's method. The ammonia evolved was absorbed in 50mL of 0.5M  $\text{H}_2\text{SO}_4$ . The remaining acid after neutralization by ammonia consumed 60mL of 0.5M NaOH. What is the percentage of nitrogen in the coal sample?(5 marks)
6.
  - a) In a Carius method, 0.1898g of coal was taken. At the end of experiment, 0.4248g of  $\text{BaSO}_4$  was obtained. Write the formula and calculate the % of sulphur present in the sample.
  - b) Distinguish the three types of liquid fuels using the range of hydrocarbon present in it.(5 marks)
7.
  - (a) Give reasons for the following:
    - (i) Iso-octane and n-heptane are used to define octane number.
    - (ii) Ethyl nitrate and acetone peroxide are used to improve the cetane number.
  - (b) Explain the elimination of the lead oxide formed in the internal combustion engine.(5 marks)

8. Explain the various steps involved in the fixed bed catalytic cracking method to produce gasoline. (5 marks)

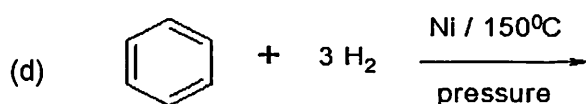
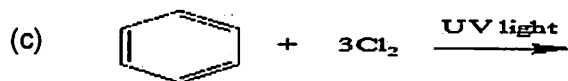
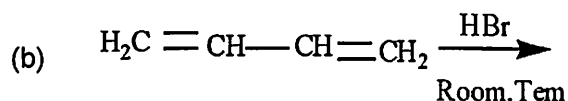
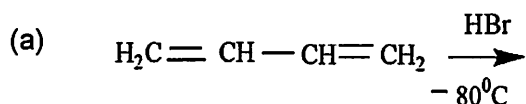
9. Explain with a neat diagram the construction and working of beehive oven method to produce metallurgical coke with a neat diagram. (5 marks)

10. (a) In an experiment, 15 mL of N/10 potassium hydroxide is used to neutralize the acid present in 1.5 g of lubricating oil. Write the formula and calculate the neutralization number of lubricating oil?

(b) Distinguish between catalytic dehydrogenation and oxidation by using isopropyl alcohol.

(5 Marks)

11. Predict the products in the following reactions with IUPAC names :



(5 marks)

12. (a) Explain the hydrodenitrogenation of petroleum fractions.

(b) In an experiment, the following values were observed:  
 value of viscosity of oil of viscosity index is 0 at  $40^\circ\text{C} = 45$   
 value of viscosity of oil of viscosity index is 100 at  $40^\circ\text{C} = 15$   
 viscosity at  $40^\circ\text{C}$  of the oil whose viscosity index is to be determined = 10  
 Write the formula and calculate the viscosity index of the oil.

(5 marks)