THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. DEGREE PROGRAMME – LEVEL 5

INDUSTRIAL CHEMISTRY – CHU 3237

FINAL EXAMINATION 2014/15

3 Hours

Date: 26.10.2015	Time: 9.30 a.m. – 12.30 pm.

Part II (60 marks)

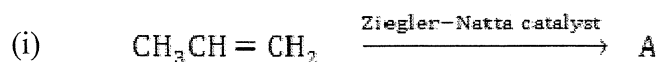Answer **four** out of six including **compulsory question number 1**.

1.(a) Using equations, briefly describe the manufacture of sulphuric acid in the process using *homogeneous catalysis*. (20 marks)

(b) Describe the environmental pollution issues associated with the discharge of effluents from the latex industry. (15 marks)

(c) Draw a flow diagram for the production of free-flowing table salt. (20 marks)

(d)(i) Write down the expression for the corrosion current ($i_{corrosion}$) when a piece of metal weighing w_1 g dropped into an aqueous solution of the metal ions weighed w_2 g ($w_1 \square w_2$) after time t s.

(ii) A piece of metal M (Relative Atomic Mass = 102) of weight 1.123 g is dipped in an aqueous solution of M^{2+} ions. After two hours, the weight of the dried metal was found to be 1.02 g. Calculate the corrosion current. (F= 96485 C mol^{-1}). (30 marks)

(e) Briefly describe what is meant by metal finishing. Write down **three** types of metal finishing processes. (15 marks)

2.(a) By considering suitable examples, explain the main difference between an amorphous substance and a crystalline substance. Comment on the melting point of each type. (20 marks)

(b) What is water glass? The use of "stabilizers" will make water glass suitable to make any glass articles. Explain. (20 marks)

(c) What is glass transition temperature? Describe the nature of a glass mixture:
(i) above glass transition temperature?
(ii) at glass transition temperature? (20 marks)

(d) What are glass ceramics? Why are they considered important? (20 marks)

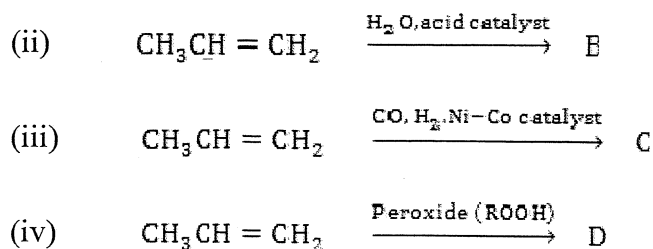(e) Why is silicon nitride considered a useful material in industry? (20 marks)

3.(a)(i) Explain what is meant by the term "spice oleoresin".

(ii) Name **three** spices used for oleoresin manufacture in Sri Lanka.

(iii) What is the difference between spices oil and spice oleoresin? (15 marks)

(b)(i) Categorize rosin and vegetable turpentine chemically.

(ii) Draw and label a simple flow diagram to show the production of vegetable turpentine from purified pine oleoresin. (20 marks)

(c) Eugenol is an essential oil isolated from cinnamon leaf oil.

(i) What is meant by the term "essential oil"?

(ii) Sketch different types of oil collectors used in the essential oil production and explain their usage. (20 marks)

(d)(i) Briefly explain by giving relevant chemical equations, how eugenol is isolated from cinnamon leaf oil.
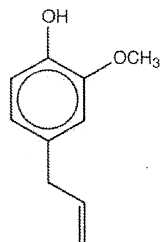
Eugenol

(ii) Explain how you would determine the percentage of eugenol in cinnamon oil using chemical method. Discuss the limitations. (45 marks)

4.(a) Cracking and reforming are the major operations in the process of petroleum refining.

(i) What do you understand by the terms 'cracking' and 'reforming'

(ii) Write reasons for carrying out cracking and reforming of petroleum.

