

THE UNIVERSITY OF ZAMBIA
FINAL EXAMINATIONS - NOVEMBER 2021

MIN 3059 INTRODUCTION TO MINERAL ECONOMICS

INSTRUCTIONS: ANSWER ANY 5 QUESTIONS
TIME: 3 HOURS

TOTAL MARKS 100

QUESTION 1

Decision-making theory of a mining firm may be viewed to focus on three important issues, namely the profit, survival and growth perspectives. Comment on each of these objectives demonstrating how they impact on the mining firm.

- | | | |
|------|----------|------------------|
| i) | Profit | [5 marks] |
| ii) | Survival | [7 marks] |
| iii) | Growth | [8 marks] |

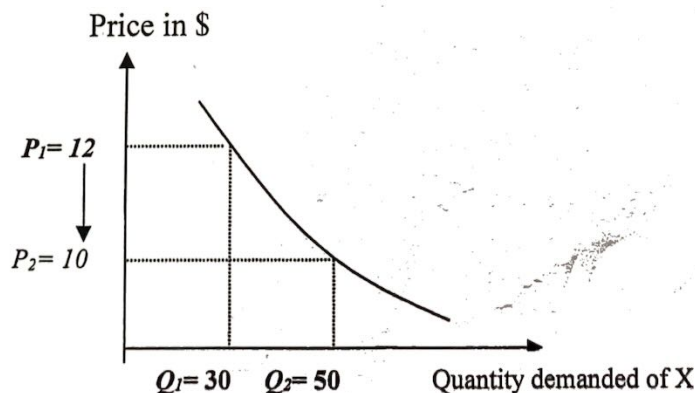
QUESTION 2

Discuss factors that lead to:

- | | | |
|------|-----------------------------------|-------------------|
| (i) | Economies of scale at plant level | [10 marks] |
| (ii) | Diseconomies of scale | [10 marks] |

QUESTION 3

- | | | |
|-----|---|-------------------|
| i) | Define what is meant by elasticity of demand | [5 marks] |
| ii) | Given details in the following diagram, determine the degree of responsiveness of the quantity demanded to a decrease in price from \$12 to \$10. | [15 marks] |



QUESTION 4

- i) What is a mineral policy? [4 marks]
- ii) What are the key elements of a country's mineral policy in developing countries. [16 marks]

QUESTION 5

- (i) Distinguish between variable costs and fixed costs. [5 marks]
- (ii) The total cost for the first 1,000 units of production is \$5,000 per month. The total cost 1,500 units is \$6,000. Assume that the variable cost linearly with production rate.

Determine:

- a) The variable unit cost [5 marks]
- b) The total fixed cost [5 marks]
- c) What is the average cost for the first 1,000 units per month? [5 marks]

QUESTION 6

Briefly discuss the impact of these types of taxes on mineral resource development.

- i) Depletion allowance [5 marks]
- ii) Depreciation allowance [5 marks]
- iii) Royalties [5 marks]
- iv) Income (corporate) tax [5 marks]

End of Examination

THE UNIVERSITY OF ZAMBIA
UNIVERSITY EXAMINATIONS – November 2022

MIN 3059 INTRODUCTION TO MINERAL ECONOMICS

INSTRUCTIONS: ANSWER ANY FIVE QUESTIONS
TIME: 3 HOURS

TOTAL MARKS: 100

QUESTION 1

Write short notes on the following market structures:

- | | | |
|------|---------------------|-----------|
| i) | Perfect market | [5 marks] |
| ii) | Oligopoly | [5 marks] |
| ii) | Monopolistic market | [5 marks] |
| iii) | Cartel | [5 marks] |

QUESTION 2

A mineral resource country without a mineral resource development policy is contemplating setting up its mineral policy. Briefly discuss the key factors that should be considered.

[20 marks]

QUESTION 3

- | | | |
|-----|---|------------|
| i) | What is sustainable development? | [8 marks] |
| ii) | Briefly discuss how mining can contribute to sustainable development. | [12 marks] |

QUESTION 4

Nonel Systems PLC produces explosives for mining companies within the SADC region. Over the past 5 years, the company has established its Total Revenue (TR) function to be:

$$TR = 100,000Q - 100Q^2$$

Where

TR = Total Revenue

Q = Total production of explosives in tonnes

The company's Internal Revenue Department has also established its Total Cost (TC) function to be:

$$TC = 0.20Q^2 + 10,000$$

Determine the following:

- | | | |
|------|--|-----------|
| i) | Break-even point | [5 marks] |
| ii) | Marginal cost and marginal revenue, when $Q = 200$ | [5 marks] |
| iii) | Marginal profit when $Q = 500$ | [5 marks] |
| iv) | Minimum cost when $Q = 1,000$ | [5 marks] |

