

B.E.(MET) Part II 4th Semester Examination, 2010

Subject: Principles of Extractive Metallurgy (MT 402)

Full marks : 70

Time

Answer Q. 1 (Compulsory) and any Five from the rest

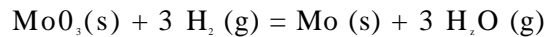
1. (Compulsory) Attempt any Five:

- i) How does increase of pressure affect the reduction of solid ZnO by CO to produce zinc vapour and CO₂ ?
- ii) Distinguish between AG and AG°
- iii) Give the reason for a change of slope of the line for ZnO formation in Ellingham diagram
- iv) Why does crushing of a mineral need more energy than grinding, per unit weight basis ?
- v) Give one example each of acidic and alkaline leaching agents used commercially.
- vi) What is the area of practical application of the Nemst equation ?
- vii) Explain the term Overvoltage.

2. Distinguish between (any three):

- a) Acidic oxides and Basic oxides
- b) Raoult's law and Henry's law - activity expressions and applications
- c) Conventional leaching and Pressure leaching
- d) Slag and Matte

3. a) Calculate the equilibrium constant and equilibrium ratio of H₂O / H₂ gases for the following reaction at 1000 K:



Data : AG° (MoO₃) = - 120,000 cal / mol and AG° (H₂O) = -45,500 cal/ mol.

What will happen in a situation where the actual H₂O / H₂ ratio is greater than the equilibrium value calculated above?

- b) Write typical equations for the vertical line and the slanted lines of Kellogg diagram. Why is there no horizontal line ?
 - c) With the help of a suitable diagram, describe briefly the condition of bed fluidization. What are the applications of fluidized beds in metallurgy ?
4. a) An copper electro-refining cell operates at a current efficiency of 88 %. How much copper deposits on cathode per day at a current of 1200 amps. ?
- b) What is the benefit and application of SX and IX processes? Give a neat labeled flow sheet of SX process.
 - c) Write the mechanism of microbial leaching, mentioning the factors that help this process.

5. a) Why is agglomeration required before reduction smelting for extraction of iron and lead ? Explain why sinters or pellets are preferred as blast furnace charge, rather than good quality lump ore.
- b) List the possible techniques of refining and explain the refining of molten steel bath to remove carbon and silicon.
6. a) Give an example of refining by formation of a vapour phase and discuss the principle ..
- b) A 12 cm thick refractory wall is exposed to a heat flux of 2250 W/m^2 . i) Calculate the temperature drop across the wall at steady state condition if the conductivity of the refractory is 0.3 W/mK . ii) If the colder side of the wall is now exposed to convection to air at $30 \text{ }^\circ\text{C}$, determine the temperatures of the hot and the cold walls. Given the convection coefficient for air (h) $75 \text{ W/m}^2\text{K}$.
- c) What is radiative heat transfer? Mentioning its importance in extractive metallurgy.
7. a) Give a brief account of the characteristic features of reduction smelting, taking any suitable example. Mention in particular i) how does a slag forms and ii) how can a slag take part in refining.
- b) Why electro-refining of a metal is required in certain cases after its pyrometallurgical extraction ? With suitable anodic and cathodic reactions, compare and contrast electrowinning and electro-refining of copper. Does the pH of the electrolyte remain unchanged during electrowinning ?
8. Write briefly on **any** three:
- a) Assumptions in construction of Ellingham diagram
- b) Mond process
- c) Flow chart for extraction zinc by hydrometallurgical route
- d) Advantages of Flash smelting
- e) Principle of Froth flotation