

EXAMINATION PAPER

SUBJECT:	EXAMINER:
CERTIFICATE IN ROCK MECHANICS: PAPER 2	JJ VAN DER MERWE
SUBJECT CODE:	MODERATOR:
COMRME	P GREYLING
EXAMINATION DATE:	TOTAL MARKS: [100]
OCTOBER 2015	PASS MARK: 60%
TIME: 9:00 – 12:00	

NUMBER OF PAGES:

SPECIAL REQUIREMENTS: 1. Answer all <u>FIVE</u> questions. 2. References other than those provided are not permitted. 3. Only approved hand-held electronic calculators may be used. 4. Write 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.
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QUESTION 1

- 1) What are the generally accepted units for Seismic Moment under micro seismic conditions?
 - a) mN/m^2
 - b) Nm
 - c) Nm/m^2
 - d) MJ/m^2
- 2) What will be the maximum vertical subsidence calculated when using the following formula Where the stoping width is 150cm, the depth is 0,080km and the stoping span is 100m?
 - a) 279mm
 - b) 158mm
 - c) 4.06mm
 - d) 931mm
- 3) The Minerals Act Reg. states that no person is allowed to work in any area where the wet/dry bulb is in excess of _____. Indicate which temperature limits are applicable?
 - a) $31.5^\circ\text{C}/35^\circ\text{C}$
 - b) $32.5^\circ\text{C}/37^\circ\text{C}$
 - c) $32^\circ\text{C}/36^\circ\text{C}$
 - d) $29^\circ\text{C}/32.5^\circ\text{C}$
- 4) What are the generally acceptable units for the Rock Wall Condition factor?
 - a) KN
 - b) KJ/m^2
 - c) MPa
 - d) None of the above.
- 5) Which of the following criterion or theory best describes the propagation of fractures?
 - a) Griffith Criteria
 - b) Hoek & Brown Empirical criteria
 - c) Lade Empirical Criteria
 - d) *Tresca's Criterion*

6) On the analysis of seismicity which of the following E_s/E_p ratios would suggest a burst type event along a Dyke structure:

- | | |
|--------|--------|
| a) 0.5 | b) 0.8 |
| c) 1.0 | d) 1.2 |

7) When designing shaft pillars and associated excavations, the major principal field stress to limit deformation should be reduced to the critical stress which is normally given as:

- | | |
|-------------------------|-------------------------|
| a) σ_c | b) $\frac{\sigma_c}{3}$ |
| c) $\frac{\sigma_c}{4}$ | d) $\frac{\sigma_c}{2}$ |

8) Sketch and annotate a section of a Horst and Graben structure and show relative displacements. (3)

9) List the three fundamental rock types, as well as a reef and a mineral being mined from each? (3)

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Question 2

- 2.1 List the factors that need to be considered when comparing laboratory and in-situ results with regards to load/deformation characteristics of a yielding timber prop. (5)
- 2.2 Sketch and describe a typical waste fill back fill system from receiving the waste to placement. (7)
- 2.3 List, sketch and describe two yielding type grouted tendons generally used in footwall excavations in seismically active areas. Show a typical load displacement graph for each unit. (8)

Question 3

Describe and explain how the following variables would influence the indicated strength of rock samples tested in tri-axial compression.

- 3.1.1) Specimen end effects (2)
- 3.1.2) Sample grain size (2)
- 3.1.3) Loading rate (2)
- 3.1.4) Orientation of bedding within the sample (2)
- 3.1.5) Sample width: height ratio (2)

Shear strength tests

- 3.2.1 Describe and explain how samples may be collected for shear strength determination? (2)
- 3.2.2 Describe and explain how samples are prepared for shear strength determination? (2)
- 3.2.3 Sketch and discuss how Brazilian indirect tensile strength tests are carried out? (6)

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Question 4

You are appointed as Rock Engineer at the North-West shaft where the shaft sinking is still in progress. The design is to pre-extract the inner shaft pillar from an adjacent shaft after which the shaft will be sunk through the mined out area. Reef intersection is at 2500m below surface.

- 4.1 What would your support recommendation be for the inner shaft pillar and the outer shaft pillar, also substantiate your choice of support? (4)
- 4.2 You are asked to assist the shaft engineer with the design of a floating steel section.
 - 4.2.1 List what relevant information must be supplied to the engineer to enable him to do the design? (3)
 - 4.2.2 How would you go about obtaining the relevant information?(2)
 - 4.2.3 Shortly list the rock properties that you will require? (3)
- 4.3 You are required to monitor the stability within the shaft after the sinking phase has been completed. Shortly discuss how you would go about to achieve the following?
 - 4.1.2.1 Monitoring program (3)
 - 4.3.2.2 Instrumentation required and where they must be installed (3)
- 4.4 Shortly discuss what the advantage of doing an early shaft pillar extraction? (2)

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Question 5

- 5.1 Name the two blasting methods for smooth wall blasting of an underground tunnel at a depth of 3000m and briefly describe how it is done. (5)
- 5.2 You are appointed as the Rock engineer on ABC mine and you have a twin decline system that was developed 30m apart. You are required to monitor for ground movement along the excavations.
- List 3 types of borehole extensometers and briefly describe the difference. (4)
- 5.3 As a rock engineer, why would you install a borehole extensometer instead of simple measuring pegs around an excavation? (3)
- 5.4 List the different numerical modelling techniques and Codes that applies the techniques? (4)
- 5.5 The following numerical modelling approaches are available. Shortly discuss each approach, showing your understanding of each approach? (4)
- Elastic vs nonlinear
 - Two dimensions vs three dimensions:
 - Static vs Dynamic:
 - Deterministic vs Probabilistic:

[20]**Total 100 Marks**