THE UNIVERSITY OF ZAMBIA

SCHOOL OF MINES

2014 EXAMINATIONS

1 GG 3041 Structural geology

2 GG 3041 Structural geology

3 GGY 2001 Introduction to geology

4 GGY 4081 Structural geology and plate tectonics

5 GGY 4091 Low temperature and applied geochemistry

6 GGY 5151 Engineering geology and rock mechanics

7 GGY 5161 Exploration geophysics

8 MET 3145 Mineral processing for mining engineers

9 MET4111 Comminution and classification

10 MIN 3019 Introduction to gemology

11 MIN 4025 Geostatistics

12 MIN 4035 Operations research

13 MIN 4065 Investment analysis

14 MIN 4075 Material handling

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12 MIN 4035 Operations research

13 MIN 4065 Investment analysis

14 MIN 4075 Material handling

15 MIN 4085 Mine ventilation

16 MIN 3059 Introduction to mineral economics

THE UNIVERSITY OF ZAMBIA
UNIVERSITY EXAMINATIONS – FEBRUARY/MARCH 2014
GG 3041 – STRUCTURAL GEOLOGY
PAPER I – THEORY

TIME: THREE HOURS

ANSWER: ANSWER **ANY FIVE (5)** QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS

1. Use well labeled 3-D block diagrams to depict the following structural geometries:
   a) Oblique left-lateral strike-slip fault
   b) Oblique right-lateral strike-slip Fault
   c) Oblique dip-slip fault
   d) Reverse fault

2. Discuss the difference between primary and secondary rock structures. Give **three** examples of each category.

3. a) What is the difference between "stress" and "strain"?
   b) Use well labeled diagrams to explain the following:
      i) Pure shear-strain relation. Equations required
      ii) Simple shear in solid mechanics

4. Explain the following terms using 1 to 2 sentences with diagrams where appropriate
   a) Cylindrical fold
   b) Overturned anticline
   c) Monocline
   d) Kink fold

5. a) Contrast between ductile deformation and brittle deformation. What are the products of each of these deformations?
   b) Briefly describe **four** types of lineations

6. a) Describe **three** main types of foliation.
   b) Draw a 3-D diagram of an upright, non-plunging fold structure with at least three layers distinguished by colored pencils (or using different symbols). Clearly label all parts of the fold with brief explanations

7. Contrast between these terms (diagrams are required):
   a) anticline and syncline
   b) symmetric and asymmetric folds
   c) normal and reverse faults
   d) hangingwall and footwall
   e) Dip and plunge

END OF EXAMINATION. GOOD LUCK!

THE UNIVERSITY OF ZAMBIA
UNIVERSITY EXAMINATIONS – FEBRUARY/MARCH 2014
GG 3041 – STRUCTURAL GEOLOGY
PAPER II – PRACTICAL

TIME: THREE (3) HOURS
ANSWER: ALL QUESTIONS. SUBMIT QUESTION PAPER TOGETHER WITH ANSWER SHEET

QUESTION 1: **STEREOGRAPHIC PROJECTION**

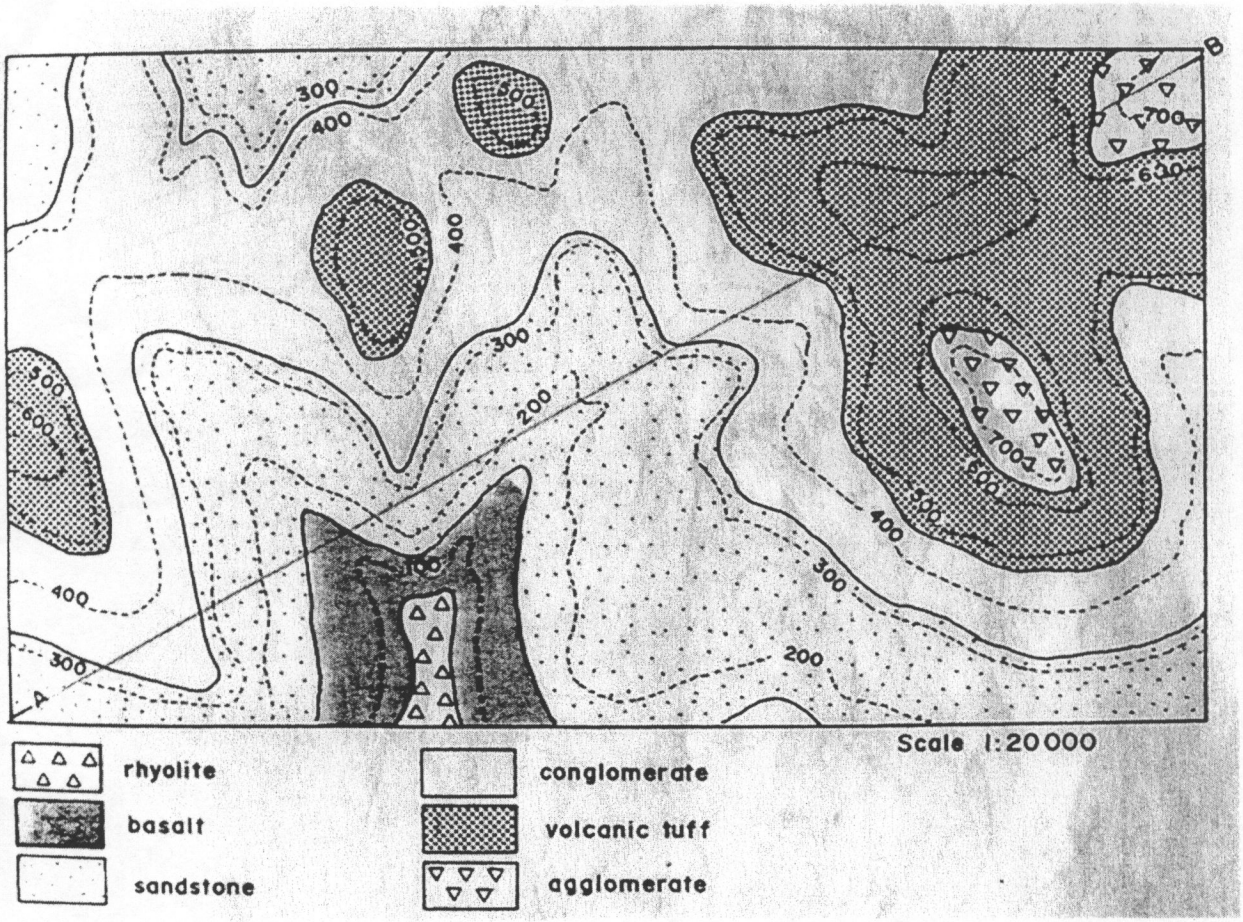
A geologist took foliation measurements from various outcrops in the field as shown below. Use the given tracing paper and stereo net to plot the poles of the given foliation measurements. Label the poles

1) N120E/10SW
2) N100E/09SW
3) N150E/12SW
4) N89E/15SE
5) N110E/12SW
6) N160E/13SW
7) N140E/08SW
8) N150E/17SW
9) N108E/10SW
10) N120E/14SW
11) N165E/12SW
12) N140E/13SW
13) N135E/15SW
14) N110E/10SW
15) N120E/10SW
16) N125E/18SW
17) N160E/10SW
18) N165E/16SW
19) N085E/14SE
20) N070E/11SE
21) N065E/10SE
22) N090E/120N
23) N100E/15SW

QUESTION 2: **CROSS-SECTION**

The map below shows an area with horizontal strata. It was found by drilling that a coal bed of 20 m thick is present at an elevation of 500m.

a) Draw in the outcrop of this coal bed. Note that 20 m on the ground is 1 mm on the map. The thickness of the bed can therefore be represented by a thick black line.
b) Draw a geological cross-section from A to B. Use a graph paper for the cross section

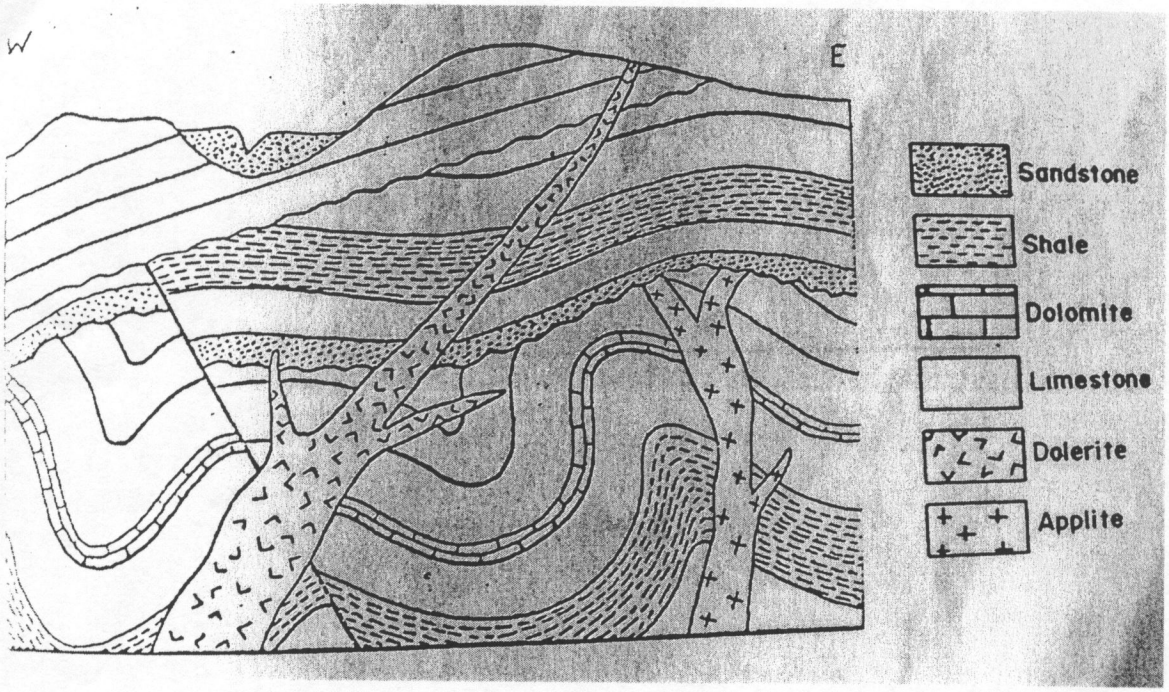


QUESTION 3: **DEFORMATION**

The map below shows a number of unconformities. Assuming that the layers were deposited horizontally:

a) Mark the unconformities with a colour pencil

b) Explain all geological events in chronological order and indicate what types of unconformities were formed successively.


W
E
Sandstone
Shale
Dolomite
Limestone
Dolerite
Applite

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS – FEBRUARY/MARCH 2014

GGY 2001 - INTRODUCTION TO GEOLOGY

PAPER II – PRACTICAL

INSTRUCTIONS: Answer all the questions. Use diagrams to illustrate your answers where ever it is necessary.

