MEMORANDUM

SUBJECT: CERTIFICATE IN ROCK MECHANICS: PAPER 2	**EXAMINER:** LJ SCHEEPERS
SUBJECT CODE: COMRME	**MODERATOR:** P GREYLING
EXAMINATION DATE: April 2013	**TOTAL MARKS:** [100] **PASS MARK:** 60%
TIME: 9:00 – 12:00	

NUMBER OF PAGES: 7

SPECIAL REQUIREMENTS:

1. **<u>ALL</u> candidates to answer all 5 questions**
2. References other than those provided are not permitted.
3. 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.

QUESTION 1 Geotechnical characteristics (20marks)

Data from a drilling programme on your mine is shown in the table below.

The positions of the drill holes are shown on the accompanying map (Figure 1). Redraw the map with your answers in your answer book (you may use the graph paper in the centre of your answer book).

Position	Height above sea level(m)	Depth of Mineralised layer below collar(m)
A	230	10
B	280	80
C	330	160
D	280	35
E	300	75
F	340	135
I	310	55

1.1 Draw in the contours of the mineralised layer on the plan and calculate the dip. Also show the fault in relation to the mineralised layer. Show the strike of the fault approximately. (10)

1.2 Also shown on the map are two section lines G-H and C-B-I.A fault is indicated at position J on Section G-H.

1.2.1 Draw section G-H and determine the dip of the fault and the throw and heave of the fault along this section. (5)

1.2.2 Draw Section C-B-I with the surface topography and mineralised layer and fault. Calculate the apparent dip of the mineralised layer and the apparent dip of the fault. (5)

[20]

