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THE OPEN UNIVERSITY OF SRI LANKA  
B.Sc DEGREE PROGRAMME/ STAND ALONE COURSES- LEVEL 5  
CHU3237/CHE 5237 INDUSTRIAL CHEMISTRY- PAPER II  
FINAL EXAMINATION- 2007/2008

(2 ½ HOURS)

Monday 23<sup>rd</sup> June 2008

1.30 p.m. – 4.00 p.m.

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

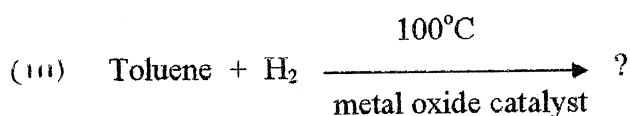
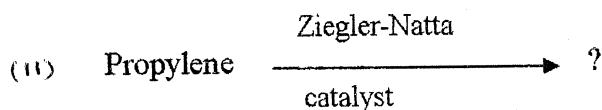
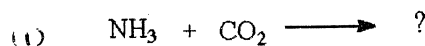
- 1(a)(i) Ceramics are generally brittle and stable to high temperatures. In contrast, plastics are generally deformable and have limited thermal stability. Discuss these differences in terms of the structures and bonding in the two classes of materials.  
(ii) Explain why refractory clays should be rich in alumina but low in oxides of calcium and iron. (30 marks)
- (b)(i) Give the reasons as to why transition metal oxides are widely used as glazers in ceramic industry.  
(ii) What is the difference between a transparent glaze and a matt glaze?  
(iii) Why is the firing temperature of the glaze considered as one of the most important factors in glazing? (30 marks)
- (c)(i) What is meant by the statement "Unlike in a crystal, long range order is not present in glass"?  
(ii) By using an appropriate sketch, show how rapid cooling of the glass body mix can avoid crystallization yielding the formation of glass. Mark all important points/areas in the sketch.  
(iii) Why is soda glass referred to as "soft glass" whereas borosilicate glass is referred to as "hard glass"? (40 marks)
2. (a)(i) What do you mean by 'catalytic reforming'? What are the factors that affect the rate and efficiency of catalytic reforming?  
(ii) Explain, in details, what you understand by the term, 'octane number'. (35 marks)
- (b) Ethylene,  $C_2H_2$ , can be converted to a large number of compounds.  
(i) Write three such compounds.  
(ii) Write conditions for each of these conversions. (15 marks)

(c) Briefly describe the following:

- (i) Fractional distillation of crude oil
- (ii) Catalytic cracking
- (iii) Vat dye
- (iv) Auxochrome

(28 marks)

(d) What is the major product formed in each of the following reactions? (22 marks)



3.(a) What are the pungent principles of ginger? Show common structural feature of them. (15 marks)

(b) Give an account on coloring matters in spices. (10 marks)

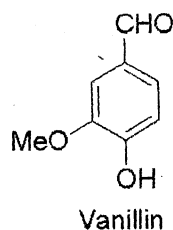
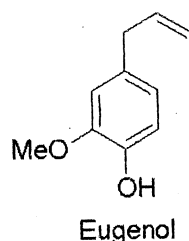
(c) Value addition is an important area in the spice and essential oil industry today.

- (i) What is meant by 'value addition'?
- (ii) Give an account of value-added products from citral and their uses.
- (iii) Describe value-added products of pepper. (25 marks)

(d) SLS 166:1972 gives the classification of cardamoms of Sri Lanka.

- (i) Why it is necessary to have such classification system?
- (ii) To how many categories cardamom is graded according these standards and what are they?
- (iii) List the factors on which this classification is based on? (15 marks)

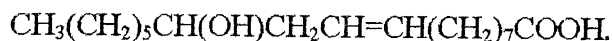
(e) How would you obtain vanillin from eugenol?