TIME: Three (3) Hours

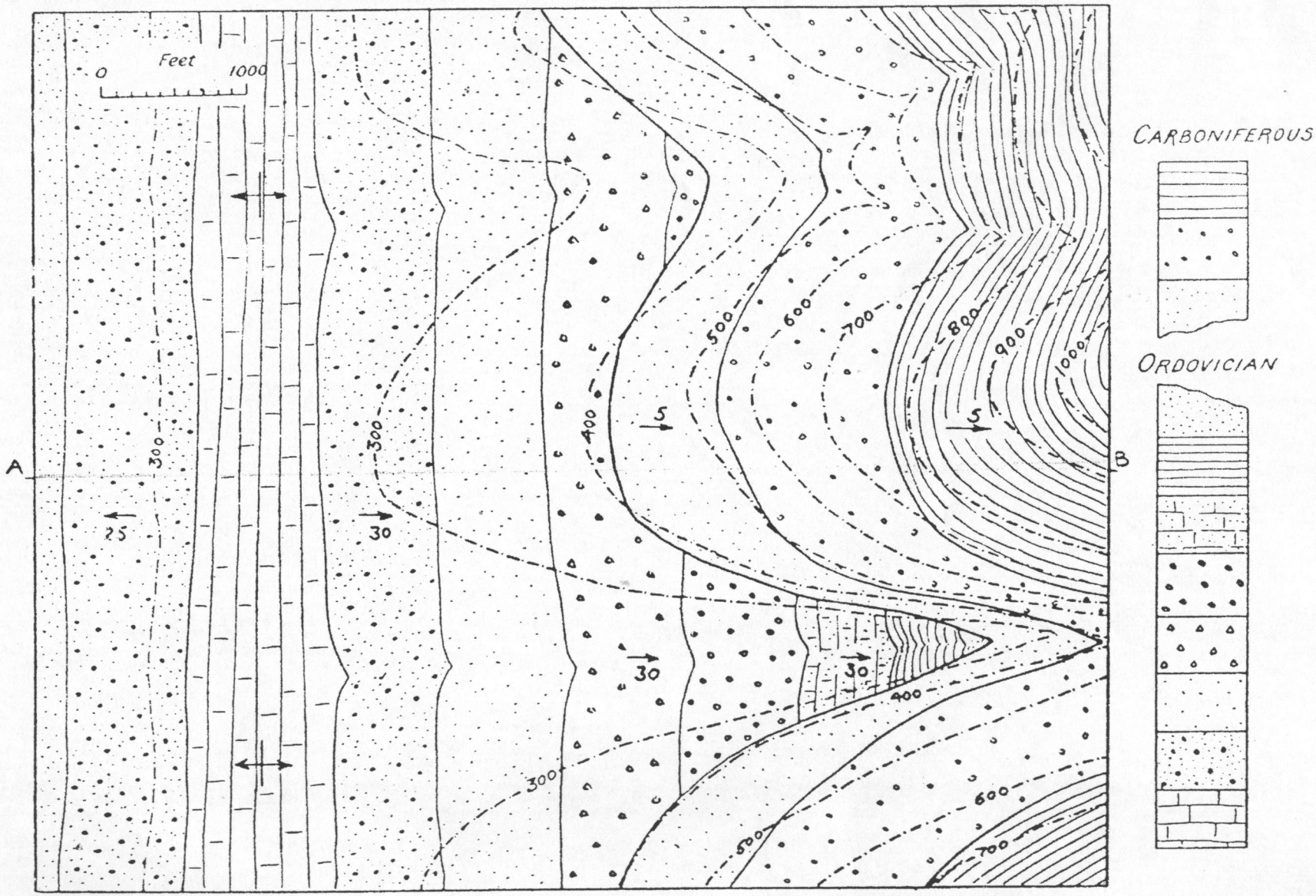
Q1. Describe the elements of symmetry which the given crystal models posses and use these features to classify them. (10 %)

Q2. Describe the properties of the given mineral specimens and use these to identify them. (30%)

Q3. Describe the texture, structure and mineralogical composition of the given rock specimens and use these features to identify the rock units from which the specimens were collected. (40 %)

Q4. Describe the geological structures of the area shown on the given map illustrating your answer by a section drawn below it along the line A-B. (20 %)

----------END OF EXAMINATION----------


0 Feet 1000
A
B
300
400
500
600
700
800
900
1000
25
30
5
CARBONIFEROUS
ORDOVICIAN

UNIVERSITY OF ZAMBIA

UNIVERSITY OF ZAMBIA FINAL EXAMINATIONS - MARCH 2014

GGY 4081- STRUCTURAL GEOLOGY AND PLATE TECTONICS

INSTRUCTIONS: Attempt any four questions. Draw figures wherever necessary. All questions carry equal marks.

Time 3 hours

Q.1. What are shear zones? Distinguish between a mylonite and a cataclasite (2 marks). Define S-surfaces and C-surfaces in a shear zone and with neat sketches show how S-C fabrics can be used as shear sense indicators in a mylonitic rock. (8 marks)

Q.2. Give the list of the five main principal deformation mechanisms (2 marks). Describe the process of dissolution creep. Give figures wherever required (8 marks).

Q.3. With a neat figure show the major zones of earth's interior along with the depths of boundaries in km (2 marks). Discuss the nature of seismic wave velocities at the crust and upper mantle and discuss their implication on characterizing lithosphere and asthenosphere (8 marks).

Q.7. Discuss in brief the driving mechanism for plate tectonics. With neat sketches show all the forces acting on plates.

Q.4. With neat sketches discuss the processes that occur along an oceanic-continental and oceanic-oceanic convergent plate boundaries.

Q.6. Show with neat sketches the configuration of various depositional basins in a continental margin arc and an Island arc settings (3). Discuss origin and nature of the rock assemblages of an accretionary prism in a subduction zone (7).

----------End----------

UNIVERSITY OF ZAMBIA

UNIVERSITY OF ZAMBIA FINAL EXAMINATIONS - MARCH 2014

GGY 4081- STRUCTURAL GEOLOGY AND PLATE TECTONICS

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----------End----------

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS – FEBRUARY 2014

GGY 4091- LOW TEMPERATURE AND APPLIED GEOCHEMISTRY

PAPER II – PRACTICAL

INSTRUCTIONS: Answer all the questions. Use diagrams and equations where ever it is necessary. All questions carry equal marks.

TIME: Three (3) Hours

Q1. The contents of Cu, Pb and Zn in the subsoil of an area are given in Table 1. Use an appropriate statistical technique to determine the mineralization potential of this area. (60 %)

Table 1

S/N°.	Zn	Pb	Cu
1	7.8	3.6	2.5
2	5.9	8.5	2.8
3	7.6	4.2	6.8
4	5	2	1.7
5	11.9	6.6	1.1
6	14.4	10.2	0.8
7	23.1	18.9	2
8	16.3	9.6	2.9
9	12.4	7.2	2.8
10	8.6	4	1.4
11	4.4	1.1	1.5
12	4.8	3.7	1
13	5.6	2.9	1.2
14	8.6	6.3	5.4
15	19.2	9	2.9
16	22.5	15.8	2.1
17	11.2	7.8	2.4
18	9.3	4.6	3.5
19	7.1	3.7	7.8
20	3.6	1.7	1.1
21	6.3	3.7	1.1
22	7.9	3.1	2.2
23	7.4	3.4	4.7
24	13.1	8.3	8
25	27.7	15.6	2.4
27	23.6	16.7	2.1
28	5.6	4.5	8.5
29	0	3.6	2.4
30	1.6	4.2	1.1
31	4.9	4.3	2.4
32	11	6	3.6
33	39.8	16.7	2.1
34	71.4	56	3.9
35	7.9	3.2	4.9
36	1.8	2.7	2.4
37	0.9	4.1	2.4
38	9.1	7.1	2.2
39	6.8	3.5	3.4
40	24.1	14.2	2
41	42.4	20.2	1.4
42	90	116	6.4
43	37.9	26.2	1.3
44	6.7	1.8	2.1
45	4.2	2.2	4.1
46	1.4	0.9	4.6
47	7.1	7.4	11.8
48	9.1	3.7	2.6
49	13.2	9	8.5

S/N°.	Zn	Pb	Cu
50	83	37.2	1.1
51	224	101.8	4
52	13.9	4.7	1.3
53	6.3	4.1	2.3
54	3.7	1.9	1
55	2.9	1.8	1.2
56	6.4	9.3	1.1
57	9	4	2.9
58	20.6	11.1	1.6
59	30.4	72.8	0.8
60	413	259.2	7.3
61	24.2	9.5	3.6
62	7	2.2	0.7
63	9	3.4	0.9
64	0.9	6.1	1
65	1.1	1.6	1.1
66	2.6	2.2	1.3
68	11.8	6	1.1
69	10.5	4.7	0.6
70	21.3	9	1.5
71	41.4	126.9	5.9
72	14	5.3	1.8
73	8.1	3.6	1.5
74	6.4	2.8	1
75	4.1	2.2	0.7
76	6.5	4.1	2.3
77	11.6	2.3	1
78	4.3	5.1	10.2
79	6	4.2	3.2
80	7.2	4.8	2.2
81	11.6	10.5	1.2
82	5.6	5.2	1
83	2.5	2.6	0.9
84	2.8	1.7	1.2
85	3.2	4.5	1.7
86	9.3	1.9	5.7
87	5	4	2.6
88	3.2	3.4	2.6
89	3.9	2.5	2.7
90	1.8	1.9	1.2
91	4.2	2.5	0.9
92	5	3.4	0.8
93	1.9	2.2	1.2
94	1.8	1.7	0.9
95	3.2	3.3	1.9

Q2. Discuss the associations of elements in the data set presented in question 1. (10 %)

Q3. Discuss the aqueous dispersion of elements from mineral commodities whose dump sites (table 2) are exposed seasonally to meteoric precipitation that has a pH of 5.6 and Eh of +0.48 volts.

(30 %)

Table 2 Chemical composition of mineral commodities

Element	Comm. A	Comm. B	Comm. C	Comm. D	Comm. E	Comm. F	Comm. G
O %	0.15	46.52	0.1	0.01	0.85	45	25
Si %	0.01	3.15	0	0	73.12	18	9
Al "	99.42	2.5	0	0	1.45	13	5
S "	0	0	0	0	0	0.63	6.02
K "	0	0.32	0	0	0	0.71	0.32
Ca "	0	0.73	0	0	0	2.25	1.38
Mn "	0.07	42.54	0	0	0	0.12	0.08
Fe "	0.41	3.15	22.27	0.36	23.89	8.89	9.70
Cu "	0.03	0.82	71.47	99.19	0	6.04	6.07
Zn "	0	0	0	0	0	0.02	7.39
Pb "	0	0.07	0	0	0	0.01	6.41
Co "	0	0.21	5.84	0.05	0	0.5	0.1
Ni "	0	0	0	0.25	0	0.03	0.03
As "	0	0	0	0	0	0.25	1.2
Au "	0	0	0	0	0	0	0.003

==========END OF EXAMINATION==========

THE UNIVERSITY OF ZAMBIA
UNIVERSITY EXAMINATIONS – FEBRUARY/MARCH 2014
GGY5151 – ENGINEERING GEOLOGYAND ROCK MECHANICS

TIME: 3 HOURS
ANSWER: ANY **FOUR** QUESTIONS. **ALL** QUESTIONS CARRY EQUAL MARKS

1. a) State the empirical formula of the Coulumb's Law and describe all quantities involved.
   b) The classification of geologic materials may be into three main groups based on their shear test parameters. With the aid of diagrams, illustrate these three main categories. (10 %)
   c) The following results were obtained from a shear box test on soil specimens compacted to in-situ density:

Normal stress (kNm^{-2})	50	100	200	300
Shear stress (kNm^{-2})	36	80	154	235

   i) Determine the shear strength parameters
   ii) Would failure occur on a plane within a mass of this sand at a point with a shear stress of 170 kNm^{-2} and normal stress of 220 kNm^{-2}? Explain your answer.

