

The Open University of Sri Lanka  
Faculty of Natural Sciences  
B.Sc. Degree Programme

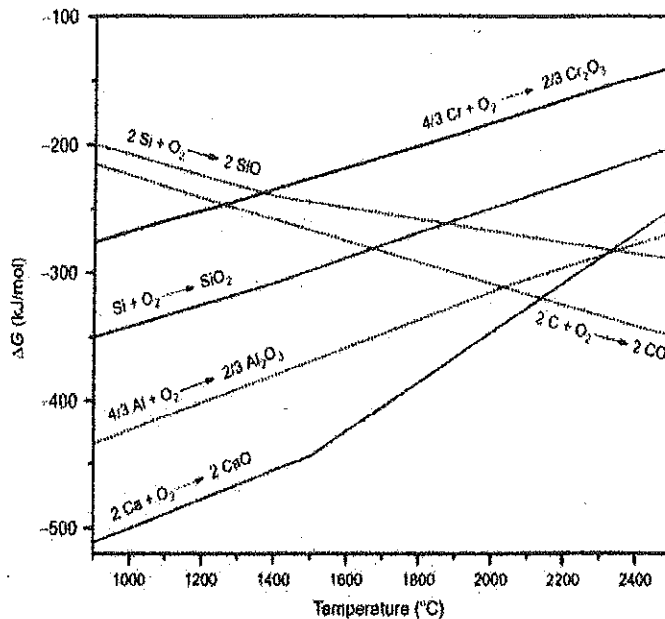


Department	: Chemistry
Level	: 5
Name of the Examination	: Final Examination
Course Code and Title	: <b>CYU5312 Industrial Chemistry</b>
Academic Year	: 2021/2022
Date	: 11/ 10/2022
Time	: 1.30 pm – 3.30 pm
Duration	: 2 hours
Index number	:

### General Instructions

1. Read all instructions carefully before answering the questions.
  2. This question paper consists of **Four** questions in **three** pages.
  3. **Answer All FOUR (04) questions. All questions carry equal marks.**
  4. Answer for each question should commence from a new page.
  5. Draw fully labelled diagrams where necessary.
  5. Relevant log tables are provided where necessary.
  6. Having any unauthorized documents/ mobile phones in your possession is a punishable offense.
  7. Use blue or black ink to answer the questions.
  8. Circle the number of the questions you answered in the front cover of your answer script.
  9. Clearly state your index number in your answer script.
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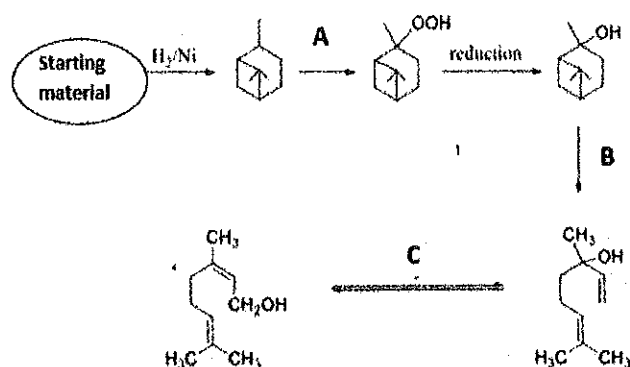
1. a) Metal ores are subjected to several treatments and concentrating is one of the steps.
- What do you mean by “concentrating” in metal extraction?
  - Briefly explain the froth flotation used for concentrating and indicate one of the applications. **(20 Marks)**
- b) Ellingham diagram (Gibbs free energy change vs temperature) for the formation of metal oxides is given below. Looking at the diagram write down the answers for the following questions.