QUESTION 5

- (i) Discuss factors that influence the supply of mineral commodities in the long term. [5 marks]
- (ii) What do you understand by the term "market equilibrium price?" [2 marks]
- (iii) With the help of a diagram, describe what conditions arise if the price is either lower or higher than the market equilibrium price? [2 marks]
- (iv) What goods are considered inferior in economics? [5 marks]
- (v) Manganese at a price of US\$200 per kg is found to have a demand level of 500 tonnes. However, if the price is reduced to US\$150 per tonne, demand is expected to reach 700 tonnes. Determine and comment on the price elasticity of demand. [6 Marks]

QUESTION 6

In examining the performance of the economy, economists look at four key areas. Briefly comment on each of these areas.

- | | | |
|------|------------------------------|-----------|
| i) | Gross Domestic Product (GDP) | [5 marks] |
| ii) | Price stability | [5 marks] |
| iii) | Employment | [5 marks] |
| iv) | International trade | [5 marks] |

QUESTION 7

What factors can lead to:

- | | | |
|-----|-----------------------------------|------------|
| i) | Economies-of-scale at firm level? | [10 marks] |
| ii) | Diseconomies at the plant level? | [10 marks] |

End of Examination

UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS – NOVEMBER 2021

MIN 3019 INTRODUCTION TO GEMMOLOGY

INSTRUCTIONS: ANSWER ANY FIVE (05) QUESTIONS

TOTAL MARKS: 100

TIME: THREE (3) HOURS

QUESTION 1

The term **enhancement** is defined as any treatment or process other than cutting and polishing that improves the appearance (colour/clarity/phenomena), durability, value or availability of a gemstone. Comment on the following enhancement methods:

- | | |
|------------------------|-----------|
| i) Bleaching | [3 marks] |
| ii) Coating | [3 marks] |
| iii) Dyeing (staining) | [3 marks] |
| v) Filling | [3 marks] |
| vi) Heating | [4 marks] |
| vii) Irradiation | [4 marks] |

QUESTION 2

Briefly discuss the five major chemical groups of gemstones giving examples of gemstones. [20 marks]

QUESTION 3

Discuss factors that affect the crystal growth and appearance of gemstones. [20 marks]

QUESTION 4

What factors are considered in the evaluation of rough and cut gemstones? [20 marks]

QUESTION 5

Write short notes on the following:

- i) Refractive index [6 marks]
- ii) Birefringence [6 marks]
- iii) Isotropic or Anisotropic gemstones [8 marks]

QUESTION 6

Physical properties of gems are important and used in the identification of gemstones. Define and discuss the importance of the following properties giving examples.

- i) Cleavage [5 marks]
- ii) Hardness [5 marks]
- iii) Fracture [5 marks]
- iv) Toughness [5 marks]

QUESTION 7

- i) What are the attributes for a material to be considered a gemstone? [5 marks]
- ii) Comment on the following materials giving examples:
 - a) Artificial materials [5marks]
 - b) Synthetic gemstones [5 marks]
 - c) Discuss the major uses of gemstones. [5 marks]

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
UNIVERSITY EXAMINATIONS – NOVEMBER 2022
MIN 3029 BASIC ROCK MECHANICS

Instructions: Answer Question 1 any other Four (4) questions,

Total Marks: 100

Duration: 3 Hours

Question 1 (Compulsory)

Calculate the stresses acting on the surfaces of haulage excavated in an orthotropic rock mass given the following parameters acting at a point around the peripheral of the excavation; ;

$$E_1=2.5, E_2=2, E_3=2.5, V_{21}=0.2, V_{31}=0.15, V_{32}=0.125, G_{12}=0.15, G_{23}=0.26, G_{31}=0.2, \epsilon_{xx}=0.1 \epsilon_{yy} = -0.5 \epsilon_{zz} =0.05 \epsilon_{xy}=0.5 \epsilon_{yz}=0.05 \epsilon_{zx} =-0.04$$

where E is the Young Modulus, G is the Shear Modulus, V is the Poisons ratio and the remaining parameters are components of the strain tensor acting at a point. [20 Marks]

Question 2

- a) The banks of a river channel need riprap for erosion protection as shown in Figure 2.1. The protected area is 500 m long and requires 1 m thick riprap extending down the bank to the bottom of the channel. What is the volume of rock needed knowing that the riprap was placed with an overall porosity of 25%? The rock is a sandstone with a bulk density of 2.7 g/cm³. [10 Marks]