2. a) During a site investigation for an engineering project, a soil sample collected from the site gave the following results:

Grain size (mm)	50.0	35.5	20	14	10	6.3	3.35	1.18	0.6	0.15	0.063
Mass retained (g)	0	15.5	17	10	11	33	114.5	63.6	18.2	17	10.5

   If the total mass of the sample was 315 grams,
   i) Plot the particle size distribution curve
   ii) Determine its effective size (D_{10}).
   iii) Calculate its uniformity coefficient.
   iv) Describe and name the soil.

   b) A portion of this sample was used for the determination of Atterberg Limits. The following results were obtained from the test:
   i) Liquid Limit (Casagrande Apparatus)

Test Number	Mass of Tin	Tin + Wet Soil (g)	Tin + Dry Soil (g)	Number of Blows
1	23.68	40.86	34.68	13
2	22.93	42.62	35.78	20
3	26.27	38.02	34.27	47

   (ii) Plastic Limit

1	25.34	32.17	31.01
2	24.83	30.48	29.51

   Determine the plasticity index of the soil.

3 a) Discuss the differences between *properties of materials* and *properties of mass* with regard to both soils and rocks. Why is there any difference between them? Why is this difference of importance in engineering geology?
   b) A slope, 45°, was cut in one of the hills for the construction of an embankment on the Great East Road. A plane, P, dipping at 30°, was seen **daylighting** into this slope. Triaxial cell tests performed on three soil specimens filling this discontinuity gave the following results:

σ_2 (kN m^{-2})	1	5	9.5	15
σ_1 (k Nm^{-2})	9.2	28	48.7	74

   If a block weighing 800kN and a contact area of 500 m^2 is resting on this discontinuity, determine:
   i) The total force resisting sliding
   ii) The factor of safety of the block against sliding
   iii) If a rock-bolt tensioned to 250 kN is installed horizontally through this block, what would be the block's new factor of safety?

Good Luck!

4. a) A resting bench for fifth year geology students was constructed in front of the School of Mines. However, just after construction, the bench failed, and it was discovered that this failure occurred along a discontinuity with a shear angle of 30^0. The design established that the structure imposed a vertical stress (σ_1) of 480 kNm^{-2} and an induced a horizontal stress (σ_2) of 210 kNm^{-2}. Determine the **normal** and **shear stresses** that acted on the discontinuity at failure.

b) A soil sample was collected from the site in question (a) for permeability testing. The permeameter used in the test had a diameter of 75 mm and was 0.15 m long. The diameter of the stand-pipe was 1.5 cm. During the test, the head decreased from 1.3 m to 80 cm in 2.25 minutes. Calculate the coefficient of permeability of the sample in cm/sec.

5. a) A soil sample of length 12 cm and 4 cm in diameter was cored from the UNZA shopping complex construction site along the Great East Road. When subjected to an unconfined compressive strength test, the sample shortened by 1 mm and increased by 0.5 mm in diameter. Determine for this soil sample its:

c) Longitudinal and diametral strains.
d) Poisson's ratio
e) Modulus of elasticity F= 30KN

b) The structures at the UNZA shopping complex construction site in (a) are designed to be supported by square pad footings measuring 1.5 m long and founded at 1.5m below ground surface. If the unit weight of the foundation soil was determined to be 15 kN m^{-3}, and shear box tests performed on three specimens of this soil gave the following results:

Normal pressure (kN m^{-2})	35	70	105
Shear pressure (kN m^{-2})	29	58	87

Determine the ultimate bearing capacity of the soil under each footing.

$N_{c(rectangle)} = N_{c\{strip\}}*(1 + 0.3.B/L)$; $N_{q\ (rectangle)} = N_{q\ \{strip\}}$; $N_{\gamma\ (recanglet)} = N_{\gamma\ \{strip\}}*(1-0.2.B/L)$

Table of bearing capacity factors

ϕ (°)	0	5	10	15	20	25	30	32	34	36	38	40	42	44	46	48	50
N_c	5.14	6.5	8.3	11	14.8	20.7	30.1	35.5	42.2	50.6	61.4	75.3	93.7	118.4	152.1	199.3	266.9
N_q	1	1.6	2.5	3.9	6.4	10.7	18.4	23.2	29.4	37.7	48.9	64.2	85.4	115.3	158.5	222.3	319.1
N_γ	0	0.5	1.2	2.6	5.4	10.8	22.4	30.2	41.1	56.3	78	109.4	155.6	224.6	330.4	496	762.9

6. a) The Lusaka City Council intends to establish a quarry for residents of New Kasama after the Bauleni Compound, south-east of Lusaka. The siting of this site requires that a detailed site investigation is done. Being a qualified Engineering Geologist, what would you indicate as:

i) Any **four** objectives for such an investigation

ii) various stages of such an investigation

b) Write brief notes on the following:

i) Ultimate bearing capacity
ii) Safe Bearing Capacity (SBC)
iii) Differential settlement
iv) Rock Quality Designation (RQD)
v) Total Core Recovery (TCR)

END OF EXAMINATION

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Good Luck!

UNIVERSITY OF ZAMBIA EXAMINATION

SCHOOL OF MINES

GGY 5161 – EXPLORATION GEOPHYSICS FINAL EXAMINATION. FEBRUARY, 2014

ANSWER ANY FIVE QUESTIONS

QUESTIONS CARRY EQUAL MARKS

TIME: THREE (3) HOURS

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1. Define the following geophysical terms:

   (a) Target
   (b) Bulk Modulus
   (c) Surface Nuclear Magnetic Resonance Surveying
   (d) Resistivity
   (e) Susceptibility
   (f) Geometric Factor
   (g) Bull's eye
   (h) Nano Tesla
   (i) Force of gravity
   (j) Chargeability

   20 marks

2. Explain with the aid of diagrams how to design a geophysical survey

   20 marks

3. Prepare a Table of "Geophysical Methods and Main Applications"

   In column one (1) name the geophysical method
   In column two (2) name the type of method
   In column three (3) name the physical property or properties
   In column four (4) list applications
   In column five (5) name a locality, if any, in Zambia, where the method can be employed.

   20 marks

4. A plot in the Ndola Rural is to be surveyed for Talc Magnetite Schist (TMS), a host rock for emeralds. The plot extends two (2) kilometers in the north-south direction and one (1) kilometer in the east-west. Existing information indicates that the southern half of the plot is underlain by schists devoid of magnetite and hence has no potential.

   Describe how you would conduct a magnetic survey for TMS.

   10 marks

   Prepare a Table indicating guidelines to qualitative interpretation of magnetic profiles and maps.

   10 marks

5. (a) State Ohm's Law 2 marks

   (b) A cylindrical object of cross sectional area A, length L, shows a potential difference V, resulting from current I flowing through it. What is its resistivity?

   3 marks

   (c) Describe how to conduct a Vertical Electrical depth Sounding (VES) using Wenner Array.

   15 marks

6. (a) Explain the following:
   (i) Grain (electrode) Polarisation
   (ii) Membrane (electrolytic) Polarisation

   10 marks

   (b) Describe how to conduct Time-Domain Induced Polarisation (IP) measurements.

   10 marks

7. (a) State the limitations of one-dimensional, 1-D, resistivity surveys. 5 marks

   (b) Explain how a two dimensional, 2-D, electrical imaging or tomography surveying is carried out.

   15 marks

END OF EXAMINATION

UNIVERSITY OF ZAMBIA
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MID YEAR FINAL EXAMINATION - 2014

MET 3145 – MINERAL PROCESSING FOR MINING ENGINEERS

Answer: Five Questions
Time : Three Hours

1.

State briefly but clearly what you understand by the following terms used in mineral processing:

- 80% passing reduction ratio
- work index
- grindability
- set of a crusher
- liberation
- middlings fraction
- angle of nip
- differential flotation
- reverse flotation
- bulk density

[20 marks]

2.

a) Describe the crushing action of a jaw crusher with the aid of a clearly labelled diagram. **[7 marks]**

b) How could the reduction ratio of a jaw crusher be altered for small adjustments, and for large adjustments? **[3 marks]**

c) Describe the crushing action of a gyratory crusher with the aid of a clearly labelled diagram. **[7 marks]**

d) Describe the protection mechanisms of jaw crushers and gyratory crushers when an uncrushable material (e.g. tramp metal) enters the crushing cavity. **[3 marks]**

3.

a) State three factors, which increases the efficiency of screening and three factors, which decreases the efficiency of screening. **[6 marks]**

b) Particles that are nearly the same size as the screen apertures are called "near-mesh" particles. What are the problems caused by such particles and how could this be overcome in a normal plant operation if the plant is sufficiently large? **[4 marks]**

c) Very often the new feed to a crusher is screened to remove the material, which is already sufficiently fine to pass on to the next stage, and only the screen oversize passes through the crusher. State three advantages that this "scalping" of new feed gives. **[3 marks]**

d) Give four reasons why industrial sizing of broken rock may be carried out. **[4 marks]**

e) What is the main objective of screening? What do understand by the capacity of a screen? **[3 Marks]**

4.

a) Describe with a simple sketch the operation of the Symons standard cone crusher. What is the purpose of the parallel zone? **[7 marks]**

b) Describe the protection mechanism of the Symons standard cone crusher when an uncrushable material enters the crushing cavity. **[1 mark]**

c) What do you understand by the 'Set' of the Cone crusher and how could this be adjusted? **[3 marks]**

d) Primary crushers in particular can be operated in one of two distinct modes: "free crushing" and "choked crushing". Explain the underlined terms.**[4marks]**

e) What are the essential differences between the grinding action of the rod mill and the ball mill? What is the effect of these differences in the grinding action on the size distribution in the respective mill products? **[5 marks]**

5.

a) Describe the grinding action of a ball mill indicating the various zones that can be distinguished. **[4 marks]**

b) In a simple ball mill-classifier circuit shown below (Figure 1), the feed rate is ***F*** t/h and the circulating load (classifier underflow) is ***U*** t/h. The samples of ball mill discharge, circulating load and classifier overflow (circuit product) were taken and screen analysed, and the percentage passing 75 μm in the mill product, circulating load, and classifier overflow were ***b***, ***u*** and ***o*** respectively.

