Second Semester Examination
2020/2021 Academic Session

July 2021

KIT 458 – Chemical Processing

Duration : 2 hours

Please check that this examination paper consists of **FOUR (4)** pages of printed material before you begin the examination.

Instructions:

Part A: Answer **ALL** questions.

Part B: Answer any **ONE (1)** questions.

Answer each question on a new page.

If a candidate answers more than **FOUR (4)** questions, only the answers to the first **FOUR (4)** questions in the answer sheet will be graded.

PART A: Answer **ALL** questions.

1. (a) Malaysia's oil palm industry spans to 5.81 million hectares of plantation and 453 palm oil mills, producing over 19.92 million tonnes of oil and almost 100 million tonnes of biomass (MPOB 2017). Large amounts of oil palm biomass wastes (such as oil palm fronds, empty fruit bunches and oil palm trunk) are simultaneously produced during palm oil extraction.

(i) Show how CO_2 gas can be produced from these biomass.

(ii) Illustrate a flow-chart depicting the process and the chemical reaction as well.

(10 marks)

(b) An industry would like to produce ammonia (NH_3) using RON 94 n-butane (C_4H_{10}), steam, atmospheric air, oxygen and hematite.

(i) Select a suitable flow diagram to produce ammonia from RON 94 oil.

(ii) Evalute the volume of carbon dioxide, CO_2 produced in dm^3 at room temperature if 10 tonnes of RON 94 oil is use.

(10 marks)

(c) Gold (Au) can be extracted by using hydrometallurgy technique by dissolving electronic waste with chemicals such as NaCN solution.

(i) Give **THREE (3)** advantages of hydrometallurgy technique as compared to pyrometallurgy technique.

(ii) Analyse by giving an appropriate equation if the leaching reaction of Au with NaCN solution is possible.

(5 marks)

2. (a) With an appropriate chemical reaction, briefly explain the use of phenol in the production of the following materials.

(i) Alkyl phenol for non-ionic detergent.

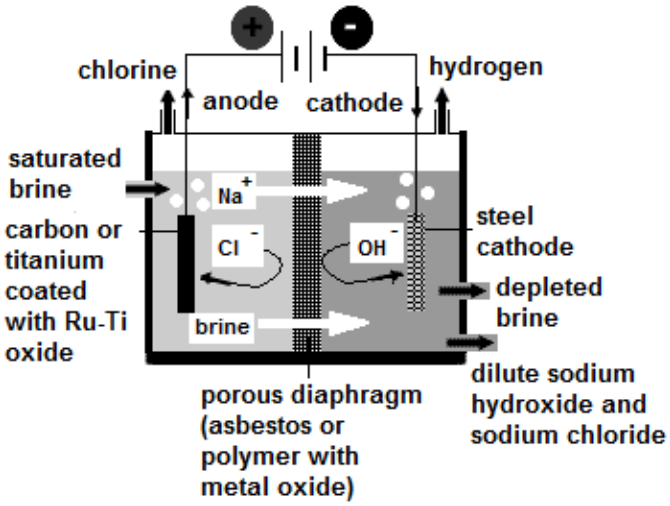
(ii) Polycarbonate.

(10 marks)

(b) The demand for styrene from various end-user industries is expected to grow with the global ethylbenzene market during the forecast period (2021-2026). Describe the sequence of ethylbenzene manufacturing process starting from the pyrolysis of gasoline.

(15 marks)

3. (a) Consider the diaphragm cell diagram as shown in figure below.



(i) Define bulk chemicals.

(ii) Deduce the reaction at anode and their possible parasitic reactions.

(iii) Discuss the disadvantages of diaphragm cell.

(12 marks)

(b) Vinyl compounds have C=C double bonds that are useful to produce polymeric materials such as acrylic compounds, styrene and its derivatives.

(i) With an appropriate chemical reaction, briefly explain catalytic transvinylation concepts.

(ii) Compare **FOUR (4)** differences between the chlorination of ethylene and chlorination of acetylene in haloalkane manufacturing.

(13 marks)

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PART B: Answer any **ONE (1)** question.

4. (a) Portland cement is the most common type of cement in general use around the world as a basic ingredient of concrete, mortar, stucco, and non-specialty grout. Write a short note on production of Portland cement from limestone, clay and silica.

(10 marks)

(b) Analyse the following processes for the production of hydrocarbon materials.

(i) Factors that dominate the olefin formation**.**

(ii) Oxime rearrangement versus nitrosyl chloride in lauryl lactam production

(iii) Factors that favor the linear hydroformylation product.

(15 marks)

5. (a) With an appropriate processing technology, briefly explain **FIVE (5)** important factors in industrial gasification of coal.

(11 marks)

(b) Pyrite (FeS_2) is the most widespread and abundant sulfide in the world and can be found in tens of thousands of localities such as Elba, Italy. Consider that one industry has mined pyrite and would like to produce sulfuric acid as their final product.

(i) Explain a possible mining process for sulphur extraction from pyrite.

(ii) Propose a suitable flow diagram, discussing the types of processes involved to produce sulfuric acid from pyrite.

(iii) Evaluate the volume of SO_2 produced at room temperature if 5 kg of pyrite is used.

(14 marks)

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