



UNIVERSITY  
OF  
JOHANNESBURG

**PROGRAM** : NATIONAL DIPLOMA  
*EXTRACTION METALLURGY*  
**SUBJECT** : MINERAL PROCESSING III  
**CODE** : MPR 32 – 1  
**DATE** : WINTER EXAMINATIONS 2014  
31 MAY 2014  
**DURATION** : (SESSION 2). 12:30– 15:30  
**WEIGHT** : 40: 60  
**TOTAL MARKS** : 100

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**EXAMINER** : DR W. NHETA  
**MODERATOR** : MR M. HENDERSON  
**NUMBER OF PAGES** : 4 PAGES

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**INSTRUCTIONS** : ANSWER ALL QUESTIONS.  
DRAW NEAT DIAGRAMS AND WRITE CLEARLY.  
MARKS CAN BE DEDUCTED FOR UNTIDY WORK.  
FOR THE CALCULATION QUESTIONS, PUT ALL YOUR FINAL  
ANSWERS AT THE END OF EACH QUESTION.  
ENSURE THEY ARE CORRECTLY NUMBERED.  
USE 4 DIGITS IN ALL CALCULATIONS UNLESS STATED  
OTHERWISE.  
PUT ALL YOUR WORKING IN THE SCRIPT.  
NO VISIBLE WORKING IN THE SCRIPT MEANS NO MARKS  
WILL BE AWARDED.

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Question 1

An ore contains galena ( $\text{PbS}$ ), dolomite ( $\text{CaMg}(\text{CO}_3)_2$ ) and silver ( $\text{Ag}$ ).

In the feed to the flotation plant, 70% of the silver is associated with the galena and 20% of the silver is free.

The feed rate is 150t/hr solids and the feed analyses 9.18%Pb and 20g/t Ag.

The concentrate mass is 41.77t/hr. The tailings grades are 0.761%Pb and 3.928g/tAg.

Calculate

- 1.1. the % free silver recovery from the feed to the concentrate (5)
- 1.2. the grade of the Ag in the galena in g/t. (6)
- 1.3. the % total silver recovery from the feed to the concentrate (5)
- 1.4. the grade of total silver in the concentrate in g/t (4)

**[20]**

Pb – 207.2    S – 32.1

Question 2

In a Beach Sands treatment circuit, after the majority of the gangue has been removed by gravity concentration, the minerals magnetite ( $\text{Fe}_3\text{O}_4$ ), ilmenite ( $\text{FeTiO}_3$ ) and rutile ( $\text{TiO}_2$ ) are recovered separately in the Separation Circuit. They are recovered in the order magnetite, ilmenite and rutile, the tailings from one stage being the feed to the next one.

The following data is available from the circuit.

- i. the original feed to the separation circuit contains 30t/hr magnetite, 37.5t/hr rutile and 30t/hr quartz ( $\text{SiO}_2$ )
- ii. the combined dry solids in the original feed have an SG of 4.410t/m<sup>3</sup>
- iii. the magnetite concentrate has a mass of 31t/hr
- iv. the recoveries to the magnetite concentrate from the original feed are 90% for the magnetite, 3% for the quartz and zero for the rutile.
- v. The ilmenite concentrate contains 44.71% of the feed mass to the ilmenite recovery stage and all of the magnetite that is in that feed.
- vi. The tailings fraction from the ilmenite recovery stage contains 4.40t/hr ilmenite and 90% of the rutile that was in the feed to the ilmenite recovery stage.
- vii. The rutile concentrate from the third stage has a mass of 30.40t/hr and it has a grade of 0.150%Fe. It also contains 0.55t/hr quartz.

Calculate:

- 2.1. The %Ti in the Separation Circuit Feed (5)
- 2.2. The %Ti in the ilmenite concentrate (5)

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- 2.3 The % Ti in the rutile concentrates (7)
- 2.4 The %Ti recovery to the ilmenite concentrates from the Separation Circuit feed. (5)
- 2.5 The %Ti recovery to the rutile concentrates from the Separation Circuit feed. (6)
- 2.6 The mass in t/hr of the original Separation Circuit feed (2)

**[30]**

Magnetite SG – 5.1	Fe – 56
Ilmenite SG – 5.1	Ti – 48
Rutile SG - 4.3	O - 16

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Question 3

- 3.1 Explain how a shaking table works to separate particles of different sizes and densities. Include in the explanation the names of the four mechanisms that are used. (18)

**[18]**Question 4

In the differential flotation of lead and zinc minerals,

- 4.1. Which mineral is floated first? (1)
- 4.2. Why? (1)
- 4.3. Why is SEX used as the collector for the first stage? (3)
- 4.4. If zinc losses to the lead concentrate remain high despite changes in the flotation conditions, what would you do next. ? (2)
- 4.5. If this shows that the lead and zinc minerals are not free from one another in the lead rougher concentrate, what circuit change would you make ? (4)
- 4.6. Why is copper sulphate added to the lead flotation tailings ahead of the collector before zinc flotation (5)
- 4.7. Why is PAX used as the collector for zinc flotation (2)

**[19]**Question 5

- 5.1 What are the three methods that are used to increase the height of the dam wall (3)
- 5.2 What the advantages and disadvantages of each one? (10)

**[13]**