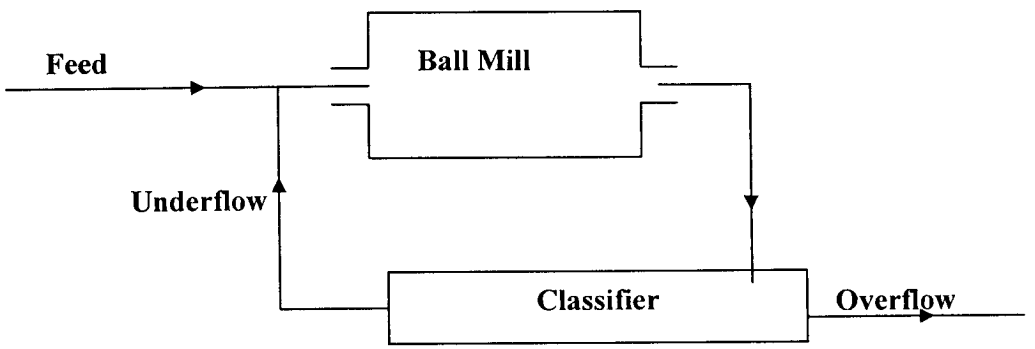


Figure 1: Ball Mill – Classifier Circuit

(i) Determine the expression of the circulating load as a percentage of new feed. **[4 marks]**

(ii) If F = 1000 t/h, b = 30%, u = 13% and o = 55%, calculate the circulating load as a percentage of new feed, and the ball mill discharge rate in t/h. **[4 marks]**

c) A mill has a 4,500 hp motor. For 80 percent power draw, what feed tonnage rate (t/h) can the mill treat if the 80 percent passing feed size is 0.5 inches and the desired product size is 80 percent passing 200 μm. Assume the Work Index of the ore is 14.8 kWh/t. **[6 marks]**

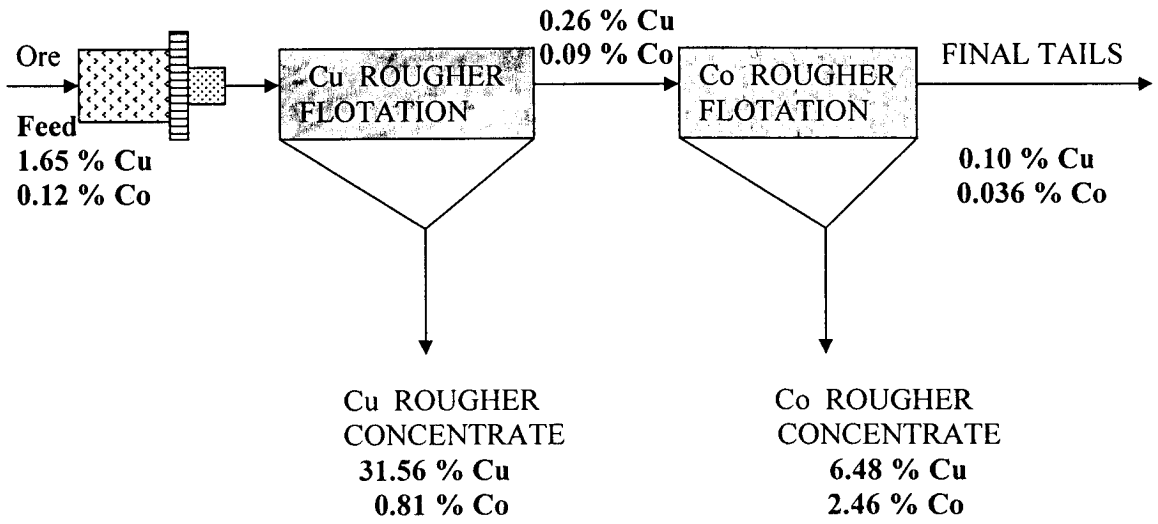
6.

a) What is froth flotation? Describe the role of the following chemical reagents in flotation:

(i) collectors
(ii) frothers, and
(iii) depressants and activators

[11 marks]

b) A copper / cobalt sulphide ore at Nchanga Concentrator is treated in a differential flotation circuit to produce a copper concentrate and a cobalt concentrate in two stages, as shown in the diagram below. The average grades of the feed and products of this circuit are as indicated.



(i) Calculate the average recoveries of copper and of cobalt from the feed to the copper rougher concentrate and to the cobalt rougher concentrate. **[6 Marks]**

(ii) If the feed tonnage (F) is 18 000 tonnes (dry) per day, how much copper will be lost to the final tailings per day? **[3 Marks]**

7.

a) What are the main methods of dewatering? Briefly describe each of them. **[5 marks]**

b) Describe briefly the construction of tailing dams by the upstream, downstream and centre-line methods. What are the advantages of each method? Illustrate with sketches. **[15 marks]**

END OF MET 3145 EXAMINATION
GOOD LUCK!!

UNIVERSITY OF ZAMBIA
SCHOOL OF MINES
MID YEAR FINAL EXAMINATON - 2014
MET 4111 – COMMINUTION AND CLASSIFICATION

ANSWER FIVE QUESTIONS **Time: 3 hours**

1.

State briefly what you understand by the following terms, used in mineral processing:

- Work index
- Separating size of a cyclone
- Middlings
- Bulk density
- Angle of nip
- Classification
- Terminal velocity of a particle
- Mineral liberation
- Choked crushing
- Comminution

[20%

2.

(a) (i) Describe the crushing action of a jaw crusher with the aid of a clearly labelled diagram. **[(Marks]**

(ii) Why do modern jaw crushers use curved swing-jaw plates? **[1 Mark]**

(iii) How could the reduction ratio of a jaw crusher be altered for small adjustments, and for large adjustments? **[2 Marks]**

(b) (i) Describe the crushing action of a gyratory crusher with the aid of a clearly labelled diagram **[6 Marks]**

(ii) What do you understand by the set of the gyratory crusher and how could this be adjusted? **[2 Marks]**

(iii) Describe the protection mechanisms of jaw crushers and gyratory crushers when an uncrushable material (e.g. tramp metal) enters the crushing cavity. **[3 Marks]**

3.

a. In a conventional closed circuit grinding operation (Figure 1), the cyclone overflow line is instrumented with a magnetic flowmeter and nuclear density gauge, and the mass of dry ore fed to flotation is 20t/h. The feed from the ore bin is sampled, and is found to contain 7 % moisture. The cyclone feed contains 35 % solids, the cyclone underflow 60 % solids and the overflow 15 % solids.

Calculate:

(i) The circulating load on the circuit. **[3 Marks]**
(ii) The amount of water required to dilute the ball mill discharge. **[4 Marks]**

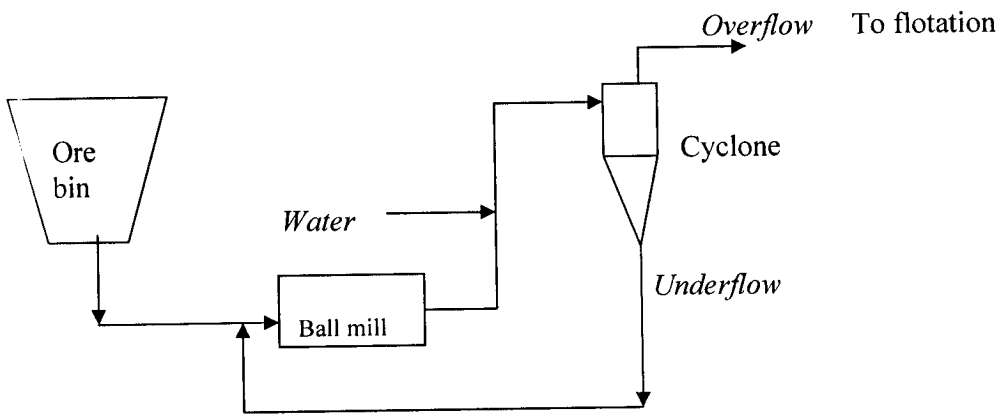


Figure 1: Closed circuit grinding flowsheet

b. Describe with a simple sketch the operation of the Symons standard cone crusher. What is the purpose of the parallel zone and what do you understand by the set of the cone crusher? **[7 Marks]**

c. What are the advantages of autogenous mills on suitable ores over conventional circuits **[3 Marks]**

d. Why are rod mills usually run in open circuit and balls mills in closed circuit with a cyclone **[3 Marks]**

4.

a. State three factors, which increases the efficiency of screening and three factors, which decreases the efficiency of screening. **[6 Marks]**

b. Particles that are nearly the same size as the screen apertures are called "near-mesh particles. What are the problems caused by such particles and how could this be overcome in a normal plant operation if the plant is sufficiently large? **[4 Marks]**

c. Very often the new feed to a crusher is screened to remove the material, which is already sufficiently fine to pass on to the next stage, and only the screen oversize passes through the crusher. State three advantages that this "scalping" of new feed gives. **[3Marks]**

d. Give four reasons why industrial sizing of broken rock may be carried out. **[4 Marks]**

e. What do you understand by the 'free settling ratio' of two minerals and what do you understand by their 'hindered settling ratio'? **[3 Marks]**

5.

a. In a grinding circuit, A SAG mill operates with a 10, 000 hp motor. Typical power draw is 80% of maximum. The 80 percent passing feed size to the mill is 5 inches and the mill discharge has an 80 percent passing size of 2.1 mm. Calculate the Operating Work Index for this mill if the feed tonnage rate is 1200 t/h. **[4 Marks]**

b. What are the two major function liners of tumbling mill perform? Give the three main groups into which mill liners can be classified. **[5 Marks]**

c. Give and discuss three factors that affect the grinding of ores. **[3 Marks]**

d. What are the essential differences between the grinding action of the rod mill and the ball mill? What is the effect of these differences in the grinding action on the size distribution in the respective mill products? **[4 Marks]**

e. Describe the grinding action of a ball mill indicating the various zones that can be distinguished. **[4 Marks]**

6.

(a) Discuss the classification mechanism of a hydrocyclone with the aid of a clearly labelled diagram. **[5 Marks]**

What are the main design variables and operating parameters of this cyclone? **[4 Marks]**

(b) Hydrocyclones have replaced mechanical classifiers in most modern grinding plants. What are the advantages of hydrocyclones over mechanical classifiers? **[3 Marks]**

(c) The most modern mechanical classifier is the rake classifier.

(i) Describe the operation of this classifier with the aid of a clearly labelled diagram, showing the various zones that can be distinguished. **[5 Marks]**

(ii) What operation controls can be used on this type of classifier and state briefly how these controls influence the separation size in this classifier? **[3 Marks]**

7.

Consider a grinding circuit, consisting of a rod mill in open circuit and a ball mill in closed circuit with a hydrocyclone, as in Figure 2.

