



GWANDA STATE UNIVERSITY

EMR: 3201

FACULTY OF ENGINEERING AND THE ENVIRONMENT

DEPARTMENTS OF METALLURGY ENGINEERING

INTRODUCTION TO HYDROMETALLURGY

EPOCH MINE CAMPUS

MR O.D. CHIKATI

AUGUST 2021: EXAMINATION

Time : 3 hours

Candidates should attempt **Question 1** and **ANY OTHER THREE** questions from this paper with question (25 marks each).

Instructions

- (a) Each question carries 25 marks.
- (b) Use of calculators is permissible.
- (c) Total attainable marks are 100.

Question 1

- (a) State and explain the five stages involved in the dissolution of metals. [5]
- (b) Define and identify the differences in the following terms briefly and concisely
- (i) Hydrolysis and Hydration
 - (ii) Filtrate and Raffinate
 - (iii) Cementation and Precipitation. [9]
- (c) A 4cm^3 waste acidic water containing $0.05\text{MH}_2\text{SO}_4$ needs to be neutralized with 0.2MNaOH to produce an alkaline solution of pH 10. How much base (0.2MNaOH) solution must be added? [6]
- (d) Briefly explain how biological insitu leaching is carried out in the extraction of minerals. [5]

Question 2

- (a) An ore containing 1.5 wt% Ni (as NiO) is fed to a pressure leach autoclave at 5000 TPD (tonnes/day) with sulphuric acid solution fed at 6000 TPD. Nickel extraction is 90 % into the leach solution which is being produced at 6500 TPD. Calculate
- (i) % solids in the leach feed [5]
 - (ii) The weight % Ni in the leach residue. (Assume solids weight decreasing by 10 % during the leach) [5]
- (b) Outline the extraction of nickel from Laterites. [15]

Question 3

- (a) What is an ion exchange resin and how does it work? [15]
- (b) Comment on the selectivity of alkalis ion during ion exchange. [10]

Question 4

- (a) A complex sulphide ore constituting ZnS , $CuFeS_2$, FeS_2 , can only be separated by flotation. The concentrates from the flotation process are to be leached using biological means. Describe in detail the 'indirect' biological leaching using any of the metal sulphides concentrates as an example. [10]
- (b) Give a detailed account of the Merrill-Crowe precipitation and carbon adsorption as methods of recovering gold from pregnant solution explaining each step carefully. [15]

Question 5

- (a) Electrorefining of copper using acidic copper sulfate solution is carried out at a current of 15000 A and 0.4 V. If the mass of cathode deposit produced on a total cathode area of $10m^2$ is $408.5kg/day$ calculate:
- (i) Current efficiency [5]
 - (ii) Current density [2]
 - (iii) Thickness of deposit [3]

(Density of copper = $8.930kg/m^3$, atomic mass of copper = 64)

- (b) Differentiate between electrowinning and electro refining. [5]
- (c) Outline and explain the electrorefining of copper. [10]

End of Exam