



THE OPEN UNIVERSITY OF SRI LANKA
B.Sc DEGREE PROGRAMME/ STAND ALONE COURSES- LEVEL 5
CHU3237/CHE 5237 INDUSTRIAL CHEMISTRY- PAPER II
FINAL EXAMINATION- 2006/2007

(2 ½ HOURS)

Wednesday 18th April 2007

2.00 p.m. – 4.30 p.m.

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

1.(a)(i) What will be the differences in prominent features of X-ray diffraction patterns of NaCl and glass?

(ii) How would you explain the following set of data?

Type of glass	Softening Temperature/ ^o C
Soda glass	560
Borosilicate glass	625

(iii) In glass industry, Na₂O and CaO are often added to silica as 'modifiers' whereas CaCO₃ is used as a 'stabilizer'. What specific roles does each of these chemicals play in a glass mixture?

(iv) What is meant by 'annealing'? What will be the consequences, if the annealing step is skipped in a production line of glass article?

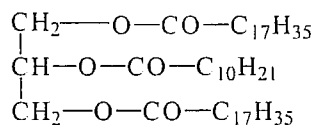
(v) Explain using suitable examples and relevant chemical equations, why spectacles made of photochromic lenses are preferred over other types.

(b)(i) Write the main chemical constituent present in kaoline group of minerals. How does plasticity of clay relate to the structure of the mineral?

(ii) How does cation exchange in clays differ from isomorphous substitution?

(iii) Referring to the structure and bonding of silicon carbide and silicon nitride, assess their suitability as new ceramic materials.

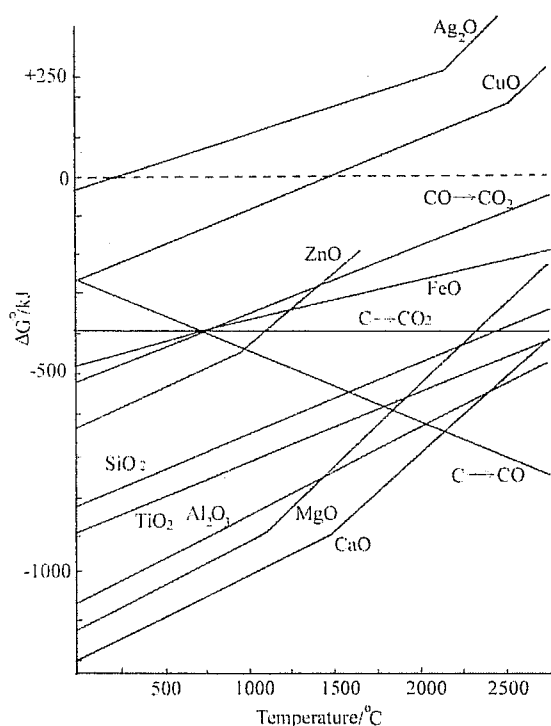
2.(a) A natural oil which consists of the following compound is subjected to hydrolysis. Acids were separated and reacted with methanol followed by purification of the products. A sample of the products was injected into a gas chromatograph.



- (i) Write down balanced chemical equations for the reactions taking place in the process described above.
- (ii) How many peaks do you expect to see in the gas chromatogram? Give reasons for your answer. (25 marks)
- (b) Write down the overall chemical equation for splitting of triglycerides. (20 marks)
- (c) Write down the overall chemical equation for the preparation of soap using triglycerides. (20 marks)
- (d) What is the ultimate method of verifying the identity of any oil? (15 marks)
- (e) How do you determine the normal range of refractive index of an oil experimentally? (20 marks)

3. Answer any **two** of Parts A, B and C.

Part A



- (a)(i) Explain why the graph for metal oxide slopes upwards.
- (ii) The free energy changes all follow a straight line. Why does this pattern change for some (e.g. Mg and Ca)?
- (b) Using the Ellingham diagram for oxides,
- (i) Predict whether carbon can be used to reduce ZnO, Al₂O₃ and MgO. Where it can be used, state the minimum temperature at which the reduction can take place.
- (ii) Write equations for the overall reactions at these temperatures. (50 marks)

Part B

- (a) Draw a flow chart to show how the following could be produced. Write balanced equations for the reactions. Give one use of each of these chemicals.

sodium bisulphite, sodium sulphate, chlorine gas and sodium sulphide (24 marks)

- (b) Write two important characteristics that determine the quality of table salt. Briefly describe the process of manufacture of table salt. (26 marks)

Part C

- (a)(i) What is meant by the term 'corrosion'?
- (ii) Write down the mathematical expression for the corrosion current in terms of the weight of metal before and after corrosion and time taken.
- (iii) A piece of metal, M of weight 1.123g is dipped in an aqueous solution. M dissolved into the solution as M^{2+} . After 2 hours, the weight of dried piece of metal was found to be 1.020g. Calculate the corrosion current. (Atomic mass of metal = 102). (25 marks)

- (b) What do you mean by the term 'passivation'? Briefly describe passivation using I vs. E plot for the metal. (25 marks)

- 4.(a)(i) Write the essential steps involved in the manufacture of Portland cement, starting from quarrying.
- (ii) If the moisture content of the raw materials is around 10%, what would be your choice of the process for the manufacture of Portland cement? Give reasons(s) for your choice.
- (iii) Draw a flow diagram for the process selected in (ii) for the manufacture of Portland cement.
- (iv) Compare the selected process with the others in terms of design, efficiency and economic benefits. (50 marks)

- (b) Briefly describe the changes taking place during hydration of crystalline phases in Portland cement. (25 marks)

- (c)(i) Distinguish between mortar and concrete.
- (ii) Describe, identifying the instrument used in each case, the standard tests available for cement paste. (25 marks)

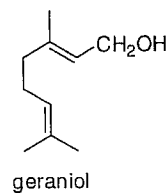
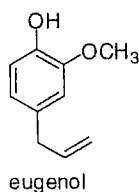
5. (a) Showing important components, sketch the set-up needed for industrial production of an essential oil. Indicate the use of each component. (20 marks)

- (b) Outline the primary processing of cinnamon bark. (10 marks)

- (c) Cinnamon leaf oil contains eugenol as the major constituent.
- (i) Describe how you propose to add value to cinnamon leaf oil.
- (ii) Show how eugenol is chemically converted to value-added products. Indicate their uses. (it is sufficient to consider two examples) (20 marks)

(d) What is meant by "spice oleoresin"? Sketch two methods that could be used to obtain oleoresin from a spice. Is there any advantage of one method over the other? If so, indicate the method and explain the advantage. (30 marks)

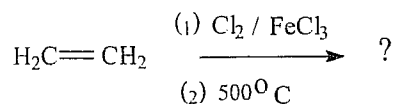
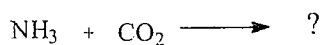
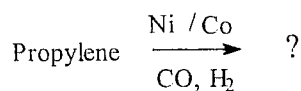
(e) Explain with appropriate chemical equations how geraniol content of citronella oil is determined using a chemical method. What are the disadvantages of this method? (20 marks)



6.(a)(i) What is meant by the term 'cracking of petroleum'?
 (ii) Differentiate between catalytic cracking and thermal cracking.
 (iii) List four advantages of catalytic cracking over thermal cracking.
 (iv) Briefly explain how catalytic cracking is carried out.
 (v) List four properties expected of a dye. (46 marks)

(b) Briefly describe the following:
 (i) mordant dye (ii) Complementary colour (iii) catalytic reforming (30 marks)

(c) What is the major product formed in each of the following reactions:



(24 marks)

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