

THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. DEGREE PROGRAMME

INDUSTRIAL CHEMISTRY - CMU3232

FINAL EXAMINATION - 2016/17

DURATION: 3 HOURS



Date: 10.01.2018

Time: 9.30 a.m. – 12.30 p.m.

- This paper consists of two parts. **Part I** (short questions) and **Part II** (structured essay).
- Part I consists of 15 short questions (**40 marks**). Recommended time to complete this part is one hour.
- Part II (**60 marks**) consists of six question; 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.

**Hand over the answer scripts of Part I and Part II separately.**

**Part I**

Index number: .....

Invigilator's signature: .....

**Answer all the questions.**

1. What is natural rubber?

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**(02 marks)**

2. A number of chemicals are used as additives in latex based rubber industry. Give two examples for additives.

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**(02 marks)**

3. Is glass a crystalline substance or an amorphous substance? Give reasons for your answer.

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**(04 marks)**

4. A glazed ceramic article has advantages over an unglazed one. Name **two** advantages of using a glaze in a ceramic body.

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**(04 marks)**

5. Distinguish between flash setting and false setting

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**(04 marks)**

6. Identify the crystalline phases responsible for

long term strength .....

rapid setting .....

**(02 marks)**

7. Give **three** special characteristics of titanium metal that is extracted from rutile and ilmenite?

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(03 marks)

8. Write balance equation for the conversation of apatite to single super phosphates?

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(02 marks)

9. State **two** factors that affect melting points of fats.

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(02 marks)

10. What is meant by the term 'Autoxidation' of fatty acids?

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(02 marks)

11. Give **three** factors that affect the rate of autoxidation.

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(03 marks)

12. What is the major technique used to refine crude petroleum?

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**(02 marks)**

13. Distinguish between cracking and reforming.

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**(04 marks)**

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

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**(02 marks)**

15. List down **two** ideal properties of a dye used in Textile industry.

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**(02 marks)**

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**Part II**

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. What will be the nature of a glass mixture?  
i. just above glass transition temperature?  
ii. at glass transition temperature? (20 marks)
- c. How much does a 300,000 tons capacity triple super phosphate factory require water? (15 marks)
- d. i. What is meant by the term 'acid value'  
ii. If the acid value of the oil sample is higher than what is expected for a pure sample, what can you interpret about the oil sample? (25 marks)
- e. i. In the manufacture of polyester fabric, describe how phthalic unhydride is produced from ortho - xylene? Give the method and conditions used. (20 marks)

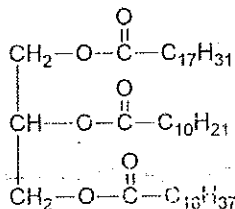
- 2.a. Briefly explain why thermal expansion coefficient is important in glass industry. Illustrate your answer with suitable examples. (20 marks)
- b. Fluxes are considered as an essential component in a glass mixture. Give reasons. (15 marks)
- c. Give reasons for the following (20 marks)
- Laminated glass is normally used for windscreens of motor cars.
  - Photo framing shops recommends antireflective glasses instead of normal glasses for a framed photo.
- d. For what specific purpose do the following item/process used in ceramic industry (20 marks)
- ball mill
  - powder pressing
- e. Sketch the structure of Boron Nitride (hexagonal) and explain why it is categorized as an advanced ceramic. (25 marks)
3. a. i. Write down the essential steps in the manufacture of Portland cement. What is the most important step in manufacturing process? (40 marks)
- ii. Draw the flow diagram for the manufacture of Portland cement by wet process.
- b. i. Draw the rotatory kiln for the dry process showing the different temperature zones within it. Identify the type of reactions that take place within these temperature zones. (30 marks)
- c. i. Distinguish between 'setting' and 'hardening'.
- ii. Compare the setting behavior, temperature rise during hydration and development of strength of the phases,  $C_3S$  and  $C_3A$  when they undergo hydration. (30 marks)

- 4.a. Write down the major heavy minerals found in Pulmodai beach? (10 marks)
- b. Describe the stages how is pure titanium dioxide manufactured from the ore using sulphate process? (30 marks)
- c. Explain the refining method of zircon (pure and less pure) into zirconium metal (30 marks)
- d. Explain the chemical process during the synthetic rutile production. (30 marks)

5. Consider the following fatty acid.



- a. Write down the shorthand notation that use numbering from
- Methyl end
  - Carboxylic end
- (10 marks)
- b. What does each of the following parameters tell you about quality of the oil?
- Low iodine value
  - High refractive index
  - Low peroxide value
- (15 marks)
- c. i. What is meant by the term 'saponification value' of fats?  
 ii. What are its significances?  
 iii. Estimate the saponification value of the following triglyceride.  
 [Atomic weight ( $\text{g mol}^{-1}$ ) C=12; H=1; K=39; O=16]



(25marks)

- d. i. What is biodiesel?  
ii. Describe the manufacturing process of biodiesel.  
iii. Briefly describe the blends of biodiesel.  
(25 marks)
- e. i. Describe the term 'refining of crude oil'.  
ii. Refining process involves several unit operations. Describe the refining process of crude oil by using a flow chart.  
iii. Give the main impurity that can be removed from crude oil by each of these unit operations.  
(25 marks)
6. a. i. What is catalytic cracking of petroleum?  
ii. What are the advantages of catalytic cracking?  
(30 marks)
- b. i. Briefly describe alkylation and polymerization techniques that have been used in octane boosting refining process.  
(35 marks)
- c. Show how propylene,  $\text{CH}_3\text{CH}=\text{CH}_2$ , available from crude petroleum is chemically converted to alcohols, aldehydes and oxides in industry.  
(35 marks)

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