(a) Imagine that, as part of a survey of the above circuit, samples were taken of the rod mill and ball mill discharges and of the cyclone underflow and overflow, and that sieve analyses of composite samples of these products gave the following results:

Fraction	Weight Percentages Retained			
	RMD	BMD	CUF	COF
+212μm	41.4	24.4	34.9	3.6
+150μm	13.8	21.6	25.1	1.2
+106μm	4.3	25.0	22.5	13.3
+75μm	4.0	13.2	9.2	18.4
+53μm	3.5	10.4	3.9	26.9
-53μm	33.0	5.4	4.4	36.6

Calculate the circulating load over the ball mill / cyclone circuit. **[2 Marks]**

(b) If the feed rate to the rod mill is 95 tph (dry weight), what is the size distribution in the cyclone feed, based upon the above data? **[6 Marks]**

(c) What is the feed rate to the ball mill, based upon your answer to question (b)? **[2 Marks]**

(d) From these data, calculate the recoveries to the cyclone underflow for the different size fractions and plot these against particle size on the graph paper. **[6 Marks]**

(e) What is the separating size in this cyclone operation, based upon these data? **[2 Marks]**

(f) What is the 'imperfection' in this cyclone operation, based upon these data? **[2 Marks]**

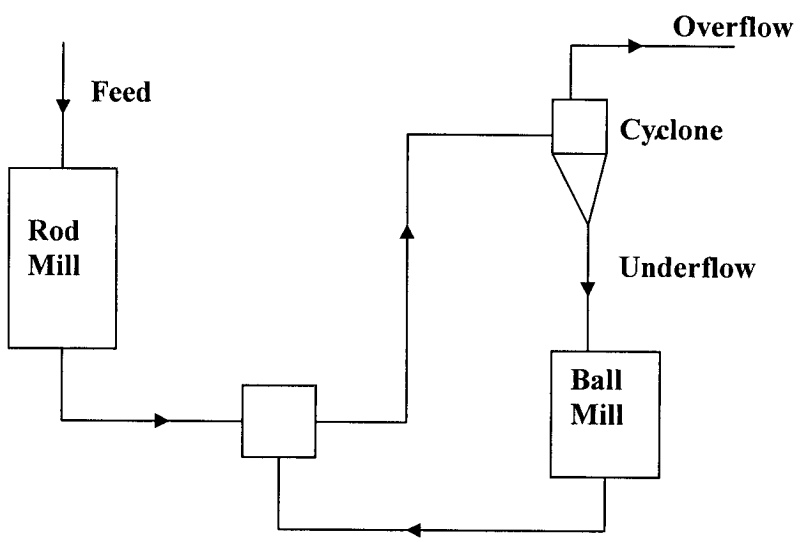


Figure 2: Rod mill – Ball mill – Cyclone circuit

END OF MET 4111 FINAL EXAMINATION
GOOD LUCK!!

UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS – MARCH 2014

MIN 3019 INTRODUCTION TO GEMOLOGY

TIME: THREE (3 HOURS) **TOTAL MARKS: 100**
INSTRUCTIONS: ANSWER ANY FIVE (5) QUESTIONS

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1. What do you understand by the term "gemstone enhancement"? Discuss four gemstone enhancement methods giving examples of gemstones. **[20 marks]**

2. The colour of a gemstone is determined by these factors. With a help of a diagram, write short notes on each of the following:

   (i) Reflection **[6 marks]**

   (ii) Absorption **[6 marks]**

   (iii) Transmitted **[8 marks]**

3. Discuss factors that affect the crystal growth and appearance. **[20 marks]**

4. What factors are considered in the evaluation of gemstones? **[20 marks]**

5. Write short notes on the following:

   (i) Refractive index **[6 marks]**

   (ii) Birefringence **[6 marks]**

   (iii) Isotropic or Anisotropic gemstones **[8 marks]**

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]**

END OF EXAMINATION

UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS

MIN 4025 – GEOSTATISTICS

INSTRUCTIONS: **ANSWER ANY 5 QUESTIONS** **TOTAL MARK: 100**
TIME: **3 HOURS**

- *Closed book*
- *Show all calculations and assumptions*
- *If you believe that a parameter or an important piece of information has been inadvertently omitted by the examiner, assume a suitable value, clearly stating it (using comments in your program), and continue with the solution.*
- *Write your answers clearly on your exam answer booklet. In your exam answer booklet, clearly mark the question number, e.g., "Question 1:". Illegible writings will not be marked.*

QUESTION 1 (20 Marks)

Provide a short answer to the following questions:

a) Explain the difference between resource and reserve. Which one will be affected if the price of metal of interest fluctuates? Which one will be affected if more drill-holes are added? **(5 marks)**

b) A deposit has 50 million tonnes of measured in-situ resource, 120 million tonnes of indicated in-situ resource and 133 million tonnes of inferred in-situ resource. **(5 marks)**

i. What would be the maximum possible reserve of the deposit? **(1 marks)**
ii. What classification would you assign to this reserve and why? **(1 marks)**
iii. What work would be required to carry out the estimation for this reserve? Describe the key factors that affect the outcome of the reserve estimation. **(3 marks)**

c) Describe three characteristic of a regionalised variable in the context of geostatistical estimation. Give two examples of typical regionalised variables in mining. **(5 marks)**

d) Explain the term "Kriging search neighbourhood" and describe techniques used to define such neighbourhoods in computerised Kriging programs. **(5 marks)**

QUESTION 2: Inverse Distance Method (20 marks)

Grade value at location x_0 is to be estimated from two samples at locations x_1 and x_2 (see Figure 1) using Inverse Distance Technique (IDT). The estimation using IDT with power p can be written as:

$$g = \frac{\sum_{i=1}^{n} \frac{g_i}{d_i^p}}{\sum_{i=1}^{n} \frac{1}{d_i^p}}$$

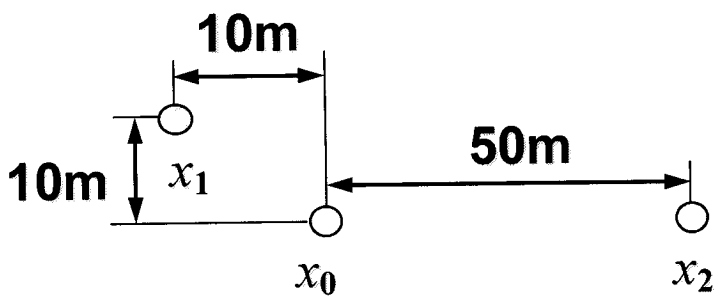


Figure 1 Sample configuration

a) For a highly continuous mineralisation, shall we use a larger or smaller value for p? **(2 marks)**

b) Can we use p=0 in Inverse Distance Technique? Explain why. **(2 marks)**

c) Calculate the PERCENTAGE weights λ_1 (for the sample at x_1) and λ_2 (for the sample at x_2) for p=1, 2, 4 and 8 and comment on the variation trends of λ_1 and λ_2 for different p. If we use an isotropic search neighbourhood with the radius of 20m, what will be the PERCENTAGE weights λ_1 and λ_2. **(5 marks)**

d) For p=4, if we add one more sample 100m away from x_0, are we going to improve the estimation (no search neighbourhood imposed)? **(3 marks)**

e) If we know grade variations of this deposit is anisotropic and assume the range of continuity in east-west direction is four times of that in north-south direction, calculate the PERCENTAGE weights λ_1 and λ_2 for p=1, 2, 4 and 8 for this case. Compare the results with those of 3) and comment. Note: to incorporate anisotropy in this case in the IDT calculation, one way is to use an adjusted distance between point $P_1 = (x_1, y_1)$ and $P_2 = (x_2, y_2)$ calculated as:

$$d(P_1, P_2) = \sqrt{[x_1 - x_2]^2 + [4 \cdot (y_1 - y_2)]^2}$$

(6 marks)

f) Comment on the major pros and cons of Inverse Distance Technique compared with kriging. **(2 marks)**

QUESTION 3: Structural Analysis (20 Marks)

Consider the figure shown in Figure 2 (showing a stratiform iron orebody, through which a set of drill-holes have been bored, perpendicular to the dip of the ore). The value given at each location is the average value of Fe (% by weight) over the intersection of the borehole with the ore.

(a) Calculate the Variogram in the East West direction **(8 marks)**

(b) Calculate the Variogram in the North-South direction **(8 marks)**

(c) What theoretical model would you fit to the East-West Variogram? Specify the parameters of the theoretical model **(4 marks)**

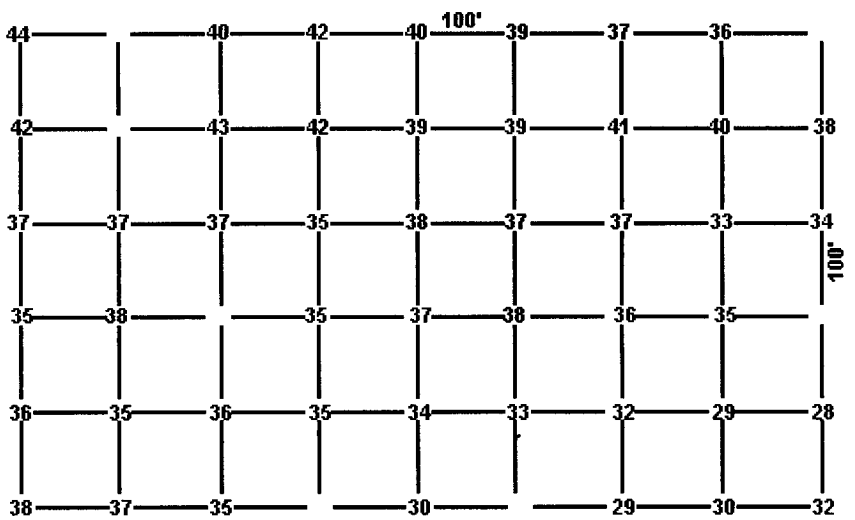


Figure 2: Example of data on a grid for the calculation of an experimental Variogram – iron ore.

QUESTION 4: Estimation (20 Marks)

(a) Grade value at location x_0 is to be estimated from two samples at locations x_1 and x_2 (see Figure 3) using kriging. For a spherical variogram model with the range of a=100m, a nugget component of C_0 and a structural component of C, derive the expression of the kriging weights λ_1 (for the sample at x_1) and λ_2 (for the sample at x_2) in terms of C_0 and C. Calculate λ_1 and λ_2 for $\frac{C_0}{C} = 0$, 1, 10 and 100 and comment on the variation trends of λ_1

and λ_2 for different $\frac{C_0}{C}$ ratios. Mathematical form of spherical variogram model can be written as: $\gamma(h) = C_0 + C\left[\frac{3}{2}\frac{h}{a} - \frac{1}{2}\left(\frac{h}{a}\right)^3\right]$. **(10 marks)**

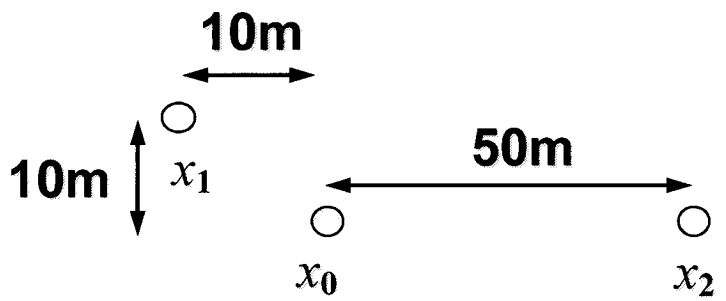


Figure 3 Sample configuration

(b) A porphyry copper deposit has been explored by means of vertical boreholes. To simplify the problem, each 'bench' in the deposit is considered separately as a plane and the borehole intersections as points within the plane. Take a typical small block, 25m by 25m, with a borehole passing through it as shown in Fig.4. Calculate the estimation variance if the value of the core intersecting the block is extended to the whole block. **(10 marks)**

HINT:

$$\sigma_E^2 = 2\bar{\gamma}(S,A) - \bar{\gamma}(S,S) - \bar{\gamma}(A,A)$$

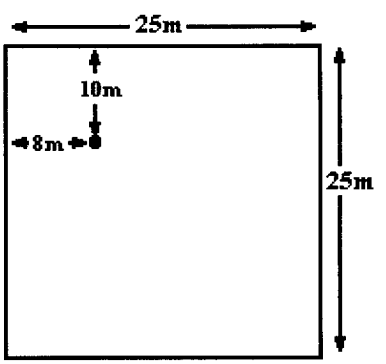


Figure 4. Estimation of panel average from one 'point' sample.

