

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

DATE: 15<sup>th</sup> April 2005  
TIME: 08:30 to 11:30 (3 hours)

TOTAL MARKS: 100  
TO PASS: 50

#  
**MINING ECONOMICS 1**

NOTES:

- (1) All steps must be shown;
- (2) Checks must be shown since they carry marks;
- (3) Density of ore in-situ 2.78 tons/m<sup>3</sup>;
- (4) Density of broken ore 1.67 tons/m<sup>3</sup>;
- (5) The examination consists of five questions.

**QUESTION 1**

In open pit operations the overlying and surrounding waste material has to be removed before any ore can be mined. This removal process is called waste stripping. The stripping ratio is defined as the number of units of barren material which must be mined to expose one unit of ore.

Calculate the percentage of the ore extracted (P) which can be stockpiled, given that there is a surplus of ore mined. The following variables are known:

|  |              |
|--|--------------|
| Stripping ratio (R)                              | 5            |
| Total unit of ore and waste mined (T)            | 50 000 units |
| Percentage extraction at the treatment plant (E) | 90 %         |
| Total units of ore required to be extracted (M)  | 6 000 units  |
| Percentage of ore to be stockpiled (P)           | Calculate    |

**10 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 were concluded the extents and contents of the ore reserve are stated as follows:

|       |   |
|-------|---|
| Cu 1: | 70 million tons of ore at an average grade of 2.0 % copper; |
| Cu 2: | 50 million tons of ore at an average grade of 4.2 % copper. |

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

|  |      |
|--|------|
| Mining extraction rate                         | 85 % |
| Dilution by waste at nil grade, not in reserve | 15 % |
| Plant recovery efficiency                      | 97 % |

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) 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

Calculate tramming width, milling width and values given the following information:

|                                    |                       |
|------------------------------------|-----------------------|
| Area stoped on a horizontal reef   | 4 000 m <sup>2</sup>  |
| Stope width and value              | 100 cm at 8.6 g/t     |
| Waste mined in stope tracks        | 800 tons at nil value |
| Waste sorted underground in stopes | 1 000 tons at 3.4 g/t |
| Development advance on reef        | 55 metres             |
| Size of development ends           | 3.5 m x 3.0 m         |
| Value of development ore trammed   | 7.0 g/t               |
| Waste sorted on surface            | 3 000 tons at 0.8 g/t |

**15 Marks**

#### QUESTION 4

- (a) State the main parameters to be used in a pay limit calculation (5)
- (b) Calculate the stoping pay limit for a gold mine given the following information: (20)

|                          |   |
|--------------------------|---|
| Gully waste              | 7 % of ore broken at stope face         |
| Development tons to mill | 10 000 tons at 4.5 g/t                  |
| Block factor             | 102 %                                   |
| Discrepancy (shortfall)  | 5 % of tons hoisted                     |
| Surface sorting          | 7 % of tons hoisted at 0.6 g/t          |
| Tons milled              | # 350 000 tons                          |
| Mine call factor         | 105 %                                   |
| Recovery factor          | 95 %                                    |
| Planned working cost     | R 300 per ton milled                    |
| Price of gold            | USD 400 per ounce (1 oz. = 31.103 48 g) |
| Currency exchange rate   | ZAR 5.85 per USD                        |

The balance of the tonnage is obtained from the stope faces.

- (c) State, in your own words, whether you believe that development costs should be included with, or excluded from the pay limit calculation. Briefly discuss the effect on the pay limit, revenues and mineral reserve inventory by such inclusions or exclusions. (5)
- (d) Discuss the possible causes of the commonly observed trend of slowly increasing pay limits over time, assuming that unit revenues remain constant over time. (5)

**35 Marks**

### QUESTION 5

In a gold mine five stopes have been worked by conventional stoping methods. The mining method has now changed to a resue mining method which results in the following changes:

| Stope | Conventional stoping          |                       |                   | Resue mining                            |                        |
|-------|-------------------------------|-----------------------|-------------------|---|------------------------|
|       | Broken area (m <sup>2</sup> ) | Stope width (cm)<br># | Stope value (g/t) | Broken reef and waste (m <sup>2</sup> ) | Total stope width (cm) |
| A     | 200                           | 176                   | 9.0               | 180                                     | 260                    |
| B     | 160                           | 152                   | 5.6               | 144                                     | 200                    |
| C     | 240                           | 144                   | 4.6               | 216                                     | 200                    |
| D     | 120                           | 160                   | 8.2               | 108                                     | 240                    |
| E     | 80                            | 168                   | 7.4               | 72                                      | 22                     |

Calculate:

- (a) Tonnage, average tramming width and value of ore trammed from conventional stoping, allowing for waste packing at 10 % of stope tonnage, at nil value. (10)
- (b) Tonnage, average tramming width and value of ore trammed from resue mining, assuming that the stoped area is completely filled with waste rock. (10)

Assume that no gold is lost in waste fill.

**20 Marks**

**Total 100 marks**