THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. DEGREE IN SCIENCE / STAND ALONE COURSE
INDUSTRIAL CHEMISTRY –CHU3237 – LEVEL 5
FINAL EXAMINATION 2010/2011
DURATION 2 HOURS

Paper 1

Date: 21.06.2011   Time: 9.30 a.m. – 12.00 noon

Index No. ....
Attempt as many questions as possible.

Total mark allocated to this paper is 120. However, the maximum a candidate can score is 100 marks. Those who obtain more than 100 will be deemed to have scored 100 marks.

1.   What is the role of stabilizers in a glass mixture?   (03 marks)

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2.   Out of soda glass, coloured glass and borosilicate glass which is more suitable for the preparation of capillaries in a laboratory? Why?   (05 marks)

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3.   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?   (05 marks)

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4.   Why is porosity an important factor in a unglazed ceramic water container?   (03 marks)

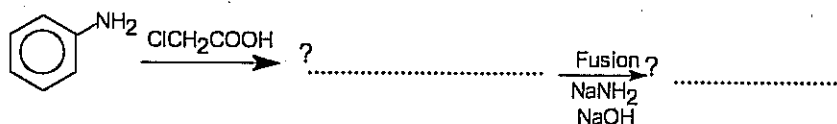   ....

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5. What are refractory clays? (03 marks)

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6. For what specific purpose is 'powder pressing' used in a ceramic industry?

(03 marks)

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

(03 marks)

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8. Distinguish between cracking and reforming. (04 marks)

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9. Write products in each of the following reactions:

(06 marks)

Propylene $\xrightarrow[\text{Solid Acid catalyst}]{\text{Hydration}}$ ....

$\xrightarrow{ClCH_2COOH}$? .... $\xrightarrow[\substack{NaNH_2 \\ NaOH}]{\text{Fusion ?}}$? ....

10. List four (04) value added products of Ginger. (04 marks)

(a) .... (b) ....

(c) .... (d) ....

11. What is the major component of nonvolatile fraction of nutmeg? (03 marks)

....

12. Why is it not suitable to pack spices in polythene packs? (03 marks)

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13. What is meant by iodine value? What does it measure? (04 marks)

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14. Calculate the iodine value of a fatty acid with the molecular formula $C_{19}H_{33}O_2$.

[Relative atomic mass C= 12; H=1; O=16; I =127] (04 marks)

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15. Write down the product(s) of the following reaction. (04 marks)

$$
\begin{array}{l}
\text{H}_2\text{C-O-}\overset{\overset{\displaystyle O}{\|}}{\text{C}}\text{-C}_{10}\text{H}_{21}\\
\quad|\quad\;\;\overset{\displaystyle O}{}\\
\text{HC-O-}\overset{\overset{\displaystyle O}{\|}}{\text{C}}\text{-C}_{17}\text{H}_{32}\\
\quad|\\
\text{H}_2\text{C-O-}\underset{\underset{\displaystyle O}{\|}}{\text{C}}\text{-C}_{15}\text{H}_{29}
\end{array}
\qquad \xrightarrow{\text{Na / C}_2\text{H}_5\text{OH}} \quad ....
$$
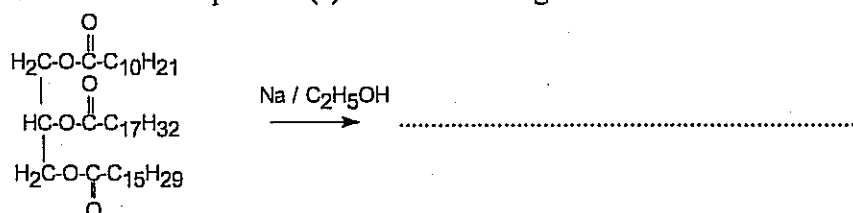
16. What would be the products that formed by interesterification of the following triglyceride? (04 marks)