QUESTION 5: BLOCK KRIGING (20 marks)

(a) Figure 5 shows the sample configuration used to estimate the grade of the shaded ore block (centroid at point A) for a uranium deposit using block Kriging.

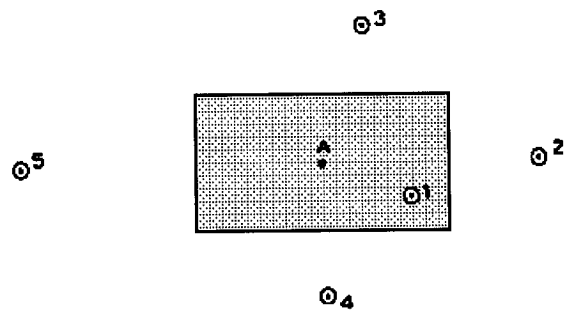


Figure 5: *Estimation of the block value is required from the five scattered samples – uranium example*

The kriging system of equations derived for this estimation problem is presented below; where w_i is the weight assigned to sample i.

$$
\begin{aligned}
& 415.5w_2 + 491.4w_3 + 403.0w_4 + 790.5w_5 + \lambda = 356.7 \\
415.5w_1 & + 581.3w_3 + 642.9w_4 + 800.0w_5 + \lambda = 572.4 \\
491.4w_1 + 581.3w_2 & + 659.9w_4 + 778.8w_5 + \lambda = 456.9 \\
403.0w_1 + 642.9w_2 + 659.9w_3 & + 745.1w_5 + \lambda = 446.8 \\
790.5w_1 + 800.0w_2 + 778.8w_3 + 745.1w_4 & + \lambda = 696.1 \\
w_1 + w_2 + w_3 + w_4 + w_5 & = 1
\end{aligned}
$$

i. What does the value 696.1 on the right hand side represent? **(2 mark)**

ii. What does the coefficient 745.1 represent? **(2 mark)**

iii. The solution to the above kriging system of equations gives the following results: w1=0.346; w2=0.0269; w4=0.234; w5 = 0.127; and λ=19.72. Determine the value of w3. **(2 marks)**

iv. Given, the sample values (ppm) as follows: x1=400; x2 = 380; x3 = 450; x4 = 280; x5 = 320, what is the kriged estimate for the ore block? **(2marks)**

v. Calculate the Kriging Variance assuming $\bar{\gamma}(V) = 344.0$ ppm^2 **(4 marks)**

vi. A sixth sample is added to improve the estimate for the block. Write the general Kriging equation for this sample. **(2 marks)**

(b) State the equation for Krige's relationship and explain the terms in the equation. **(8 marks)**

QUESTION 6: Grade-Tonnage Curve (20 marks)

The grade-tonnage and average grade above cutoff-tonnage relationships are important in evaluating the production rate, cutoff grade and life of an open pit mine. The data is given below for the Nine-to-Five gold prospect.

Cutoff Grade (oz*/tonne)	Tonnage above Cutoff (000's)	Ore Grade (oz/tonne)	Oz. Au above Cutoff (000's)
0.00	18,500	0.060	1,110
0.01	16,135	0.068	1,094
0.02	12,724	0.082	1,044
0.03	10,070	0.097	978
0.04	8,094	0.1124	910
0.05	6,611	0.128	843
0.06	5,477	0.143	781
0.07	4,595	0.158	724
0.08	3,896	0.172	672
0.09	3,336	0.187	624
0.10	2,879	0.202	581
0.11	2,504	0.216	541
0.12	2,192	0.231	505
0.13	1,930	0.245	473
0.14	1,708	0.259	443
0.15	1,519	0.274	416
0.16	1,357	0.288	391
0.17	1,217	0.302	368
0.18	1,096	0.316	346
0.19	990	0.330	327

*oz = ounces

(a) Plot the grade – tonnage graph for this ore body on graph paper. The Cut-off grade data should be on the X-axis of your graph. **(10 marks)**

(b) Assume the following: **(5 marks)**

- Recovery: gold = 80 %, silver = 60 %

- Price: gold = $300/oz, silver = $8/oz

- Direct operating costs:

  $8.10/tonne of material mined and processed
  $1.10/tonne of waste

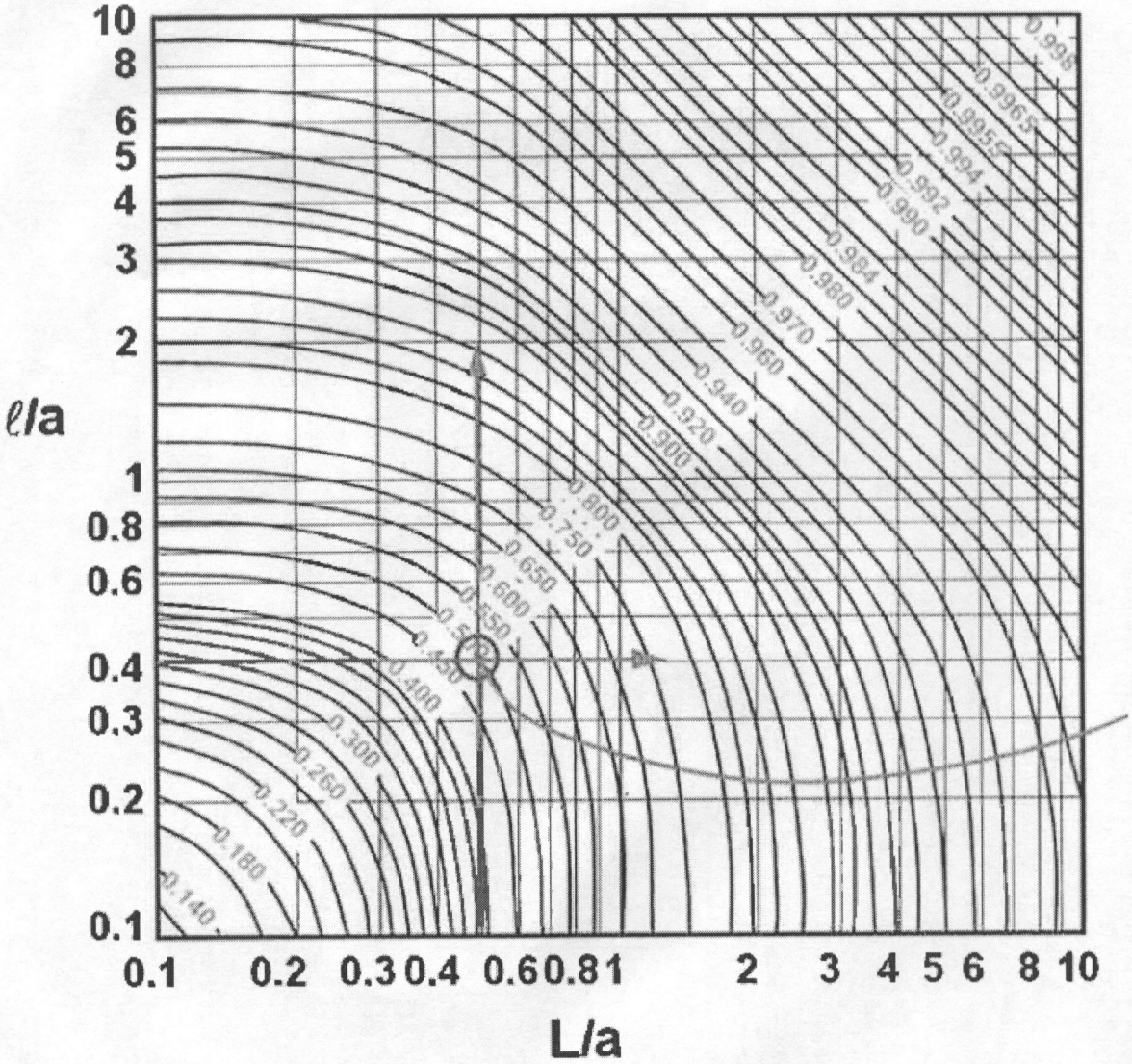
- Indirect costs (ore) = $1.79/tonne
- Indirect costs (waste) = $1.79/tonne

If the cut-off grade is chosen as 0.04 oz gold/tonne, what would be the Gross Value of the ore body? Include the silver and the recovery factors.

