GWANDA STATE UNIVERSITY

FACULTY OF ENGINEERING AND ENVIRONMENT

DEPARTMENT OF METALLURGICAL ENGINEERING

INTRODUCTION TO MINERAL PROCESSING

EMG 3103

November 2023 Examinations

This examination consists of 5 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: Graph paper and a scientific calculator

Examiner's Name: Ms K.L Mahamba

INSTRUCTIONS

1. Answer Question A1 in section A and any other 3 questions in Section B

2. Question A carries 40 marks and each question carries 20 marks in Section B

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SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION A1

a) What are the negative impacts of Mineral Processing activities on the environment and the country's economy? **[4]**

b) Explain the effects on the grinding performance of a ball mill of operating the grinding

mill at a speed above or below the critical speed**.** **[5]**

c) Explain the following terms

i. Magnetic separation. **[2]**

ii. Dense Medium Separation. **[2]**

iii. Gravity Separation. **[2]**

d) The P80 of a new copper ore sample after grinding is 0.106 mm from a F80 of 1.26 mm. Another copper ore sample of known Work Index of 17.6 KWh/t is ground under the same conditions. Its F80 was measured as 960 microns and a P80 of 87 microns was achieved after grinding. Calculate the Work Index of the new ore sample in KWh/t. **[5]**

SECTION B: ANSWER ANY THREE QUESTIONS

QUESTION TWO

a) Discuss the steps that you would take to design a gold processing plant for installation at a new mine 10km south east of Filabusi town, starting from exploration until the plant is ready for construction. **[10]**

b) Draw the process flowsheet that you may develop and explain how you would select key process equipment. **[10]**

QUESTION THREE

a) Express the Rittinger, Kick and Bond's theories of comminution in mathematical form, and discuss their applicability, highlighting their strengths and weaknesses. **[10]**

b) A gold ore is screened through a 35mm screen. The average size distribution of feed, oversize and undersize were determined. The fraction below the cut point in the feed, oversize and undersize were 0.46, 0.075 and 0.9 respectively. Determine the efficiency of the screen. **[5]**

c. Determine the size ratio of talc (SG 2.75) and rutile (SG 4.25) particles that have the same terminal velocity in water, given that the viscosity of water is 0.001 Pa s. **[5]**

QUESTION FOUR

a) Describe the industrial applications of a hydro cyclone. **[5]**

b) Briefly explain the processing of coal from ROM**. [5]**

c) An alluvial ore sample was subjected to float and sink analysis to separate the Titanium rich mineral from quartz. The separated fractions were then assayed for Titanium, and the results are shown below (Table 1).

Table 1: Float and Sink Results of Titanium Ore

Specific gravity Of test (1)	Fractional Weight (%wt) (2)	Assay (%Ti) (3)
<2.55	2.00	0.003
'+2.55 <2.60	8.29	0.04
'+2.60 <2.65	26.11	0.04
'+2.65 <2.70	20.17	0.04
'+2.70 <2.75	11.91	0.17
'+2.75 <2.80	10.92	0.34
'+2.80 <2.85	7.87	0.87
'+2.85 <2.90	4.55	1.30
'+2.90	8.18	9.10

(i) Determine the 50% cut point density for the Titanium rich ore. **[5]**

(ii) How much of the material would report to sinks at the S.G of 2.75? **[5]**

QUESTION FIVE

a) Explain the principle of gravity concentration. **[5]**

b) A plant is being fed with metallic ore assaying 4.0 g/t Pt equivalent minerals, producing a concentrate product assaying 150 g/t Pt equivalent minerals and tailings assaying 0.5g/t Pt equivalent minerals. What is the recovery of Pt equivalent minerals? **[5]**

c) Given the following mixture of minerals, whose properties are given below: -

MINERAL	S.G	MAGNETIC RESPONSE	ELECTROSTATIC RESPONSE
Quartz	2.65	None	None
Tantalite	5.2-8.2	Paramagnetic	Conductive
Zircon	4.7	None	None
Rutile	4.25	None	Conductive

Develop the process flow sheet and explain the equipment that you would select and use to separate all four minerals. **[5]**

d) What are the effects of the following on the milling circuit:

  i.   Tonnage increase

  ii.   Increase in mill feed water

  iii.   Ore hardness. **[5]**

END OF QUESTION PAPER.