

THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. DEGREE PROGRAMME

INDUSTRIAL CHEMISTRY – CMU3232 –LEVEL 5

FINAL EXAMINATION 2014/15

DURATION: 3 HOURS




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Date: 26.10.2015

Time: 9.30 am – 12.30 pm

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- This question paper consists of two parts. **Part I** (short questions) and **Part II**.
- Part I consists of **15** short question (**40 marks**). Recommended time to complete this part is one hour.
- Part II consists of six questions; you are expected to answer four (04) out of six questions including the first compulsory question. Recommended time to complete this part is two hours.

**Part I**

Index Number .....

Invigilator's signature .....

**Answer all the questions**

1. Natural rubber is one of the major agricultural export products of Sri Lanka. What is the major chemical component present in natural rubber? Give **two** examples for dry rubber products that are made in Sri Lanka.

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(03 marks)

2. What specific group of elements/ compounds of elements in the Periodic Table are used in glazing mixtures? Why?

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(04 marks)

3. Name two properties of clay which would make them a useful raw material in ceramic Industry.

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(02 marks)

4. What are the essential raw materials used in the manufacture of Portland cement?

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(02 marks)

5. What would be the hydration products of  $C_3S$  and  $C_2S$ ?

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(02 marks)

6. How are beach mineral sands formed?

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(06 marks)

7. What is the trace element geochemistry of beach sand heavy minerals zircon, monazite and rutile etc?

Properties	Rutile	Monazite	Zircon
<i>Chemical Formula</i>			
<i>Extractable Metal</i>			

(03 marks)

8. List the major components (natural isolates) of the following essential oils:

Clove oil .....

Citronella oil .....

(03 marks)

9. List **two** value added products of citral.

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(02 marks)

10. Give **two** factors that affect the melting points of fats and oils?

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(02 marks)

11. What is meant by splitting of triglycerides?

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(02 marks)

12. What is alkylation in catalytic reforming?

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(02 marks)

13. Give **three** factors which affect rate and efficiency of catalytic reforming.

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(03 marks)

14. What is meant by the term “metal finishing” in metal industry?

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(02 marks)

15. Why metal finishing is important in metal industry?

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(02 marks)

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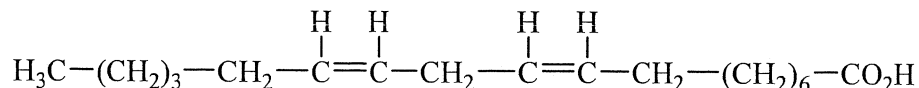
**Part II (60 marks)**

Answer **four (04)** out of six questions including the **compulsory question number one**.

- 1.a. (i) What is meant by the term “anodising” of a metal?  
(ii) What does throwing power of a metal bath measure?  
(iii) List the main factors that determine the throwing power of a plating bath.  
(20 marks)
- b. Suggest the type of glass used for the following purposes. Give reasons for your answer.
  - (i) Partitioning in a radiology unit in a hospital.
  - (ii) Windscreen of motorcars
  - (iii) In a display window of a shop
  - (iv) Eye wear in a laboratory (20 marks)
- c. Explain why glass is categorized as an amorphous substance. (10 marks)
- d. (i) Explain why fats do not have a distinct melting point.  
(ii) What is slip point of a fat? (15 marks)
- e. How is propylene oxide produced from propylene in hydroperoxydation process?  
(20 marks)
- f. (i) What is meant by the term “dye” as applied in textile industry?  
(ii) Write **three** ideal properties of a dye. (15 marks)

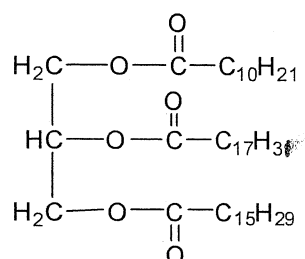
- 2.a. Name the major constituents in naturally occurring clay. (10 marks)
- b. Explain why kaolinite is more suitable as a raw material for ceramic industry compared to montmorillonite. (25 marks)
- c. (i) What is meant by cation exchange capacity of clays?  
(ii) What factors will affect the cation exchange capacity of 2:1 minerals?  
(30 marks)
- d. Draw the structure of layered boron nitride. What resemblance does it have with allotropes of carbon? (15 marks)
- e. Explain how and why Alumina is more suitable than glass to be used as a tube cover in high pressure lamps. (20 marks)
- 3.a. (i) Distinguish between cement, mortar and concrete.  
(ii) Draw the flow diagram for the manufacture of Portland cement by Dry process. (30 marks)
- b. (i) Distinguish between 'setting' and 'hardening'.  
(ii) Write equations **only** to show the hydration reactions that are responsible for setting of cement (Assume ratio  $C_3A$  : gypsum = 1:1).  
(iii) What is the role of gypsum in setting of cement paste?  
(iv) Compare the setting behaviour, temperature rise during hydration and development of strength of the phases,  $C_3S$  and  $C_3A$  when they undergo hydration.  
(70 marks)
- 4.a. What are the six major types of phosphate resources are being mined in the world? To which category, the Eppawala Apatite deposit belongs to?
- b. Discuss the manufacturing process of the conversion of apatite to single super phosphates.
- c. How much of water is approximately required for a 300,000 tons capacity triple super phosphate factory?
- d. Write down the feasibility of the commercialization of Eppawala Phosphate Deposit (100 marks)

- 5.a. (i) Write down the IUPAC name and short hand notation (using the  $\omega$  series) of the following fatty acid.

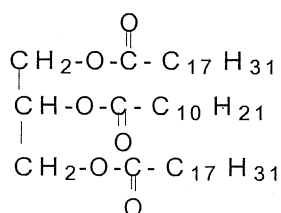


- (ii) Define iodine number of a fat. What does it measure?
- (iii) Calculate the iodine value for the fat which contains following triglyceride, (molecular weight of this compound is 759 g/mol and relative atomic mass of iodine -127).

(40 marks)



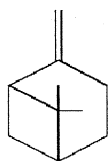
- b. A natural oil consists of the following triglyceride as the main ingredient.



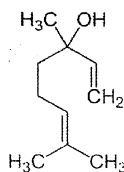
- (i) What is meant by the term “interesterification of oils?
- (ii) What is the purpose of doing interesterification of oils?
- (iii) What would be the products when the above mentioned compound undergoes an interesterification reaction? (15 marks)

- c. (i) Value addition is an important area in the essential oil industry. What is meant by the term “value addition” of essential oils/ natural isolates?
- (ii) Distillation is the main method used to extract essential oils from aromatic plants. Give **two** different types of distillation methods that are used for extraction of essential oils.

- (iii) The one of the value added product of  $\beta$  – Pinene is linalool which is used in the synthesis of vitamins A and E. Show the chemical conversion of  $\beta$  – Pinene to Linalool.



$\beta$ - pinene



Linalool

(45 marks)

- 6.a. Write a short note on the hydrocarbon constituents present in crude petroleum.

(40 marks)

- b. Catalytic cracking results in the production of carbonium ion intermediates. Explain how

(i) an olefin

(ii) a branched olefin

are formed by catalytic cracking. Give mechanism of the process.

(30 marks)

- c. Explain how phenol is prepared from isopropyl benzene. Describe the procedure and give the mechanism involved.

(30 marks)

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