



UNIVERSITY OF
KWAZULU-NATAL
INYUVESI
YAKWAZULU-NATALI

SCHOOL OF ENGINEERING

MAIN EXAMINATIONS: MAY/ JUNE 2025

COURSE AND CODE: MINERALS PROCESSING ENCH4MP

DURATION: 2 HOURS

TOTAL MARKS: 100

INTERNAL EXAMINER/S: Dr J Pocock

INTERNAL MODERATOR: Dr S Fashu

EXTERNAL MODERATOR: Mrs M Schalkwyk

INSTRUCTIONS:

1. **ALL** questions should be attempted. Answer in **INK**.
2. Any programmable or non-programmable calculator may be used provided it has been cleared of any information that would subvert the purpose of the examination.
3. Calculations must be shown in sufficient detail to illustrate your understanding of the procedure.
4. This examination question paper, together with all associated diagrams, **MUST BE HANDED IN TOGETHER WITH YOUR SCRIPT.**

Student Number:

SECTION A (SELF-STUDY)

QUESTION ONE

Using at least two examples from the case studies presented, by comparing the process flowsheets from the case studies, explain how the liberation size as well as the physical and surface chemical properties of the values and gangue materials determine the way in which an ore body is processed in the most economic way.

TOTAL/24/

QUESTION TWO

Explain how one of the sedimentary rock deposits described in the case studies was formed and using a block diagram, explain how it is processed in South Africa. What are the particular properties of the values and the gangue materials which are exploited to achieve a separation?

TOTAL/13/

QUESTION THREE

Explain how one of the igneous rock deposits described in the case studies was formed and using a block diagram, explain how it is processed in South Africa. What are the particular properties of the values and the gangue materials which are exploited to achieve a separation?

TOTAL/13/

SECTION B (LECTURED MATERIAL)

QUESTION 4

Dense Medium Separation is used extensively in the processing of diamond ores to separate the more dense diamonds from the less dense kimberlite gangue material.

- When using dense medium separation, what are the important properties of the solids used in the preparation of the dense medium, and why are they important? (5 marks)
- Why is it not feasible to use a dense liquid rather than a suspension in dense medium separation? (3 marks)
- A diamond processor is separating diamond rich concentrate from kimberlite gangue. Dense Medium Cyclones are being used with an Ecart Probable Moyen (E_p) of 0.05 at a separation density of 2800 kg/m^3 . A density analysis of the feed to the cyclones is given in table 1, below:

Density Range (S.G. Units)	Mass Percentage in Feed (%)	Diamond Content in fraction (%)
Less than 2.6	40	1
2.6 to 2.8	25	5
2.8 to 3.0	15	12
3.0 to 3.2	10	45
More than 3.2	10	85

Diamonds are recovered to the underflow, determine the mass yield, diamond content of the underflow, and diamond recovery from the cyclones. (12 marks)

Tromp function equations are provided on page 5.