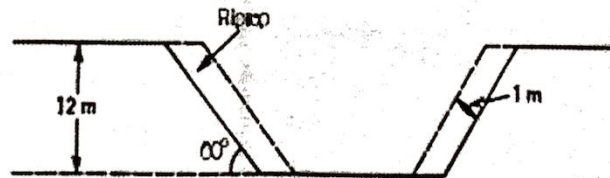


Figure 2.1: Riprap River banks

- b) Nchanga granite has the unconfined compressive strength of 629 MPa but the unconfined compressive strength of Luapula granite is only 148 MPa. The diameter of the thinnest cylinder of Nchanga granite that supports a certain weight is 3.85 cm. Find the diameter of the thinnest cylinder of Luapula granite that supports the same weight. [10 Marks]

Question 3

- a) In Rock mechanics, there are two categories of tests that are conducted for classification and characterization of rock materials

(i) Name the two categories

[2 Marks]

- (ii) List at least five tests in each category highlighting the significance of each test in Rock mechanics [5 Marks]
- b) With the help of a sketch, distinguish between unconfined and confined compressive strength tests
- (i) From sample preparation to the final stage, outline the procedure for testing of a rock sample to determine compressive strength [13 Marks]
- (ii) Calculate the Uniaxial Compressive Strength (UCS) of the core sample in MPa given the following data: [5 Marks]
- Diameter of a rock core sample is 5.4 cm
 - Applied load = 615kN

Question 4

- a) Mine spoils of porosity (n_0) are dumped into a triangular trench to depth (H_0), as shown in Figure 4.1. Over time, the spoils become compacted under their own weight until the porosity is reduced to (n). Show that the subsidence (ΔH) of the surface of the spoils is given by Equation 1.

$$\Delta H = H_0 \left[1 - \sqrt{\frac{1-n_0}{1-n}} \right]$$

Equation 1

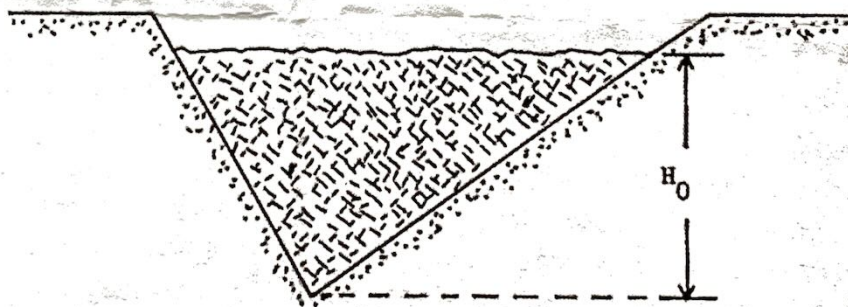


Figure 4.1: Mine spoils dumped into a triangular trench

Question 5

- a) Assuming the rock mass in Figure 5.1 is transversely isotropic, calculate the horizontal stress at point P which is 445m given the poisons ratio 0.05. [20 Marks]

