

BOWEN UNIVERSITY
FACULTY OF SCIENCE AND SCIENCE EDUCATION
DEPARTMENT OF CHEMISTRY AND INDUSTRIAL CHEMISTRY
B.SC. Degree 2014/2015, FIRST SEMESTER EXAMINATION

COURSE CODE: ICH 302 COURSE TITLE: Raw Materials Inventory and
Industrial Chemical Processes I

COURSE CREDIT: 2 Date: Jan. 26, 2015 Time Allowed: 2 hours

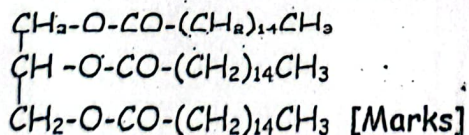
INSTRUCTIONS: ATTEMPT ANY FOUR QUESTIONS

QUESTION 1: [25MARKS]

- a. Write down the possible structures and IUPAC names of C_6 hydrocarbons you would expect to be present in crude oil.
- b. Differentiate between dry and wet natural gases.
- c. Carbon dioxide is an important by-product of steam-reforming in production of synthesis gas; describe available techniques for removing it from the product stream. Illustrate with chemical reaction equation.
- d. One of the disadvantages of using naphtha as a feedstock for ammonia manufacture is that carbon dioxide (CO_2) removal costs are higher than when methane is used, explain why it is so with relevant chemical reaction equations.

QUESTION 2: [25 Marks]

- a. What are the chemical composition of oils and fats?
- b. Using examples of structural formulae of oils and fats explain;
 - i. hydrogenation of oils
 - ii. hydrolysis of fats
- c. Define saponification value. Calculate the saponification value of the following:



- c. What is the significance of the saponification value? [10 Marks]

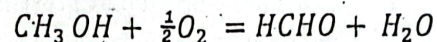
QUESTION 3: [25 Marks]

- a. State three major differences between water gas and producer gas apart from their production methods.
- b. Why is it that in modern water gas plants steam and air are blown alternatively?

- c. Give four (4) industrial uses of water gas.
- d. Describe the steam-reforming process for hydrogen synthesis with the aid of well-labeled flow diagram.
- e. List six (6) industrial uses of hydrogen.

QUESTION 4: [25 Marks]

- a. Define the following terms as related to chemical process
 - i. Degree of conversion
 - ii. Product yield
- b. What basic technical indices are used to determine the efficiency of a technological process?
- c. Formaldehyde (HCHO) is obtained from methanol (CH₃OH) by oxidation using a silver catalyst according to the reaction equation:



In addition to this main reaction, some concurrent reactions occur that produce formic acid (HCOOH), carbon monoxide (CO), carbon dioxide (CO₂), methane (CH₄), and other products.

Assume 3.2 kmol of methanol were used for oxidation purposes. A total of 1.8 kmol of formaldehyde and 0.8 kmol of by-products were produced from that amount, and 0.6 kmol of methanol remained unoxidized. Calculate:

- i. The degree of conversion of methanol
- ii. The formaldehyde yield
- iii. The process selectivity with respect to formaldehyde.

QUESTION 5: [25 Marks]

- a. Hydrocarbon feedstock which is to be used in the steam-reforming process contains traces of organosulphur contaminant; with the aid of flow diagram and chemical reaction equations, describe how the sulphur can be removed and why must it be removed? [15 Marks]
- b. One of the disadvantages of using naphtha as a feedstock for ammonia manufacture is that carbon dioxide (CO₂) removal costs are higher than when methane is used, explain why it is so with relevant chemical reaction equations. [10 Marks]