

INDUSTRIAL CHEMISTRY

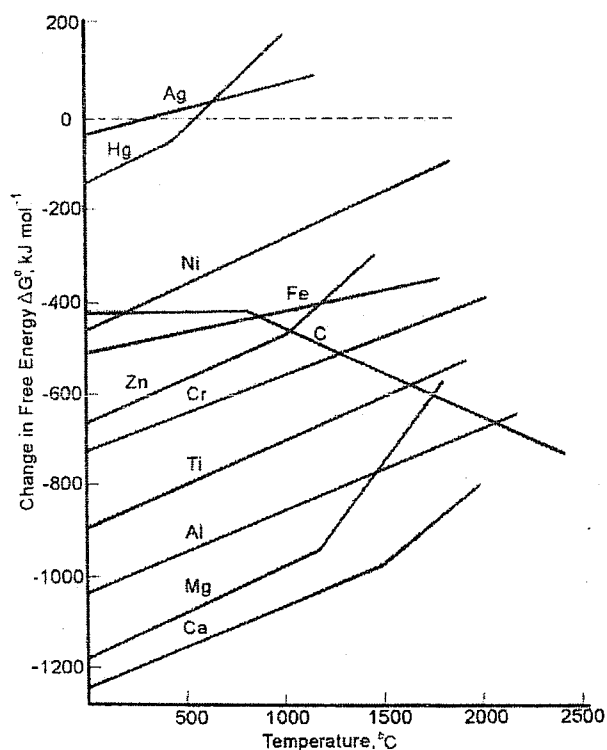
ASSIGNMENT I TEST

Date: 21<sup>st</sup> September 2006

Time: 3.30- 5.00 p.m.

Answer all the questions.

1.



- (a)(i) Explain why the graph for metal to metal oxide slopes upwards.  
 (ii) The free energy changes all follow a straight line. Why does this pattern change for some (e.g. Hg, Mg and Ca)? (25 marks)
- (b) Using the Ellingham diagram for oxides,  
 (i) Predict whether carbon can be used to reduce ZnO, Al<sub>2</sub>O<sub>3</sub> and MgO. Where it can be used, state the minimum temperature at which the reduction can take place.  
 (ii) Find if aluminum will reduce chromium oxide.  
 (iii) Indicate at what temperature mercuric oxide will decompose into its elements. (55 marks)

(c) A mixture of  $H_2$  and  $N_2$  in a reaction vessel is allowed to attain equilibrium at  $472^\circ C$ . The equilibrium mixture of gases was analysed and found to contain  $0.1207 \text{ mol dm}^{-3} H_2$ ,  $0.0402 \text{ mol dm}^{-3} N_2$  and  $0.0027 \text{ mol dm}^{-3} NH_3$ . Calculate the equilibrium constant  $K_C$  for  $N_2(g) + 3 H_2(g) \rightarrow 2 NH_3(g)$ .

If a mixture of  $2.0 \text{ mol}$  of  $H_2$ ,  $2.0 \text{ mol}$  of  $N_2$  and  $1.0 \text{ mol}$  of  $NH_3$  is placed in a  $1.0 \text{ dm}^3$  container at  $472^\circ C$ , will  $N_2$  and  $H_2$  react to form more  $NH_3$ ?

(20 marks)

2.

(a) The mineral sands are generally found in areas on or closer to the beaches in sand dunes. Sri Lanka has one of the richest mineral sand deposits in the world.

(i) What do you mean by the term 'mineral sands'?

(ii) Name three main mineral sands found in Sri Lanka.

(17 marks)

(b) The Natural Rubber industry is divided into latex based and dry rubber based industries. Give two examples of products manufactured in each of these industries. Name three additives used in both these industries.

(21 marks)

(c) Write the raw material used and name the process involved in the extraction of iron and aluminum.

(12 marks)

(d) In nature there are many clay minerals with kaolin structure as the base. Kaolinite belongs to this kaolin group of minerals.

(i) Draw the structure of kaolinite.

(ii) Describe the ion (base) exchange capacity of kaolinite.

(25 marks)

(e) Write the raw materials used in traditional ceramic industry. Indicate the role(s) of each of these in a ceramic body.

(25 marks)

3.

(a) Casting is one of the methods used in shaping ceramic ware.

(i) Briefly describe, the basic principle involved in the process, *slip casting*.

(ii) Describe, with diagrams, the essential steps in the process, *drain casting*.

(iii) Compare solid casting vs. drain casting.

(iv) Identify two products manufactured by each of the processes, dry pressing and drain casting.

(45 marks)

(b) In non-oxide ceramics, N and C takes the place of O in combination with Si or B. Boron nitride BN and silicon nitride  $Si_3N_4$  are some examples of non-oxide ceramics.

(i) Draw and explain the structures of BN and  $Si_3N_4$ .

(ii) Give one application of each of these ceramics.

(40 marks)

(c) Discuss the synthesis, structure and properties of the mixed oxide ceramic,  $BaTiO_3$ .

(15 marks)

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