



**PROGRAM** : NATIONAL DIPLOMA  
*EXTRACTION METALLURGY*  
**SUBJECT** : MINERAL PROCESSING III  
**CODE** : MPR 32 – 1  
**DATE** : WINTER SSA EXAMINATION  
SEMESTER I  
28 JULY 2016  
**DURATION** : SESSION 1 (8:00 – 11:00)  
**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

A two stage DMS plant is separating chromite ( $\text{FeCr}_2\text{O}_4$ ) from magnetite ( $\text{Fe}_3\text{O}_4$ ) and quartz ( $\text{SiO}_2$ ). A separate low intensity magnetic separation (LIMS) stage would be used to recover magnetite from streams containing magnetite that would otherwise be discarded.

The first stage is screening, with the screen undersize being sent to an LIMS circuit. The screen oversize goes to the first stage DMS plant where the floats are discarded to the final tailings. The first stage DMS sinks are re-crushed and then deslimed.

The fines from the desliming would be sent to the LIMS circuit while the coarse from the desliming stage are sent to the second stage DMS circuit. The floats from this stage would go to the LIMS circuit while the sinks are the final product.

The LIMS circuit would recover a magnetic concentrate rich in magnetite but this stage has not been included in this question.

The following information is available –

1. Screen feed

Mass is 200t/hr

Contains 13.92t/hr Cr

Grade is 65% quartz

2. Screen undersize

Mass is 12t/hr

Contains 5% of chromite in screen feed

Contains 10% of magnetite in screen feed

3. 1<sup>st</sup> stage DMS

Bath density is 2.7t/m<sup>3</sup>

Floats contain 80% of quartz in 1<sup>st</sup> DMS feed

4. Desliming coarse fraction (2<sup>nd</sup> stage DMS feed)

contains 90% of the chromite in the feed to desliming.

has an SG of 4.190t/m<sup>3</sup>

has a mass of 76.65t/hr

5. 2<sup>nd</sup> stage DMS floats

mass is 51t/hr

has an SG of 4.079t/m<sup>3</sup>

contains 25.89t/hr magnetite

Calculate: -

- |  |     |
|--|-----|
| 1.1 %Fe in the screen feed   | (6) |
| 1.2. %Cr in 1 <sup>st</sup> stage DMS sinks                                    | (4) |
| 1.3. %Fe in 2nd stage DMS feed   | (6) |
| 1.4. SG of the deslimed fines fraction   | (5) |
| 1.5. % chromite in 2 <sup>nd</sup> stage DMS sinks.                            | (4) |
| 1.6. %Cr recovery to 2 <sup>nd</sup> stage DMS sinks from original screen feed | (5) |

**[30]**

Fe - 55.9 Cr – 52 O – 16

SG – chromite 4.5 SG – magnetite 5.1 SG quartz – 2.65

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Question 2

An ore containing Magnetite, Chromite and Quartz is fed to a magnetic separation circuit. The feed rate is 50t/hr. Initially there is a low intensity machine, followed by a high intensity machine that treats the non-magnetics from the first stage. The solids density is 3.190. There is twice as much Magnetite ( $\text{Fe}_3\text{O}_4$ ) as Chromite ( $\text{FeCr}_2\text{O}_4$ ) while some of the Quartz ( $\text{SiO}_2$ ) is free and some locked. The Quartz locked in the Chromite is in the ratio of 10: 1 Chromite: Quartz while in the Magnetite the ratio is 8 parts magnetite to 1 part Quartz.

In the first stage of separation, 98% of the Magnetite and 5% of the Chromite are recovered to the magnetic fraction. In the HIMS circuit, the remainder of the magnetite is recovered together with 95% of the chromite in the HIMS feed.

Calculate:

- |   |     |
|---|-----|
| 2.1 t/hr Chromite in the feed                       | (4) |
| 2.2 % mass recovery to LIMS magnetics               | (4) |
| 2.3 % Fe of the LIMS non magnetics                  | (4) |
| 2.4 % Quartz in HIMS non magnetics                  | (4) |
| 2.5 % Chromite Recovery into the HIMS non magnetics | (4) |

Chromite SG – 4.5   Magnetite SG – 5.1   Quartz SG – 2.65  
Fe – 56   Cr – 52   O – 16

**[20]**

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Question 3

- 3.1 Discuss depression in a complex base metal sulphide ore flotation with reference to Sphalerite in the presence of Cu minerals.
- 3.2 Explain what happens when the sphalerite is re-activated.

**[20]**

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Question 4

- 4.1 In Perm Roll Drum Separators there are two forms of laminations used  
What are they? (2)
- 4.2 Explain how they differ, what they are used for and why. (7)
- 4.3 Describe how the three main classes of material in magnetism react in different ways to a magnetic field. (6)

**[15]**

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Question 5

- 5.1 Give a brief description of a sample. (3)
- 5.2 Why is sampling important? (3)
- 5.3 Sample handling is very important in sampling. State precautions that needs to taken into consideration when drying a sample. (3)
- 5.4 What are the three types of samples normally taken on a plant and what are they used for? (6)

**[15]**

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