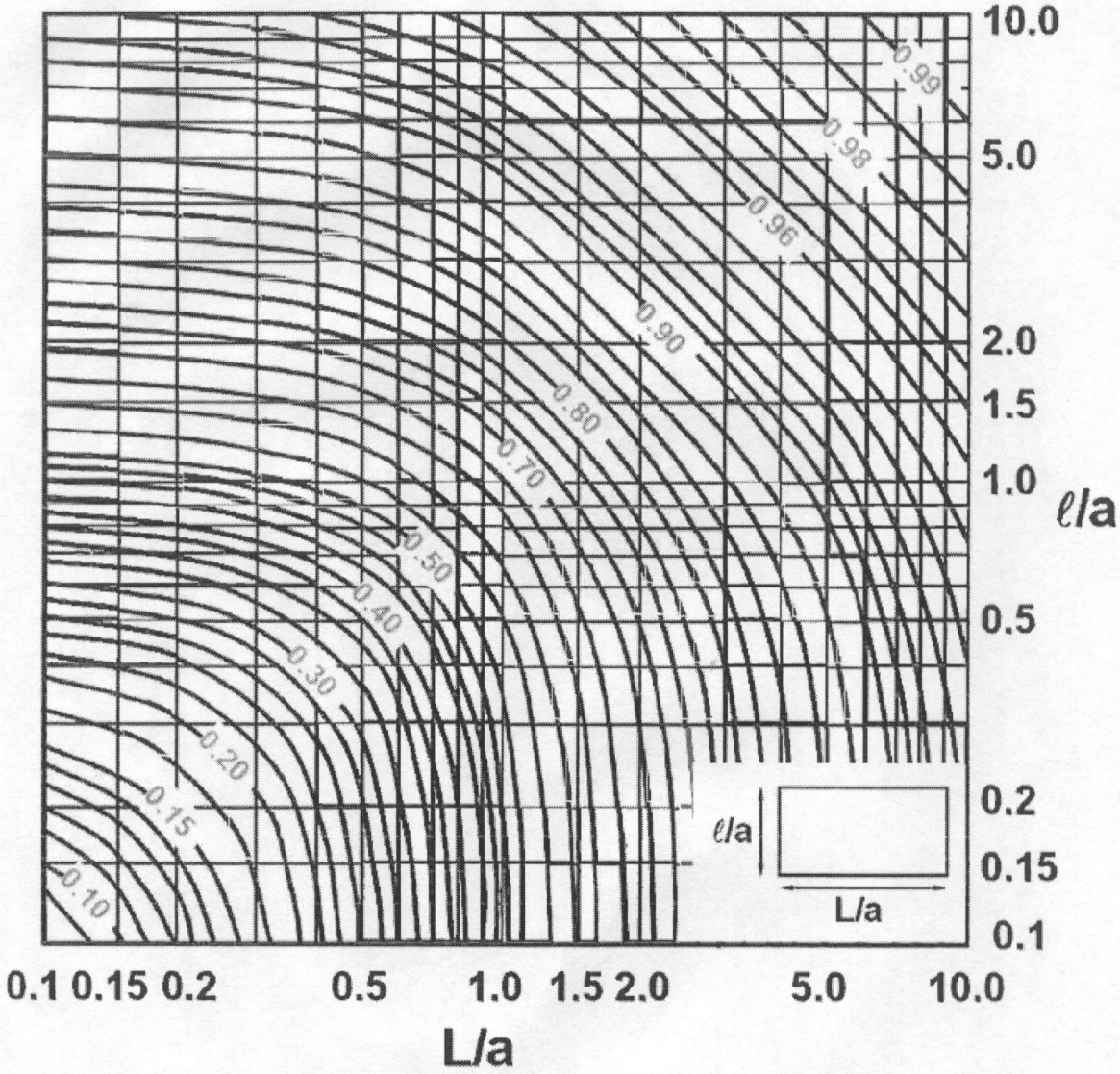
(c) What would be the Net Value of the ore body assuming an overall stripping ratio of 3.5:1?
(5 marks)

APPENDIX A

H Graph 2-D



APPENDIX B
F Graph 2-D



END-OF-EXAMINATION

UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS – FEBRUARY 2014

MIN 4035 OPERATIONS RESEARCH

TIME: THREE (3) HOURS **TOTAL MARKS: 100**
INSTRUCTIONS: ANSWER ANY FIVE (5) QUESTIONS

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1. The following table gives details of a network graph.

Activity	Duration
1,2	8
1,3	12
1,5	7
2,4	3
2,5	5
2,6	12
3,1 (dummy)	0
3,8	9
4,6	7
5,6	4
5,7	2
6,7	6
7,8	10
7,9	6
8,9	8

i) For the data given in the above table, construct the network. **[5 marks]**
ii) Determine the critical path. What is the expected completion time of the project? **[10 marks]**
iii) What is the significance of the critical path? **[5 marks]**

2. A mine produces coal from two sections A and B. The production statistics for each section are as follows:

	Section A	Section B
Hoisting capacity, t/day	4,000	3,000
Mining output, t/manshift	20	28
Haulage performance t/unit/shift	300	190

The underground force operates on a two shifts per day basis. Production miners are restricted to 120 per day.

The haulage fleet in the mine consists of 10 units but since sections A and B are close together, a unit can work a portion of a shift in another section with no loss in production.

Mill capacity including surface bins is limited to 5,000 tonnes per day. The profit per tonne averages US$2.00 for production from section A and US$3.00 for output from section B.

If the objective is to maximize profit find:

(i) The maximum daily profit **[8 marks]**
(ii) The number of tonnes to mine daily from each section. **[6 marks]**
(iii) The best allocation of resources in each section. **[6 marks]**

3. A mining company is contemplating a drilling program on its land located within the Lower Zambezi. The drilling program would cost US$5 million. There is a 0.05 probability that the program would be successful, resulting in a return of US$10 million. Should the program be unsuccessful, the company will have to decide whether or not to sell the prospect. The prospect can be sold for US$2 million with a probability of 0.6 and at US$6 million with a probability of 0.4. However, if the prospect is not sold, then the company will use it for agricultural purposes with a definite return US$12 million.

(i) Construct the decision tree for the company **[10 marks]**
(ii) According to the expected values, what is the company's best strategy? **[10 marks]**

4. A summary of a mine transportation problem is given in the transportation matrix table below.

Origin	P1	P2	P3	P4	Total units available
W_1	US$10	US$10	US$30	US$8	***20***
W_2	16	9	5	15	***14***
W_3	22	12	7	15	***30***
Total units required	***16***	***16***	***24***	***8***	***64***

The origins are warehouses W1, W2, and W3. Destinations are P1, P2, P3 and P4. Supply from W1 = 20 units, W2 = 14 units, W3 = 30 units. Total plant requirements at P1 = 16 units, P2 = 16, P3 = 24 units, and P4 = 8 units. Unit transportation costs are given

(i) From the given details, establish the initial feasible solution using the least cost method. **[10 marks]**
(ii) Determine the optimal solution using solution in (i) above using the Stepping Stone method. **[10 marks]**

5. Zimoil a major supplier of lubricant to mining companies distributes 8,000 drums of oil to ZCM. The costs of determining the order amount of each type of oil, preparing the order forms, and the delivery amounts to US$150.00. Zimoil has its own warehouse. Warehousing and handling costs are pro-rated at US$2.50 per drum per year. The average price paid to oil suppliers is US$800 per drum. Insurance and interest charges mount to 12%.

(i) What is the economic order quantity for oil drums? **[12 marks]**
(ii) How often should orders be placed? **[8 marks]**

6. Discuss the application of some of the operations research techniques in mining giving examples. **[20 marks]**

END OF EXAMINATION

UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - FEBRUARY 2014

MIN 4065 - INVESTMENT ANALYSIS

Instruction: Answer all questions

Time : 3 hours **Total Marks**: 100

QUESTION 1

i. Explain the rationale behind interest [4 marks]

ii. In making investments what risks are you likely to face? [4 marks]

iii. Explain the concept of minimum acceptable interest rate [4 marks]

iv. Distinguish major investment alternatives [4 marks]

v. As a prudent investor outline what strategies you should use [4 marks]

QUESTION 2

i. Explain what effects of inflation on projects [5 marks]

ii. If the inflation rate is 6% per year and a person invests K50,000 in a bank account at 9% per year simple interest for 10 years will purchasing power of the original principal be protected? [5 marks]

iii. If the person in (ii) was paying tax at 35% on interest will he protect his purchasing power. [5 marks]

iv) How much money must be deposited in a savings account each month to accumulate K10,000 at the end of 5 years, if the bank pays interest at the rate of 6% per year compounded [5 marks]

a) monthly
b) daily

QUESTION 3

A bridge with a 100 year life will cost K20 million, it will be resurfaced every 5 years at a cost of K 1 million. The annual inspection and operating costs are estimated at K50,000. Calculate the present worth of the bridge using the capitalized equivalent (100 years can be assumed as an infinite life). Interest rate in 10% per year. [20 marks]

QUESTION 4

a) Given the following cash flows an investment of K50,000 in year and revenue of K16,719 for 5 years, calculate;

(i) the rate of return [5 marks]
(ii) The payback period [5 marks]

b) A public project has benefits of K75 million and cost of K55 million. The disbenefits are estimated to be K15 million (or as a cost). How should this proposal be evaluated? [10 marks]

QUESTION 5

Five alternative machines are being evaluated by a mine. The mine has a budget of K250,000 and a MARR of 15%, which machines should be chosen? Assume that n = 100 years and salvage valve is zero.

Size	**Annual Revenue**	**Initial cost**	**Interest rate**
Economy	K5000	50,000	10%
Regular	25,000	100,000	25%
Super	36,000	200,000	18%
Delay	45,000	220,000	20.45%
Super delux	50,000	300,000	16.67%

[20 marks]

END OF EXAM

THE UNIVERISTY OF ZAMBIA

FINAL EXAMINATIONS – MARCH 2014

MIN 4075 - MATERIALS HANDLING

Time: THREE (3) HOURS. **FULL MARKS: 100**

INSTRUCTION: Answer question number 1 and any other FIVE.

1. (a) The correct selection of men and materials transport equipment is a sensitive issue in terms of safety, economy and for efficient mining. Write the key factors that governs the selection for the above purpose. **(6 marks)**

   (b) Compare the drum winding and the frictional (KOPE) winding system in context of their applications and write three advantages and disadvantages of each system.

   (6 marks)

   (c) Given: the winding drum diameter is 4.4 m, r.m.s. torque for the winder is 109 kNm; the maximum speed of rope is 7.0 m/s. Calculate the power of the motor (in kW) from the values given above. **(8 marks)**

2. (a) What are the main considerations in the selection of a winding rope for hoisting of men and materials from underground?

   (4 marks)

   (b) Briefly explain the difference between the strand rope, non-strand rope and locked coil rope. Write the circumstances in which they are best suited. **(4 marks)**

   (c) Calculate the total length of the rope , keeping in mind the requirements of the Mine Regulation, for 1200m depth of a shaft, the tandem cage height is 5.0 m,the distance between the head gear, the sheave and the winding drum is 50m. The diameter of the winding drum is 2.5m. **(8 marks)**

3. (a) Before any hoisting rope is put in service, some prescribed test are required to be done. List these tests giving reasons why those tests are done. **(10marks)**

   (b) A locomotive weighing 15 tonnes has to pass round a curve of 160 m diameter at a speed 0f 30 km/hour. If the gauge of the track is 1.0 m, what should be the super - elevation of outer rail so that there is no thrust between the flanges of the outer wheel and the outer rail. **(6 marks)**

4. (a) Compare the merits and demerits between the conveyer belts and locomotives used underground. In a mine where the ventilation is generally sluggish, between the above ~~which between the above~~ two, system ~~between the conveyor and locomotives between the conveyor.~~ Which one would you recommend and why? **(10 marks)**

(b) A locomotive (with the train) weighs 50t, generates tractive effort (T.E.) is 125kN/t, is required to move with the velocity of 1.78m/s. If the efficiency of the locomotive engine is 80%, calculate the power required (in kW) to move the locomotive train. **(6 marks)**

5. (a) (i) A proper design layout for pit-top and pit-bottom employing cages or skips for handling materials is extremely necessary. Explain why? **(5 marks)**

(ii) Describe with the help of a neat diagram the pit top layout using traverse system and explain how this operates? **(5 marks)**

(b) A wire rope, round strand with fibre core, has a diameter of 2.54 cm. Find the mass of the rope and the breaking strength. The values of K and s are 0.40 and 56 respectively. **(6 marks)**

6. (a) What is meant by fleet angle in context of drum winding system? Explain by help of a simple diagram. **(4marks)**

(b) Calculate the fleet angle (in degrees) from the data given below:

Ratio of T_1/T_2=2.02, where T_1 and T_2 are the weight of loaded and empty cages respectively and coefficient of friction between the sheave and the winding rope=0.51degrees

If the calculated fleet angle is not within the prescribed limit, how can this be corrected? **(4 marks)**

(c) There are certain parts of winding rope which are particularly liable to suffer deterioration Show by means of a diagram the points of expected maximum damage. **(8 marks)**

7. (a) In a mine where you are working ,the management has planned to transport minerals to the surface using hydraulic system . If the rate of pumping of minerals required to meet the production target = 2000kg/min, from the depth of 50 m deep level, calculate the power of the pump(in kW) and the type of pump you would recommend for this purpose. Take value of g=10m/s^2. **(10marks)**

(b) What is meant by suction head and delivery head in the case of a pump? Write the normal value of suction head for water and show it by calculation. **(6 marks)**

UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATION – FEBRUARY 2014

MIN 4085 MINE VENTILATION

TIME: 3HRS **FULL MARKS: 100**

INSTRUCTIONS: Answer any five (5) questions

Question 1

a) Given: Air quantity Q=70.79 m^3/s , Shock loss H_s=559.9 Pa, Area of Mine Airway A= 3.68 m^2, Average air density in mine airway, ρ=1.2 kg/m^3, contraction factor, Z=2.5. Find the area of the regulator, A_r

[10 Marks]

b) The Vapour pressure in normal air mixture is 12.7mm mercury. If the temperature is 21.1^{0}C and atmospheric pressure 759.5m mercury, calculate the specific volume of dry air in the mixture.

