THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. DEGREE PROGRAMME – Level 5
INDUSTRIAL CHEMISTRY – CMU3232
MODEL FINAL EXAMINATION 2013/14
3 hours

Date: ****** **Time:** *******

- This question paper consists of two sections. **Part I(Short questions)** and **Part II (Structured type).**
- **Part I** consists of **15** short questions; recommended time to complete this part is **one** hour.
- **Part II** consists of **six (06)** questions; you are expected to answer **four (04)** questions including **one compulsory question** to be answered out of six. Recommended time to complete this part is **two** hours.

Part I (40 marks)

Index Number..... **Staff signature**.....

Answer all questions

1. Write down the raw material used for the extraction of the following metals. Indicate the process involved.

	Raw materials	process
Iron	.....	.....
Aluminium	.....	.....

(04 marks)

2. Write three important features of the Ellingham diagram for oxides of elements.

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(03 marks)

3. State the main reason for the use of transition metal compounds in the glass mixture for the preparation of colored glass.

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(02 marks)

4. What physical property is associated with the "brilliance" in lead cut glass?

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(02 marks)

5. What are refractory clays?

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(02 marks)

6. Distinguish between 'flash set' and 'false set' in relation to cement.

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(03 marks)

7. Write the major crystalline phases present in Portland cement clinker.

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(02 marks)

8. What are three crystalline forms of Zirconia?

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(03 marks)

9. Write balance equation for the conversion of Zircon sand to zirconia. Give reaction condition.

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(03 marks)

10. Distillation is the main method used to extract essential oils from plant materials. Give two examples for distillation other than water distillation method.

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(03 marks)

11. In water distillation, why is it important for the plant material in the still to be agitated while water boils?

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(03 marks)

12. Distinguish between cracking and reforming

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(03 marks)

13. What do you understand by the term 'octane number'?

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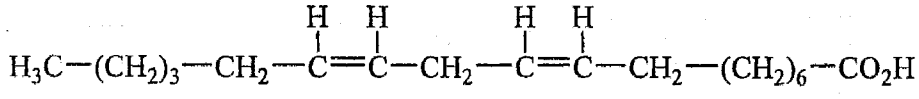
.....

(02 marks)

14. Write down the IUPAC name of the following fatty acid.



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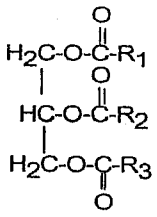
(02 marks)

15. What would be the products that formed by interesterification of the following triglyceride?



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(03 marks)

Part II (60 marks)

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

1.a. (i) What is meant by isomorphous substitution in a clay mineral? Explain by giving an example. Why is isomorphous substitution important in agriculture and in environmental protection? **(30 marks)**

b. (i) What do you mean by "hydraulic cement"?
(ii) Draw the flow diagram for the manufacture of Portland cement by the wet process.

(20 marks)

c. (i) Write reasons for carrying out cracking of petroleum.

(ii) What is meant by steam cracking? What do you produce from steam cracking of petroleum? **(20 marks)**

d. (i) What is an essential oil? Give the major component of essential oils in Clove leaf and citronella
(ii) What is meant by the term Rancidity of oils? How does it occur in oils.

(30 marks)

2.a. (i) What is the role of stabilizers in a glass mixture?

(ii) Out of soda glass, coloured glass and borosilicate glass which is more suitable for the preparation of capillaries in a laboratory? Why?

(iii) Out of Na_2O, Al_2O_3 and Cr_2O_3 which is more suitable to add to a mixture to prepare coloured glass? Why?

(20 marks)

b. (i) Assess the suitability of silicon nitride and boron nitride as new ceramic material by considering their bonding and coefficient of thermal expansion. Which one of these is called inorganic graphite? Why?

(15 marks)

(ii) Name two advantages of a glaze on a ceramic body .Why is it important to select carefully the firing temperature of a glaze? **(15 marks)**

c. X-ray diffraction is widely used to observe the internal arrangement of substances.

(i) What type of X-ray pattern would you expect to see in
(α) glass ? (β) Potassium chloride?

(ii) How do you relate this information to the melting point of each substance?