$$
\begin{array}{l}
\text{H}_2\text{C-O-}\overset{\overset{\displaystyle O}{\|}}{\text{C}}\text{-R}_1\\
\quad|\quad\;\;\overset{\displaystyle O}{}\\
\text{HC-O-}\overset{\overset{\displaystyle O}{\|}}{\text{C}}\text{-R}_2\\
\quad|\\
\text{H}_2\text{C-O-}\underset{\underset{\displaystyle O}{\|}}{\text{C}}\text{-R}_3
\end{array}
\qquad \xrightarrow{\text{interesterification}} \quad ....
$$
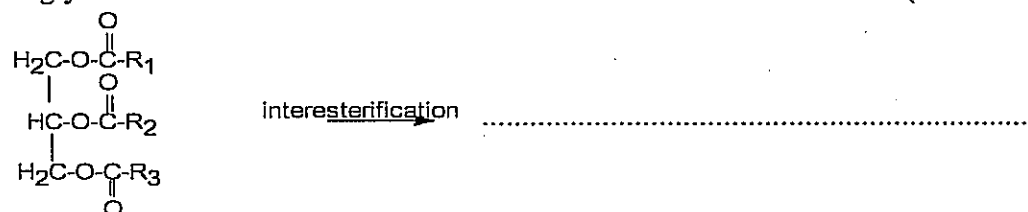
17. What physical property of the triglyceride would change due to interesterification? (02 marks)

....

18. Write **two** examples of products manufactured in the latex based industries:

(04 marks)

Dipped products: ....

Foam rubber: ....

19. Identifying the raw material used, write the process involved in the extraction of iron. (04 marks)

....

20 Write **two** major sources of sulphur. (02 marks)

....

21 Write chemical equations for the production of normal super phosphate (NSP) and triple super phosphate (TSP) from fluorapatite, [3 $Ca_3(PO_4)_2$. CaF_2].
(04 marks)

....

....

22. Briefly explaining the phenomenon, write an equation to illustrate corrosion.
(04 marks)

....

....

23. Name **four** types of corrosion. (04 marks)

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....

24 Stating what is meant by metal finishing, write **three** types of this process.
(06 marks)

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25 Write equations for the production of sodium sulphide and sodium sulphite from NaCl. Give **one** industrial use of each of these products. (09 marks)

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Sodium sulphide   ....

Sodium sulphite   ....

26. Write important characteristics that determine the quality of table salt.

(02 marks)

....

....

27. Write **four** factors upon which the rate of evaporation of water in a saltern depends.

(04 marks)

....

....

28. Write **two** factors that determine the actual method of manufacture of Portland cement.

(04 marks)

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....

29. Distinguish between 'setting' and 'hardening'.

(04 marks)

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

(04 marks)

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THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. DEGREE PTOGRAMME/ STAND ALONE COURSE – LEVEL 5
INDUSTRIAL CHEMISTRY – CHU3237/ CHE5237
FINAL EXAMINATION 2010/2011 - PAPER II
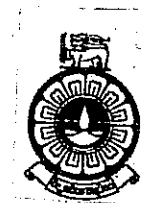
2 HOURS

Date:21.06.2011	Time: 1.30 p.m. – 4.00 p.m.

Answer any **FOUR (04)** questions. *Only four answers will be marked.*

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? (20 marks)

(ii) 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)

(iii) 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)

b.. 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)

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

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

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

2.a (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) 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)

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

i. $CH_3CH_2CH_2CH_2CH_3 \xrightarrow[\text{Heat}]{\text{Pt Catalyst}}$
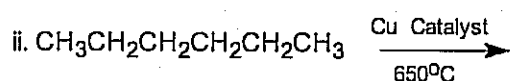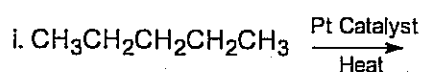
ii. $CH_3CH_2CH_2CH_2CH_2CH_3 \xrightarrow[650^{\circ}C]{\text{Cu Catalyst}}$ (20 marks)

d. (i) List down properties a compound should have for it to be a dye.

