

**REPUBLIC OF SOUTH AFRICA  
DEPARTMENT OF MINERALS AND ENERGY  
EXAMINATION FOR THE MINE SURVEYORS CERTIFICATE OF COMPETENCY**

DATE: 15 October 2004 - Friday  
TIME: 8:30 – 11:30 (3 Hours)

TOTAL MARKS: 100  
TO PASS: 50

**SUBJECT: MINING ECONOMICS 1**

**Notes:**

- (1) All steps must be shown.
- (2) Checks must be shown, since they carry marks.
- (3) Assume a RD of  $2.78 \text{ t/m}^3$  for in-situ rock and  $1.67 \text{ t/m}^3$  for broken rock

**QUESTION 1**

Explain the following:

- |                              |     |
|------------------------------|-----|
| (a) Primary development;     | (2) |
| (b) Secondary development;   | (2) |
| (c) Mineral resource;        | (2) |
| (d) Mineral reserve;         | (2) |
| (e) Cutting of samples;      | (2) |
| (f) Discounting of samples;  | (3) |
| (g) Regression of estimates; | (2) |
| (h) Milling width;           | (2) |
| (i) Milling grade;           | (2) |
| (j) Sweeping;                | (2) |
| (k) Vamping;                 | (2) |
| (l) Reclamation.             | (2) |

**[25 Marks]**

## QUESTION 2

An extensive diamond drilling programme for delineation and core sampling purposes has indicated the presence of two adjacent copper ore bodies Cu 1 and Cu 2. After the estimation and classification processes have been concluded the extents of the ore reserve are known as follows:

- Cu 1: 85 million tons at an average grade of 3.0% copper;
- Cu 2: 57 million tons at an average grade of 4.2% copper.

The ore bodies will be mined in proportions equal to their estimated mass to ensure simultaneous total extraction. The ore extracted will be sent to a single combined treatment plant. The following design assumptions (resource to reserve conversion factors) apply:

- (1) Maximum mining extraction rate is 80%;
- (2) Dilution by external and internal waste at zero grade, not in reserve, is 15%;
- (3) Plant recovery efficiency is 95%.

The required rate of production of fully refined copper is 5 000 tons per month.

Calculate:

- (a) Grade of ore to plant head feed (% copper); (5)
- (b) Monthly tonnage of ore to be mined from each ore body (tons per month); (5)
- (c) Annual depletion of the ore reserve (tons per annum of ore reserve); (5)
- (d) The life of the mine (months). (5)

[20 Marks]

## QUESTION 3

You are responsible for the reconciliation of monthly depletion or production figures from an open-pit mine situated in sub-Saharan tropical South Africa, which produces ore that is sensitive to moisture content levels.

The treatment process requires that wet ore mined is dried out before entered into the ore stream to the treatment plant, otherwise the efficiencies of the settling dams would be seriously compromised - negatively affecting treatment rates.

### QUESTION 3 CONTINUED

After reconciling a month's production in December/January you are faced with a mine call factor outside of its normal range and a tonnage shortfall. You do not have current sampling processes in place, such as bulk sampling, belt sampling or tailings sampling programmes, and thus you must reconcile to the known reserve block estimates.

Discuss what first-level investigations you would initiate in the following areas:

- (a) In-pit ore depletions/ extractions – volume and location; (5)
- (b) Impact of weather on water content - impact on density; (5)
- (c) Truck tallies – control on ore tramming from source to destination; (5)
- (d) In-pit stockpiling – for drying-out purposes; (5)
- (e) Contributions to and from wet-weather stockpiles – dilution of accuracy; (5)
- (f) Calibration of plant belt weightometers – mass balances. (5)
- (g) Losses to tailings and/or residues. (5)

[35 Marks]

### QUESTION 4

The average grade of a kimberlite diamond mine (volcanic pipe) is expressed in carats per hundred tons (cpht). The average sales value of the product (carats) is expressed in US dollar per carat (US\$/ct). The economic value of a diamond mine is often expressed as US dollar per ton of kimberlite in the ground (US\$/t).

- (a) Derive the mathematic relationship between grade (cpht), sales value (US\$/t) and economic value (US\$/t); (5)
- (b) If a mine is said to contain a grade of 21 cpht at an average value of US\$60/ct, calculate its economic value (in US\$/t); (5)
- (c) If the in-situ resource contains 3 million tons, calculate the total potential economic revenue in the ground (in US\$); (5)
- (d) If total mining and treatment cost is US\$14/t, will the mine mentioned in question 4 (b) make a profit? (5)

[20 Marks]

[Total 100 marks]