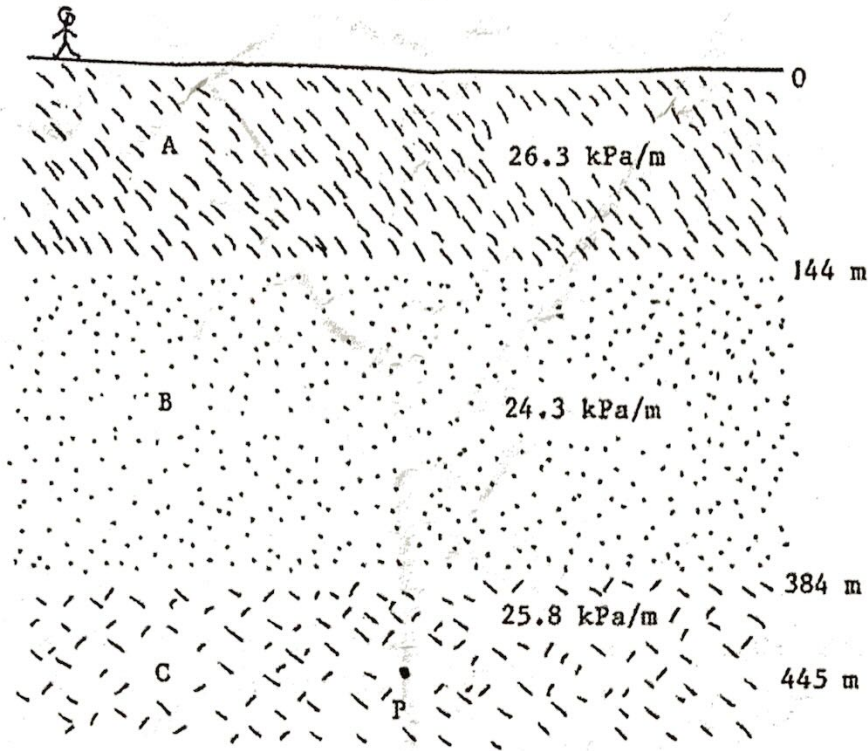


Figure 5.1: Transversely isotropic rock mass

Question 6

- a) List five mechanical properties and five physical properties of rock **[2.5 Marks]**
- b) Describe five geometric properties of the rock mass **[2.5 Marks]**
- c) A rectangular room with floor dimensions of 38.2m and 19.5m is excavated at a depth to the roof of 130. The density of the overburden is 2000kg/m^3 . The roof is supported by 28 identical pillars, each carrying the same load. Each pillar has an area of 1.36m^2 and is made of the rock with unconfined compressive strength of 92.5 MPa. Soon after completion, the terrorist begins to destroy the pillars one by one. What is the greatest number of pillars that can be destroyed without causing the roof to collapse **[15 Marks]**

END OF EXAMINATION!!!!

THE UNIVERSITY OF ZAMBIA
UNIVERSITY EXAMINATIONS – NOVEMBER 2022
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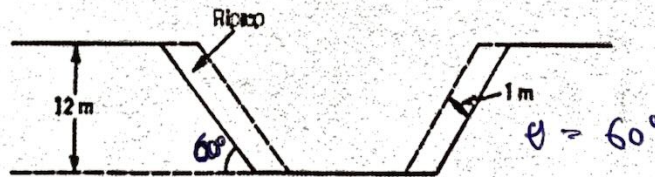


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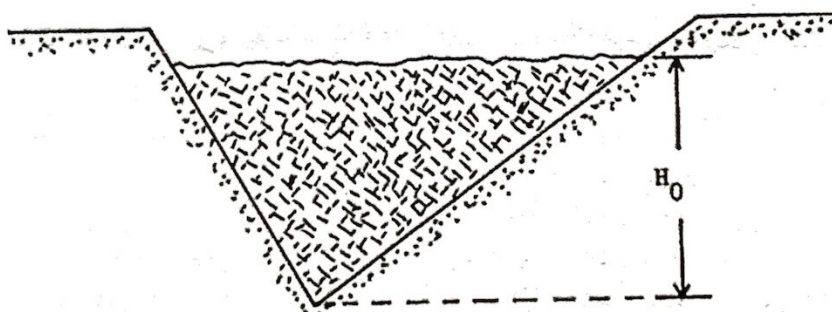


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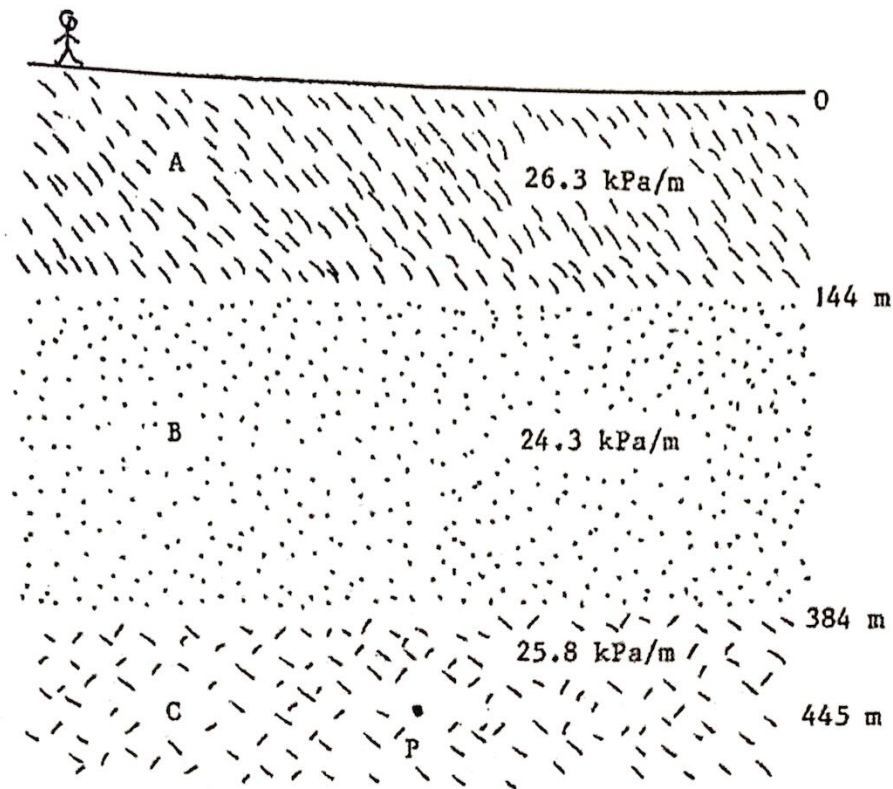


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