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

DATE: 21 April 2006 TOTAL MARKS: **100**
TIME: 08h30 to 11h30 (3 Hours) 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 t/m^3 for in-situ rock and 1.67 t/m^3 for broken rock

START OF EXAMINATION PAPER **[5 Questions, 5 Pages]**

QUESTION 1

Explain the following in your own words:

(a) Primary development: (2)
(b) Secondary development: (2)
(c) Mineral resource: (3)
(d) Mineral reserve: (3)
(e) Discounting of samples: (2)
(f) Regression of estimates: (2)
(g) Milling width: (2)
(h) Milling grade: (2)
(i) Reclamation. (2)

[20 Marks]

QUESTION 2

A 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: 80 million tons at an average grade of 3.5% copper;
Cu 2: 60 million tons at an average grade of 4.3% 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 87%;
(2) Dilution by external and internal waste at zero grade, not in reserve, is 10%;

The required rate of production of fully refined copper is 6 000 tons per month.
The plant recovery efficiency is 96%.

Calculate:

(a) Grade of ore to plant head feed (%age 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 compromised - negatively affecting treatment rates.

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 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

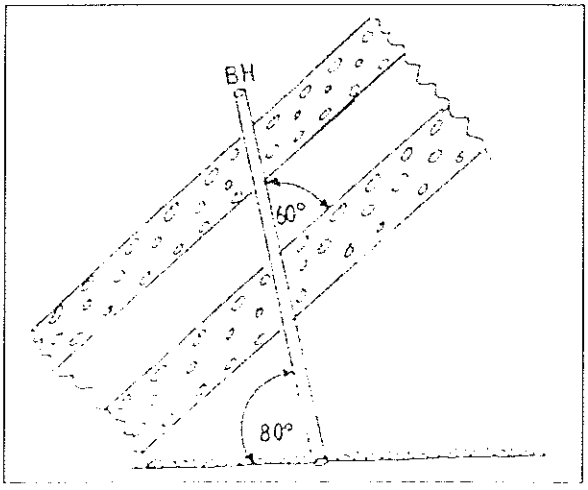
In a crosscut below the reef horizon a borehole was drilled upwards at an angle of + 80° to the horizontal in order to intersect reef.

The borehole was directed at an angle towards the direction of the true dip of the reef, which resulted in the reef cutting across the core at an angle of 60°.

The core was logged according to its appearance as shown below:

Sample	Core length (cm)	Value (g/t)	Grade (cmg/t)	Comments
1	10.0	5.0	50	Reef
2	20.0	13.0	230	Reef
3	22.0	0.0	0	Trace
4	13.0	16.0	200	Reef
5	14.0	22.0	270	Reef

The sketch below (not drawn to scale) refers.



Calculate:

(a) True dip of the reef (° from horizontal) (3)
(b) Reef width (cm) (2)
(c) Reef value (g/t) (2)
(d) Channel width (cm) (2)
(e) Channel value (g/t) (2)

[11 Marks]

QUESTION 5

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): (4)

(b) If a mine is said to contain a grade of 20 cpht at an average value of US$70/ct, calculate its economic value (in US$/t): (3)

(c) If the in-situ resource contains 4 million tons, calculate the total potential economic revenue in the ground (in US$): (3)

(d) If total mining and treatment cost is US$16/t, will the mine mentioned in question 5 (b) make a profit? (4)

[14 Marks]

END OF EXAMINATION PAPER **[Total 100 marks]**
