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

DATE: 16 April 2004
TIME: 08h30 to 11h30 (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 t/m^3 for in-situ rock and 1.67 t/m^3 for broken rock

START OF EXAMINATION PAPER **[6 Questions, 6 Pages]**

QUESTION 1

A mine has a mineral resource of 600 000 tons. It currently sells 10 000 tons per month into the market, but expects that these sales volumes will drop by 15% per annum. Financially the mine breaks even at a sales volume of 5 000 tons per month. Plant recovery efficiency is 95%.

Calculate:

(a) The life of the mine, in years; (5)
(b) How much of the mineral resource remains un-mined after closure (tons). (5)

[10 Marks]

QUESTION 2

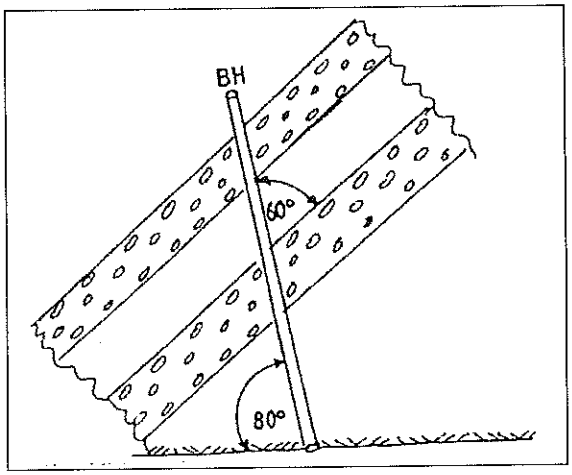
In a crosscut below the reef horizon a borehole was drilled upwards at an angle of + 80° to the horizontal in order to intersect reef.

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	47	Reef
2	20.0	13.0	244	Reef
3	22.0	0.0	0	Trace
4	13.0	16.0	195	Reef
5	14.0	22.0	289	Reef

The sketch below (not drawn to scale) refers.



Calculate:

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

[15 Marks]

QUESTION 3

An underground mine works two reefs. It is assumed that both reef horizons A and B are fully developed and will be commenced and exhausted simultaneously.

Geological and mining parameters:

Item	Reef A	Reef B
Area on dip	6 000 000 m^2	18 000 000 m^2
Average stoping width	110 cm	100 cm
Payability (reserve)	65%	90%
Additional unpay (resource) mined	10%	15%
Geological loss (faults, dykes, sills etc)	15%	20%
Estimated stoping value	9.00 g/t	13.00 g/t

Treatment parameters:

Sorted on surface at nil value	10 000 tons p.m.
Tons milled	300 000 tons p.m.
Mine Call Factor and Recovery Factor combined	90%

Calculate:

(a) The tonnage proportion to be mined from each reef horizon, expressed as a percentage of total mining production (%). (5)

(b) The life of the mine, in months (m). (5)

(c) The average recovery grade, in grams per ton (g/t). (5)

[15 marks]

QUESTION 4

You are given basic information about a gold mine's ore reserve statement (Table 1) and tabulations of two production statements, six months apart (Tables 2 and 3). You are asked to comment on the mine's mining policy – does it engage in over-mining or under-mining? And what is the trend?

Table 1: Ore reserve summary

Grade Categories (g/t)	Block Value (g/t)	Block Width (cm)	Inclined Area (m^2)
5.0 - 5.9	5.40	110.0	400 000
6.0 - 6.9	6.60	120.0	500 000
7.0 - 7.9	7.20	115.0	300 000
8.0 - 8.9	8.60	105.0	200 000
greater than 9.0	12.00	100.0	150 000
Totals and averages	7.12	112.6	1 550 000

Table 2: December 2003 production statement

Grade Categories (g/t)	Current mining December 2003	
	Mass mined (t)	Stoping Width (cm)
5.0 - 5.9	30 000	115.0
6.0 - 6.9	46 000	120.0
7.0 - 7.9	36 000	100.0
8.0 - 8.9	25 000	107.0
greater than 9.0	21 000	105.0
Totals and averages	158 000	109.9

Table 3: June 2004 production statement

Grade Categories (g/t)	Current mining June 2004	
	Mass mined (t)	Stoping Width (cm)
5.0 - 5.9	20 000	110.0
6.0 - 6.9	30 000	115.0
7.0 - 7.9	35 000	120.0
8.0 - 8.9	36 000	105.0
greater than 9.0	40 000	100.0
Totals and averages	161 000	109.0

QUESTION 4 CONTINUED

Do the following:

(a) Complete Table 1 - the ore reserve summary; (4)
(b) Complete Table 2 – the December 2003 production statement; (4)
(c) Complete Table 3 – the June 2004 production statement; (4)
(d) Calculate over- or under-mining in December 2003 (g/t); (4)
(e) Calculate over- or under-mining in June 2004 (g/t); (4)
(f) Calculate %age over-and under-mining (tons) for both periods; (3)
(g) Is the mine over- or under-mining and if so is it getting better or worse? (2)

[25 Marks]

QUESTION 5

The following sampling data gathered in a 27 metre-long panel is available:

Section	Distance from start (m)	Sample Width (cm)	Sample Value (g/t)	Internal Waste (cm)	External Waste (cm)
1	1	7	44.0	12	10
		7	52.0		50
2	7	10	48.0	3	14
		7	60.0		56
3	13	12	56.0	8	20
		7	60.0		48
4	17	8	36.0	5	24
		7	56.0		50
5	25	9	60.0	12	16
		7	72.0		57

(a) Explain the difference between regular and irregular sampling. (3)

Complete the full tabulation and calculate the weighted averages of:

(b) Channel width; (3)
(c) Stope width; (3)
(d) Sampling grade (g/t); (3)
(e) Sampling grade (cmg/t). (3)

[15 Marks]

QUESTION 6

You are given the following small dataset and asked to perform a first-pass statistical analysis of its key parameters:

Values:

6	4
2	1
9	1
14	3
13	3
14	0
0	4
6	5
13	8
2	5

Calculate the following statistical parameters:

(a) Number of data points; (1)
(b) Arithmetic mean; (1)
(c) Mode; (1)
(d) Median; (2)
(e) Standard deviation; (2)
(f) Third quartile value; (3)
(g) 90^{th} Percentile value; (3)
(h) Range; (1)

Graphically plot the data in the following formats, using class intervals of 2 g/t, starting at 0 g/t:

(i) Histogram; (3)
(j) Cumulative frequency distribution graph (also termed an ogive). (3)

[20 Marks]

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