(20 marks)

d. Compare soda glass and borosilicate glass in terms of
(i) chemical composition and
(ii) coefficient of thermal expansion **(10 marks)**

e. What is the significance of the glass transition temperature in a glass mixture? **(10 marks)**

f. Explain how a simple oxidation-reduction reaction is used in optical industry to produce photo chromic glasses. **(10 marks)**

3.a. (i) What do you mean by 'hydraulic cement'?
(ii) Draw the flow diagram for the manufacture of Portland cement by the wet process.
(iii) Write the essential differences between this process and the dry process. **(40 marks)**

b. Indicating the temperature, briefly describe the important processes that take place during burning of raw materials in the kiln. **(20 marks)**

c. (i) Distinguish between 'flash set' and 'false set'. Can you overcome problems due to these? If so how?
(ii) Briefly describe the changes that take place when C_2S phase undergoes hydration. Compare this with the hydration of C_3S. **(40 marks)**

4. a (i) Define the value added approach of Mineral Commodities.
(ii) What are the super phosphates?
(iii) How much does a 300,000 tons capacity triple super phosphate factory require water? **(... marks)**

b. (i) Discuss the Manufacturing process of single super phosphate?
(ii) What are the main constraints in manufacturing of single super phosphate from Eppawala Apatite deposits? **(.... Marks)**

c. (i) Why does Ilmenite being processed to produce synthetic rutile in the market?
(ii) Evaluate the positives and negative of the sulphate process and chlorite process during the production of titanium pigments. **(...marks)**

d. (i) Compare and contrast the physical properties of natural and synthetic retiles.
(ii) Explain the major steps of the production of Synthetic retiles from the Ilmenite sands from Pulmodai. **(... marks)**

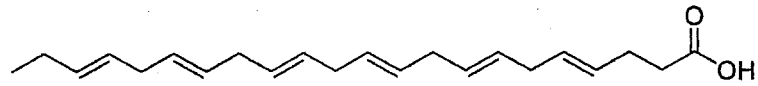
5.(a). (i) The most widely used distillation method for extracting essential oils from plant materials is steam distillation. Sketch the distillation equipment showing all the necessary parts. Briefly explain the use of each component.
(ii) Show using chemical equation how geraniol is converted to citronellol **(25 Marks)**

(b) (i) Structure of the essential fatty acid docosahexaenoic acid (DHA) is given below

a. Classify the acid DHA according to the number of double bonds.

b. Classify the acid DHA according to the position of the double bond from the methyl end.

c. Give the IUPAC-IUB name as well as the short hand notation of the acid.



(15 marks)

© (i) Define "acid value" of fats and oils.

(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.

10.000 g of palm oil are dispersed in 50.0 ml of ethanol and the final volume of the solution was 60.86 ml. The mixture required 50.0 ml of 0.1 M KOH for neutralization.

(iii) Calculate the acid value of this oil.

(20 marks)

(d) (i) Draw a flow chart to indicate the basic steps of Cold and semi boiled process used in soap making.

(ii) Give **three** advantages of cold process.

Biodiesel is one of the value added products of fatty acids.

(ii) What is meant by the term 'biodiesal'?

(iii) What do you mean by B100 and B20? **(40 marks)**

6.a. Cracking and reforming are major operations in the process of petroleum refining.

(i) What is meant by the term 'catalytic cracking'?

(ii) Show by chemical equations how would a branched olefin and olefin form from $RCH_2\ CH_2\ CH{=}CH_2$ during catalytic cracking.

(iii) What is the difference between catalytic cracking and Thermal cracking?

(30 marks)

b. (i) What do you understand by the term, octane number?

(ii) What methods can be used to increase the octane number of gasoline?

(iii) Petrol used in cars has an octane number of 90. Would the addition of the following substances increase/ decrease the octane number of petrol.

n-Octane Toluene Hexane

Methyl tertiary butyl ether **(30 marks)**

b. (i) How is adipic acid produced is produced from benzene

(ii) Give two industrial uses of adipic acid.

(20 marks)

c. State the products formed in each of the following reactions.

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

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

(20 marks)