- Thermodynamically, explain the free energy change for oxidation of metal with increasing temperature.
  - “Cr can be easily extracted at low temperature (around 1300 °C) with the coke than the Al”. Justify your answer.
  - The balance equation for the Cr extraction from its ore using coke is  $2Cr_2O_3 + 3C \rightarrow 4Cr + 3CO_2$   
Calculate the percentage atom economy for this reaction.  
(Cr-52, O-16, C-12)
  - Suggest a method to extract Al metal looking at the above Ellingham diagram. **(50 Marks)**
- c) Throwing power is measured in electroplating to check certain abilities.
- What is the main difference between electro plating and electroless plating?
  - What is “throwing power”?
  - Give **two factors** that enhance the throwing power. **(30 Marks)**
2. a) Isomorphous substitution is very common in Montmorillonite clay.
- What do you mean by “isomorphous substitution”?
  - Briefly explain how isomorphous substitution takes place in Montmorillonite clay.
  - Comment on the cation exchange capacity of Montmorillonite. **(30 Marks)**

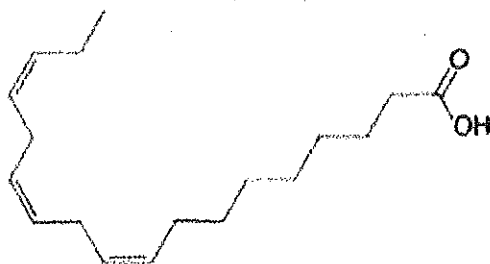
- a) Clay is the main raw material used to produce the traditional ceramics.
- Write down the other raw materials used for production of traditional ceramics with their sources and the function.
  - Write down the production steps during the production of a traditional ceramic article. **(20 Marks)**
- b) Modifiers alter the properties of fused silica glass. Borosilicate and Lead glass are two examples for modified glasses.
- Write down ingredients (composition) of fused silica glass.
  - Write down the major additives used to form Borosilicate glass and Lead glass.
  - Write two properties of glass ceramics compared to ordinary glass. **(20 Marks)**
- c) During the production of Portland cement  $C_3A$  production, cooled clinkers grind using two grinders in the presence of gypsum
- What is the reason for adding gypsum?
  - Write down the function of each grinder.
  - What is the chemical composition of  $C_3S$  and  $C_3A$ .
  - Comment on the setting of the  $C_3S$  and  $C_3A$  if gypsum is added with the balance chemical equations for the initial hydration of  $C_3S$  and  $C_3A$ . **(30 Marks)**

3. a) Turmeric oleoresin mainly produced by single stage extraction
- What is the difference between spice oils and spice oleoresins.
  - Briefly explain the single extraction manufacturing process of turmeric oleoresin. **(20 Marks)**
- b) Pure essential oil of pine turpentine is converted to value added products such as geraniol, nerol and linalool.



- What do you mean by "value added product"?
- What is the starting material used to form above three products?
- Identify the reagents and/or conditions (A, B and C) applied during the chemical conversion of above three compounds.
- Write down an application of above value-added products. **(30 Marks)**

- c) Except for the olive oil, all crude oils are usually refined before marketing.  $\alpha$ -Linolenic acid is one of the polyunsaturated fatty acid presents in olive oils and its structure of is given below.



- Comment on the  $\omega$ x series of above fatty acid.
- Write down the IUPAC name of the following fatty acid.
- Draw the fatty acid represent by the short-hand notation 20:3  $\omega$ 6.
- Compare the melting points of above compound with the fatty acid with the short-hand notation 20:3  $\omega$ 6.
- What is the reason to subject the crude oil for refining process?

**(50 Marks)**

4. a) The petroleum yield obtained by catalytic cracking is high,

- Briefly explain the above statement.
- Describe how branched olefin is formed by a linear olefin during catalytic cracking.

**(30 Marks)**

- b) Ethane cracks to both ethylene and methane. The produced methane can be used to form carbon black and ethylene is used to produce to form ethyl benzene

- Write down the initiation step and relevant reactions for the production of ethylene and methane.
- Write down the balance chemical reactions for the formation of carbon black.
- Write down the balance chemical reaction for the formation of ethyl benzene.

**(35 Marks)**

- c) The conversion of benzene to cyclohexane for the purpose of production of adipic acid is very common in petrochemical industries. During this process cyclohexane is air oxidized in the presence of catalyst to form main two reactants needed for the production of adipic acid.

- Write down the balance chemical reaction with the relevant conditions for the conversion of benzene to cyclohexane.
- Comment on octane number of benzene and hexane.
- Write down the balance chemical reaction for the air oxidation of cyclohexane.
- Write down a use of adipic acid production of nylon fibre.

**(35 Marks)**

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