EXAMINATION PAPER

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA CERTIFICATE IN ROCK MECHANICS PAPER 2 – BASIC ROCK MECHANICS PRACTICE **SUBJECT CODE:** COMRME **EXAMINATION DATE:** 25 OCTOBER 2007 **TIME:** 9:00 – 12:00	**EXAMINER:** G C MORE O'FERRALL **MODERATOR:** M L TRELOAR **TOTAL MARKS:** [100] **PASS MARK:** 60%

NUMBER OF PAGES: 5

SPECIAL REQUIREMENTS:

1. **Answer *<u>ALL FIVE</u>* questions**
2. References other than those provided are not permitted.
3. Hand-held electronic calculators may be used.
4. Put your examination number on the outside cover of each book used and on any graph paper or other loose sheets handed in.

NB: your name must not appear on any answer book or loose sheets.

5. **<u>Write in ink on the RIGHT HAND SIDE of the paper only (only the right hand pages will be marked).</u>**
6. Show all calculations on which your answers are based.
7. Illustrate your answers by sketches of diagrams wherever possible.
8. In answering these questions, full advantage should be taken wherever necessary of your practical experience as well as of the data given.
9. Answers must be given to an accuracy that is typical of practical conditions unless stated otherwise.

CERTIFICATE IN ROCK MECHANICS OCTOBER 2007

PAPER 2

A REMINDER THAT ONLY ANSWERS ON THE RIGHT HAND SIDE OF THE PAGE WILL BE MARKED. THE LEFT HAND PAGE IS FOR ROUGH CALCULATIONS AND WILL NOT BE MARKED!

QUESTION 1 – GEOLOGY

a) In sedimentary geology, what is meant by the term "Pseudo-stratification"? **2**

b) What is the term given to distinguish the differing parts of a deposit? **2**

c) In a sedimentary deposit, by what word are the very thinnest layers known? **2**

d) What is an "Isocline"? **3**

e) Explain **and** draw a box diagram to indicate the difference between a Dextral and a Sinistral fault. **8**

f) Name the three main rock types and give a brief description as to how they were formed. **3**

[20 Marks]

QUESTION 2 – ROCK AND ROCKMASS BEHAVIOUR

a) Excavations made in a rock mass are subjected to numerous structural variances. Name 4 structural conditions to be considered when determining the behaviour of these excavations being developed in the rock mass. **4**

b) A bord and pillar mining project is in the conceptual phase of the design. What Laboratory tests would you recommend to be conducted on the rock mass and why would you recommend them? **10**

c) A main development end on your mine has intersected poor ground which has slowed advances. An exploratory 60 m long diamond drill hole, with **orientated drill core**, has been drilled ahead of the face to gather information on expected ground conditions. You must analyse the orientated core recovered from the hole.

You record a **total** of 380 joints in the core. There appear to be two distinct sets of strike joints, dipping at roughly 20 and 80 degrees respectively. While the one set is rough and undulating, the other is smooth, planar and slickensided. Traces of micaceous filling, varying in thickness from 0 – 3 mm, are visible in the joint planes. No water seems to be present. There also appears to be a 3.0-metre thick weathered dyke running through the middle of this zone, at an angle of 45 degrees.

Calculate the rock mass quality based on the Q-system, using the tables provided in appendix 1. Motivate your reason for each value chosen for use in the rock mass rating.

6

[20 Marks]

QUESTION 3 – FUNDAMENTAL PRINCIPLES OF MINING LAYOUTS AND MINING LAYOUT DESIGN

a) The rock engineering audit of a mine is generally aimed at assessing the mine's overall rock engineering strategy and its implementation. This auditing process comprises two main components. Name and describe these components and list the main audited sub-components related to these two components (structure your answer to clearly identify the main and sub-components of the two different sections in the auditing process) **15**

b) In a table, give an example of 4 load cells that monitor the load on 4 different types of support units, and indicate their type of operation and complexity. **5**

[20 Marks]

QUESTION 4 – MINING SUPPORT AND MINING SUPPORT DESIGN

a) Given the following:

Pillar strength = $KW_{eff}^{05}/H^{0.75}$ Pillar Stress = $\sigma_v/1\text{-}e$

Factor of Safety = Pillar strength/Pillar stress

Downrated UCS of pillar material = 80 MPa

Density of overburden material = 3120 kg/m^3

Mining depth below surface = 180 m

Pillar length = 10 m

Pillar height = 180 cm

Extraction ratio = 83 %

Gravitational constant = 9.81 $m.s^{-2}$

Factor of Safety = 3.0

(i) calculate the actual pillar width; and **7**

(ii) given a new pillar width of 5 metres, calculate the new Factor of Safety **3**

All calculation answers to be given to 2 decimal places

b) Assuming the above layout requires elongate support between the pillars, and based on a 95 % fall-out height of 3.7 metres, calculate the area that a single downrated elongate support unit with a support capacity of 270 kN is able to support. **5**

c) Tabulate 5 reasons for using backfill as a support medium **5**

[20 Marks]

QUESTION 5 – INVESTIGATION AND EVALUATION

a) List 5 parameters derived from recorded wave forms following a seismic event. **5**

b) When installing seismic sensors (geophones) both underground and on surface, it is vitally important to ensure that certain aspects are done correctly to ensure that the information recorded following a seismic event is accurate. Name 5 of these aspects. **5**

c) Most Rock Engineering models are Langrarian and can be categorised into either differential or integral methods. The importance of this is to understand how any given technique can be best applied and how efficient it may be in solving any given problem. Name 5 different modelling techniques that are typically used in numerical modelling packages used in the Rock Engineering discipline. **5**

d) When building a model to assess the various criteria that you are most interested in, there should be some logical steps to follow in building up this model. Name 5 of these. **5**

[20 Marks]

Appendix 1

	STRESS REDUCTION FACTOR	
A	No shear, faults, dyke or weakness zone	1
B	One shear, fault, dyke or weakness zone	2.5
C	One shear, fault, dyke or weakness zone with blocky ground conditions	4
D	Curved joints or dome structure approaching a pothole, reef roll or OPL's	7.5
E	Curved joints or dome structure approaching a pothole, reef roll, OPL's with blocky ground conditions	8
F	Many faults, dyke and weakness zones.	9
G	Wide shear zone	10

	JOINT ALTERATION NUMBER	
A	Tightly healed, hard rockwall joints, no filling	0.5
B	Slight infill, coating < 1mm	1
C	Joint filling > 1 mm	2
D	Joint filling > 3 mm	4
E	Zones or bands of disintegrated or crushed filling, open joints.	8

	JOINT SET NUMBER	
A	Massive, no to few joints	1
B	One joint set	2
C	One joint set plus random joints	3
D	Two joint sets	4
E	Two joint sets plus random joints	6
F	Three joint sets	9
G	Three joint sets plus random joints.	12
H	Four or more joint sets, random, heavily jointed.	15
I	Crushed rock	20

	JOINT WATER	
A	Dry	1
B	Dripping water	0.5

	JOINT ROUGHNESS NUMBER		
A	Discontinuous joints		4
B	Rough or irregular	undulating	3
C	Smooth	undulating	2
D	Slickensided,	undulating	1.5
E	Rough or irregular	planar	1.5
F	Smooth	planar	1
G	Slickensided	planar	0.5