(ii) List **three** advantages of catalytic cracking over thermal cracking. (25 marks)

(b) Briefly describe the following terms:

(i) Naphtha (iii) Mordant dye (iii) Auxochrome (15 marks)

(c) Propylene is an important feedstock in the petrochemical industry. What are the products that are made from propylene via the following reactions?
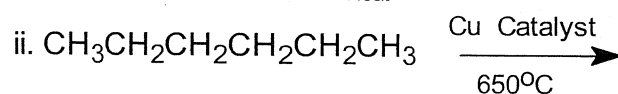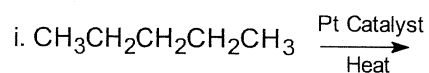
(i) $CH_3CH = CH_2 \xrightarrow{\text{Ziegler–Natta catalyst}} A$

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(ii) $CH_3CH = CH_2$ $\xrightarrow{H_2O, \text{acid catalyst}}$ B

(iii) $CH_3CH = CH_2$ $\xrightarrow{CO, H_2, Ni-Co \text{ catalyst}}$ C

(iv) $CH_3CH = CH_2$ $\xrightarrow{\text{Peroxide (ROOH)}}$ D

(20 marks)

(d)(i) What do you understand by the term "octane number of a fuel?

(ii) Give **two** methods that used to increase the octane number of a fuel.

(iii) What is the major product of each the following reactions?

i. $CH_3CH_2CH_2CH_2CH_3$ $\xrightarrow[\text{Heat}]{\text{Pt Catalyst}}$

ii. $CH_3CH_2CH_2CH_2CH_2CH_3$ $\xrightarrow[650^oC]{\text{Cu Catalyst}}$
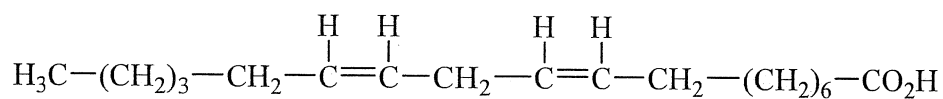
(30 marks)

(e)   State the products of the following reactions.   (10 marks)

5.(a)(i) Write down the IUPAC name and short hand notation (using the Δ system) of the
following fatty acid (**A**).

$$H_3C-(CH_2)_3-CH_2-\underset{H}{\overset{H}{C}}=\underset{H}{\overset{H}{C}}-CH_2-\underset{H}{\overset{H}{C}}=\underset{H}{\overset{H}{C}}-CH_2-(CH_2)_6-CO_2H$$
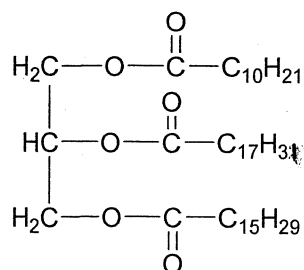
A

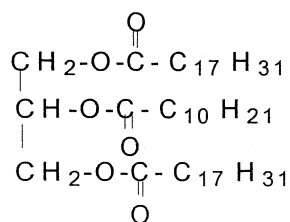(ii) Define iodine number of a fat. What does it measure?

(iii) Calculate the iodine value for the fat which contains following triglyceride.
(molecular weight of this compound is 759 g/mol and relative atomic mass of iodine
-127)

(40 marks)

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(b) A natural oil consists of the following triglyceride as the main ingredient.

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\begin{array}{l}
CH_2-O-\overset{\overset{O}{\|}}{C}-C_{17}H_{31} \\
CH-O-\underset{\underset{O}{\|}}{C}-C_{10}H_{21} \\
CH_2-O-\underset{\underset{O}{\|}}{C}-C_{17}H_{31}
\end{array}
$$

    (i)   What is meant by the term "interesterification of oils? What is the purpose of carrying out interesterification of oils?

    (ii)   What would be the products when the above mentioned compound undergoes an interesterification reaction?

    (iii)   What physical property of natural oil would change due to interesterification?

    (iv)   Briefly describe a chromatographic method for the analysis of oil.

(40 marks)

(c)(i) What is meant by the term slip point of fats?

  (ii) Explain how the fatty acid composition of the triglycerides can determine whether a substance is a fat or oil. (20 marks)

6.(a)(i) Draw the flow chart for the wet process of manufacture of Portland cement.

  (ii) Giving the relevant temperature (or the temperature range), write down the reactions that take place in the kiln during burning.

  (iii) Draw the rotary cement kiln for the wet process, indicating the zones for the different processes that take place in the kiln. (70 marks)

(b)(i) Distinguish between 'flash set' and 'false set'.

  (ii) Compare the setting behaviour and development of strength of the crystalline phases, C_3S and C_3A when they undergo hydration. (30 marks)

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