[10 Marks]

Question 2

Consider a two mesh network shown in figure 1. A differential pressure of 2500 Pa is applied across the circuit and natural ventilating pressure of 500 Pa acts in the direction of air flow within mesh 1. A regulator, R_6 is constructed in the rightmost branch in order to limit the airflow in the branch to 20m^3 /s. Given the resistances of all airways, find the distribution air flow and the resistance of the regulator.

[20 Marks]

Question 3

Given the ventilation circuit and resistances which is redrawn in diagrammatic manner in figure 2 determine the distribution of air flow. Assume that the fan pressure remains constant at 2000 Pa and that there is no natural ventilation.

[20 Marks]

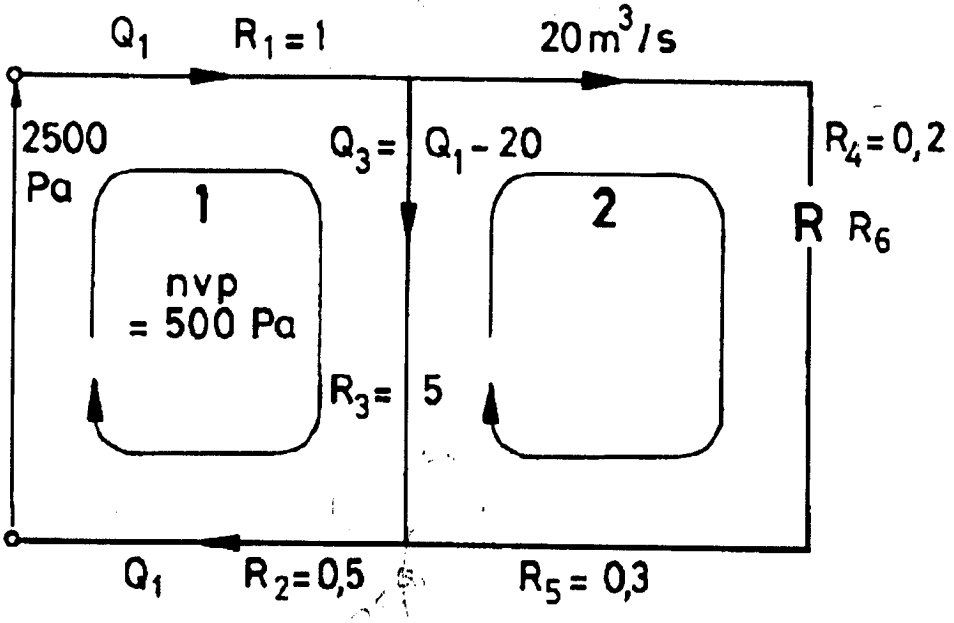

Figure 1 Two mesh diagram

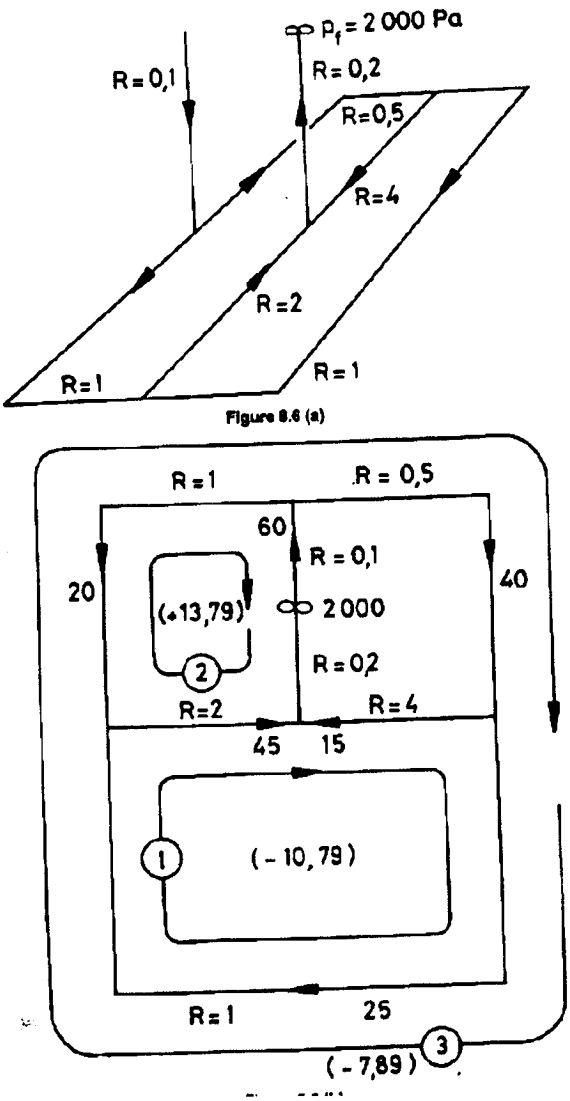

Figure 2 Mine Ventilation circuit

Question 4

Explain with the help of simple diagram the following methods used for cleaning contaminated mine air from dust:

a) Thermal Precipitation **[5 Marks]**
b) Electrical precipitation **[5 Marks]**
c) Gravitational method **[5 Marks]**
d) Optical Method **[5 Marks]**

Question 5

a) A 4.88 m diameter service and production shaft is used to down cast 184 m^3/s of fresh air to the underground workings. An altimeter survey indicated that the shaft has a pressure loss of 1.057 kPa from the surface collar to the 1200ml production level. The shaft is equipped with guides and other support structure for skip hosting of the muck. Determine coefficient of friction K and R factors for the shaft.

[10 Marks]

b) A pipe of diameter 2 cm rises through vertical distance of 5 m over the total pipe length of 2000 m. Water of mean temperature 15 ^0C flows up the tube to exit at atmospheric pressure of 100 kPa. If the required flow rate is 1.6 litres per minute , find the resistance of the pipe, the work done against friction and the head of water that must be applied at the pipe entrance. **[10 Marks]**

Question6

Determine the total equivalent resistance, the total (mine) static head and the quantity of air flowing through each air way, assuming natural splitting in fig 3.

Assume the resistance for each airway to be 0.559 Ns^2/m^8 and the total quantity to be 47.19 m^3/s

[20 Marks]

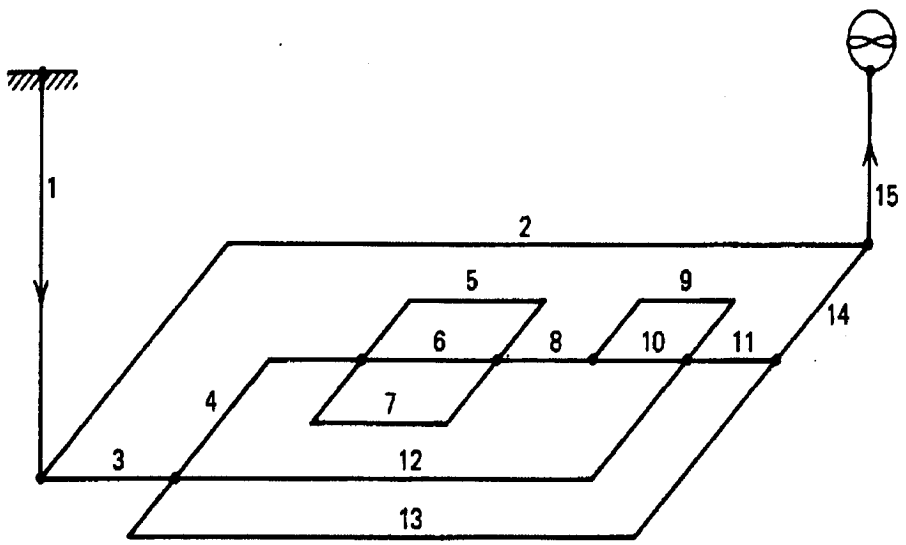

Figure 3. Schematic diagram of Mine ventilation circuits

----------End of examination----------

UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - FEBRUARY 2014

MIN 3059 - INTRODUCTION TO MINERAL ECONOMICS

MET 5489 - ECONOMICS AND MANAGEMENT

GGY 5202 - MINERAL ECONOMICS AND MANAGEMENT

Instructions: Answer All Questions **Total Marks**: 100

Time : 3 Hours

1) a. Provide a wider definition of economics emphazing and discussion three distinct issues in economics [5 marks]

b. Write notes on the production possibility curve, how it helps resolve distinct issues in economics and explains the use of resources in a society and changes in technology. [4 marks]

c. Outline three central economic questions and how they are solved [3 marks]

d. As an economist what do you understand by the following terms?

(i) Market [2 marks]

(ii) Division of labour [2 marks]

(iii) Specialization [2 marks]

(iv) Economic systems [2 marks]

2) a. Discuss the major sectors and flows in an economy [10 marks]

b. With the help of a diagram and equations show how the economic sectors are interlinked [10 marks]

3) a. As a business manager, what major problems should you be considering and how do the concepts of demand and supply help you resolve these? [4 marks]

b. Define, discuss and explain the determinants of individual demand and market demand [4 marks]

c. Define, discuss and explain the determinants of supply and market supply [4 marks]

d. Discuss the concepts of market equilibrium, consumer surplus and producer surplus [4 marks]

e. State the law of demand and explain its economic implications [4 marks]

4) Discuss the following concepts

(i) Elasticity [4 marks]

(ii) Point elasticity of demand [4 marks]

(iii)Cross elasticity of demand [4 marks]

(iv)Major determinants of price elasticity of demand [4 marks]

(v) Price elasticity [4 marks]

5) Given that the equations of supply of demand and supply are

$Qd = 10 - 2P$

$ds = 5 + 3P$

Determine market equilibrium price [20 marks]

END OF EXAM