(ii) What do you mean by vat dying? Give two examples for vat dye. (30 marks)

3.a.(i) Explain what is meant by the terms;
- Spice oil
- Spice oleoresin.
(ii) List three Sri Lankan spices (with the part used) and one major ingredient present in the oil of each of them.
(iii) What are pungent principles? Give one example with its source. (35 marks)

b.(i) Sketch the equipment showing all the necessary parts used for the isolation of citronella oil. Briefly state the use of each component.
(ii) List four factors affecting the rate of oil recovery which depend on the Equipment. (35 marks)

c. Show how you would carry out the following conversions. (30 marks)

(i)

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(ii)
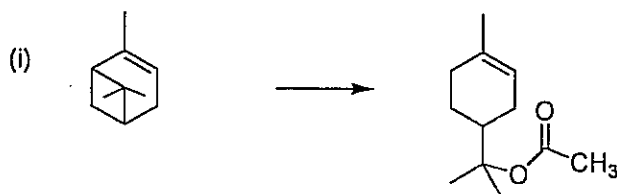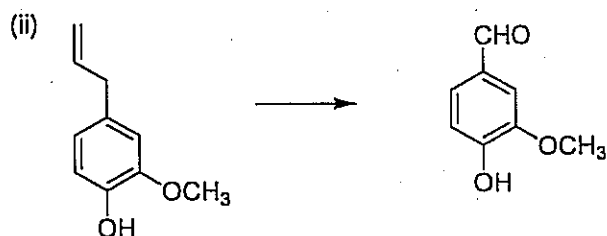
4.a.(i) Draw the full structure of the following fatty acid.

18:3 Δ9c, 12c, 15c

(ii) Give the ω notation of the above fatty acid.   (20 marks)

b. (i) Define the saponification value. Write its significance.

(ii) Estimate the saponification value of the following compound.
(C= 12; H=1; O=16; K = 39)

$$
\begin{aligned}
&\quad\quad\quad\quad O \\
&\quad\quad\quad\quad \| \\
&CH_2\text{-}O\text{-}C\text{-} C_{17}H_{31} \\
&CH\text{-}O\text{-}C\text{-} C_{10}H_{21} \\
&| \quad\quad\quad O \\
&CH_2\text{-}O\text{-}C\text{-} C_{18}H_{37} \\
&\quad\quad\quad\quad O
\end{aligned}
$$
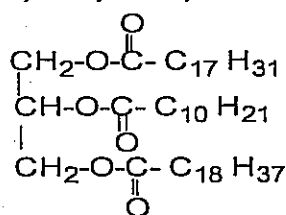
(iii) Write down the products that are formed during the splitting reaction of the above compound.

(iv) What would be the products when the above mentioned compound undergoes a transesterification with methanol.

(v) The composition of the products formed in (iii) can be determined by Gas Liquid Chromatograph (GLC). Write down the mobile and stationary phase in GLC.

(vi) What is the principle of separation? How many peaks do you expect to see in the GL chromatogram?   (80 marks)

5. Answer any **two** of Parts **A, B** and **C**. If more than **two** parts are answered, only the 1st two in the order of writing will be marked.

Part A

a. Write the important features of the Ellingham diagram for oxides. What are the advantages of it?   (30 marks)

b. Write essential chemical equations for the following reactions that can take place in a blast furnace.

    (i)   Reduction of iron oxide

    (ii)   Slag formation   (20 marks)

Part B

a.(i) What is measured by the 'throwing power' of a plating bath?

  (ii) What is the mass of lead that will be deposited from a Pb^{2+} solution by the passage of 0.2 A current for 2 h? (Pb= 207.2)   (20 marks)

b.(i) Write down the mathematical expression for the corrosion current in terms of the weights of metal before and after corrosion and time taken.

  (ii) 1.123 g of a strip of metal M (At. wt.= 102g) is dipped in an aqueous solution. M dissolved into the solution as M^{2+}. After 2 h, the dried strip of metal weighed 1.02 g. Calculate the corrosion current.
(F= 96485 C mol^{-1}).   (30 marks)

Part C

a.(i) Briefly describe the use of additives in solar salt work.

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

                                            (20 marks)

b. Draw a flow diagram to show magnesium is extracted from seawater in the Dow process.   (15 marks)

c. Compare the advantages and disadvantages of the methods using diaphragm cell and mercury cathode cell for the production of caustic soda.   (15 marks)

6.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)

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