(20 marks)

(f) Explain with appropriate chemical equations how citral content of lemon grass oil is determined using a chemical method. (15 marks)

4. (a)(i) Explain the essential difference between a fat and an oil.  
 (ii) Define the terms, saponification value and iodine number. Write the significance of these terms.  
 (iii) Castor oil is a mixture of triglycerides, having about 90% of its fatty acid content as the unsaturated hydroxy aliphatic acid, ricinoleic acid,



Estimate the saponification value and iodine number of castor oil.

(C= 12, H= 1, O= 16, K= 39, I= 127)

(50 marks)

- (b) Draw a flow- diagram to show how an oil is refined and explain the important steps. (20 marks)  
 (c) Some of the reactions shown by the ester group are splitting, reduction and interesterification.  
 (i) Write equation(s) for each of these reactions, giving condition(s).  
 (ii) Give important use(s) of these reactions. (30 marks)

5. Answer any two of Parts A, B and C.

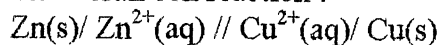
#### Part A

- (a) The principal source of phosphorus compounds is phosphate rock- a complex material containing the mineral fluorapatite,  $[3 \text{Ca}_3(\text{PO}_4)_2 \cdot \text{CaF}_2]$ .  
 (i) Using chemical equations show how phosphoric acid, normal super phosphate and triple super phosphate can be produced from fluorapatite.  
 (ii) What serious environmental problem(s) are encountered in the use of phosphate rock? (30 marks)  
 (b) Write essential chemical equations for the following reactions that take place in a blast furnace  
 (i) reduction of iron oxide  
 (ii) slag formation (20 marks)

#### Part B

- (a)(i) What do you mean by the term, 'corrosion'?  
 (ii) Write equations to illustrate 'corrosion'. (15 marks)

- (b) Write down the half- cell reactions for the following Galvanic cell and hence obtain the overall cell reaction :



$$E_{\text{Cu}^{2+}(\text{aq})/\text{Cu(s)}}^{\circ} = 0.34 \text{ V}; \quad E_{\text{Zn}^{2+}(\text{aq})/\text{Zn(s)}}^{\circ} = -0.76 \text{ V}$$

Calculate the standard Gibbs free energy change ( $\Delta G^{\circ}$ ) for the above cell reaction.

(F= 96485 C mol<sup>-1</sup>).

(20 marks)

- (c)(i) What do you mean by 'metal finishing'?
- (ii) How many grams of lead will be deposited from a solution of  $\text{Pb}^{2+}$  ions by a current of 0.15 A, flowing for 1 hour?  
( $\text{Pb} = 207.2$ ;  $1 \text{ F} = 96500 \text{ C}$ ) (15 marks)

### Part C

- (a) Common salt is the starting point of the inorganic heavy chemical industry.
- (i) Draw a flow chart to show how the following could be produced from common salt.  
Sodium sulphate, sodium sulphide and sodium sulphite.
- (ii) For each of the above chemicals,  
( $\alpha$ ) Write equations to show how they are produced. ( $\beta$ ) Give one industrial use. (30 marks)
- (b)(i) Write, using equations, the essential steps involved in the production of soda ash by the Solvay process.
- (ii) In this process, ammonia is recovered for recycling. Write chemical equations to show ammonia recovery. (20 marks)
- 6.(a)(i) Define the term, Portland cement as in the British Standard.
- (ii) What was the unique feature of mortar and concrete made from Portland cement? (15 marks)
- (b)(i) Write two factors that determine the actual method of manufacture of Portland cement.
- (ii) Draw the flow chart for the wet process of manufacture of Portland cement, starting from chalk and clay..
- (iii) Compare wet process vs. dry process of manufacture of Portland cement.
- (iv) List the reactions taking place during burning of cement in the kiln. Give the Temperature/ temperature range for each of these reactions. (60 marks)
- (c)(i) Write down the product(s) formed when each of the clinker phases undergoes hydration, in the absence of gypsum.
- (ii) Comment on the rates of hydration of these phases. (25 marks)