TOTAL/20/

QUESTION FIVE

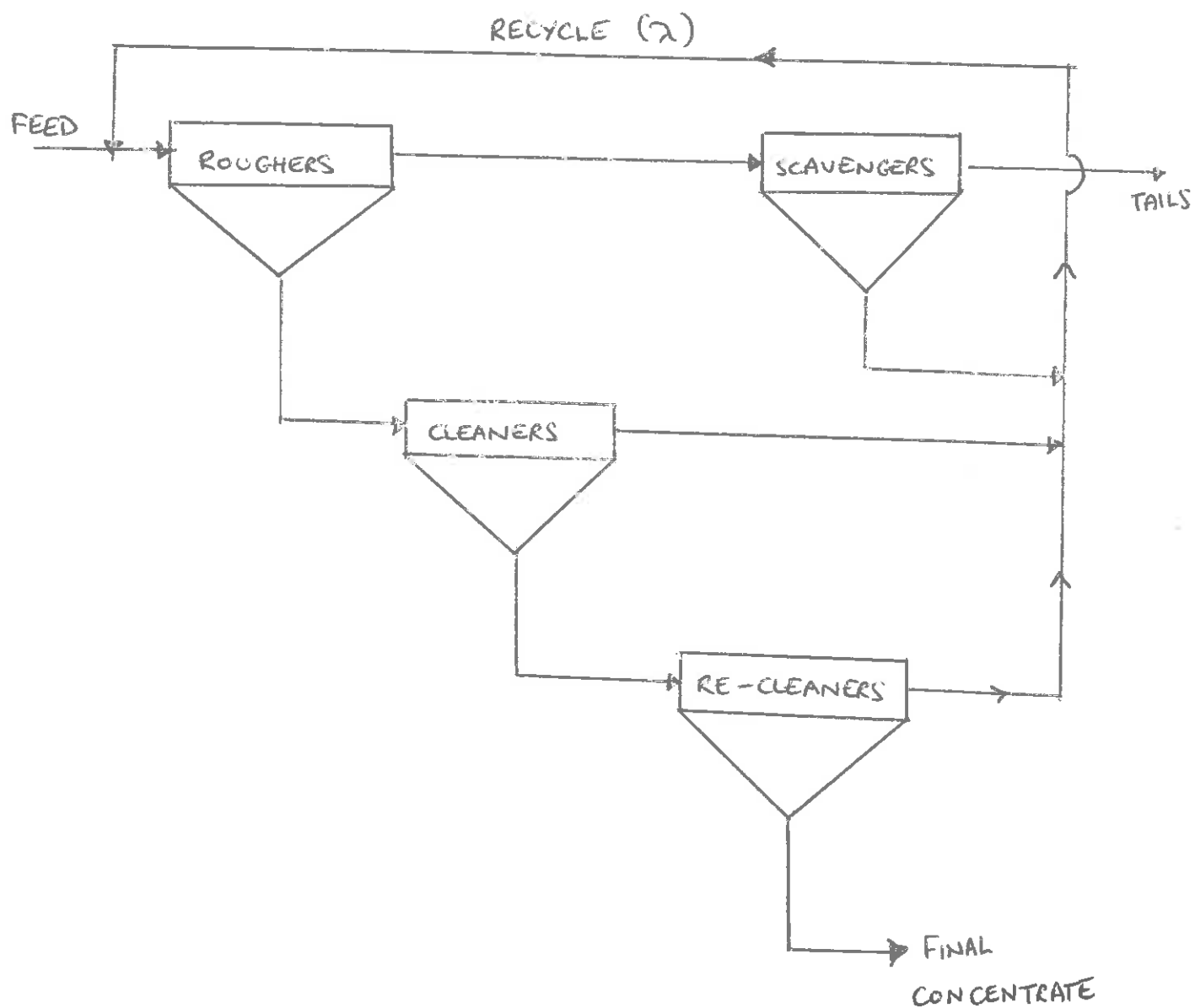
- a. What is meant by the terms ferromagnetic, paramagnetic and diamagnetic materials in magnetic separation? (3 marks)
- b. Using a diagram, explain how a low intensity wet magnetic separator is used to achieve a separation of magnetic and non-magnetic materials. (7 marks)

TOTAL/10/

QUESTION SIX

- a. In froth flotation, what causes some particles to be 'fast floating', whilst others are 'slow floating'? (4 marks)
- b. What is the role of collectors in froth flotation? (2 marks)
- c. A flotation circuit for the recovery of a zinc sulphide concentrate is shown in the diagram on page 4. For a given set of flotation rate constants, determine the overall recovery to the concentrate ($R(k)$) in terms of the stage recoveries (r_r, r_c etc.) (14 marks)

TOTAL/20/



Tromp Functions:

For recovery to the underflow:

Where $x < x'$

$$T(x) = 50 \exp\left(\frac{(x - x')}{z}\right)$$

Where $x > x'$

$$T(x) = 100 - 50 \exp\left(\frac{(x' - x)}{z}\right)$$

x = specific gravity of the density fraction

x' = specific gravity of the separating medium

$$z = \frac{-E_p}{\ln 0.5}$$

E_p = Ecart Probable Moyen