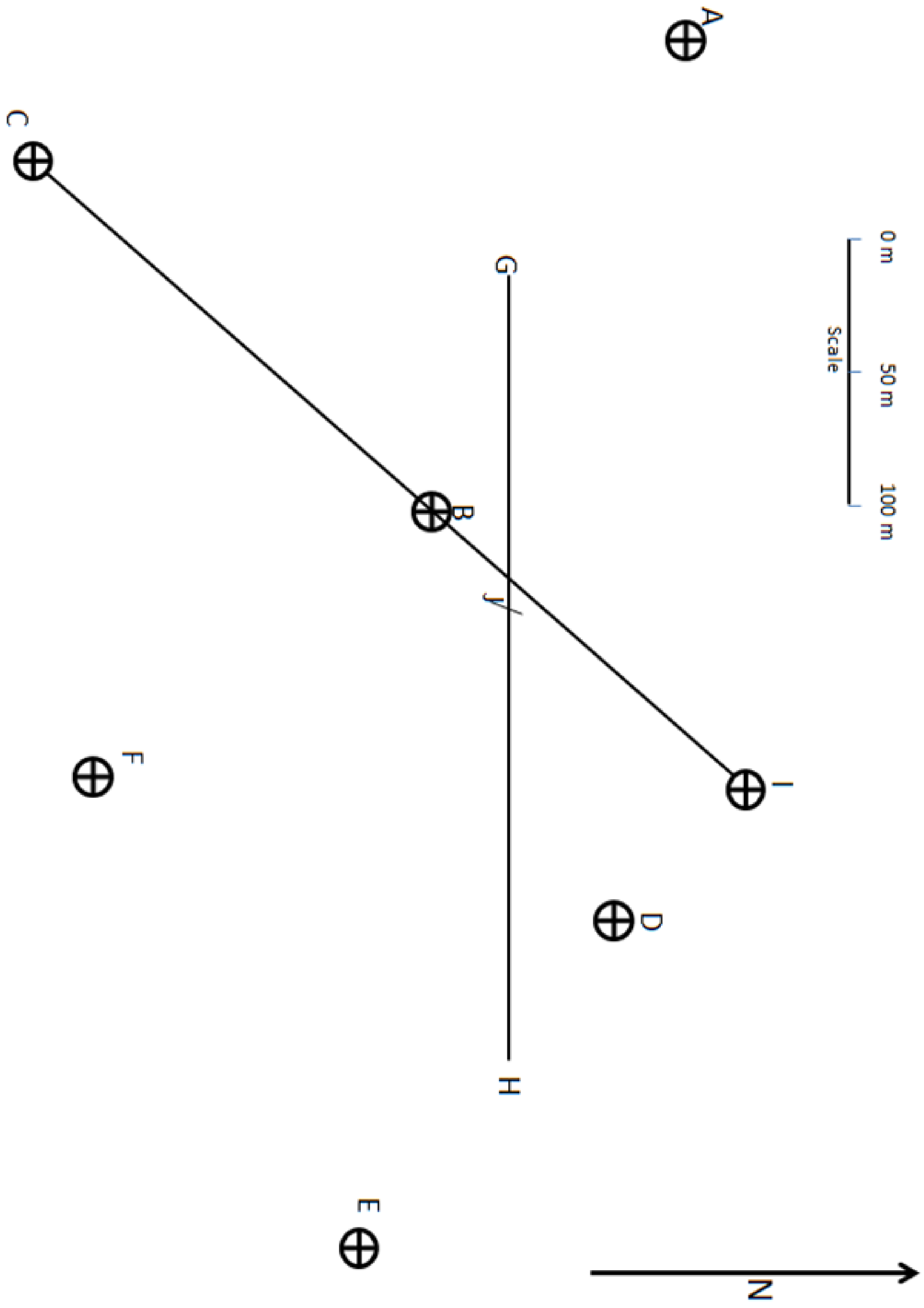


Figure 1 Map of borehole data

QUESTION 2.Rock and rockmass behavior (20marks)

You have both deep and shallow development ends on your hard rock mine. Use the geotechnical data below to answer the questions (show all calculations and assumptions).

Density of rockmass: 3000kg/m^3

Gravitational acceleration: 9.81m/s^2

UCS of host rock: 100 MPa

UCS of soft erosion channel: 20 MPa

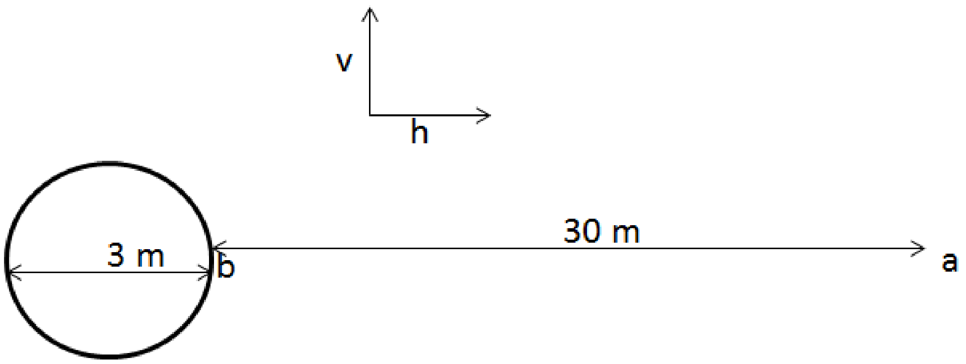
UCS of stiff dyke: 200 MPa

Shallow area depth: 200 m

k-ratio: 2

Deep area depth: 3000 m

k-ratio: 0.5



2.1 For 3m diameter circular tunnels being developed in both the deep and the shallow mining areas, calculate the stress at positionsa and b (transfer the table to your answer sheet and complete the emptycells). (8×½=4)

Stress		Position a	Position b
deep	σ_h		
	σ_v		
Shallow	σ_h		
	σ_v		

2.2 Indicate if you expect fracturing to occur in the host rock at positions a and b for shallow and deep development and why (4)

2.3 For deep development, if position a was located in the soft erosion channel, would you expect fracturing to occur? (2)

2.4 For a square tunnel in the deep area, what would the vertical stress (σ_z) at point b be? (1)

2.5 Calculate the RCF for a planned circular tunnel in the deep area that will traverse the host rock as well as the erosion channel and the dyke (transfer the table to your answer sheet and complete the empty cells). Assume a rockmass rating of 60%. Show all calculations and assumptions. (6×½=3)

RCF	Host rock	Soft erosion channel	Stiff dyke
Deep tunnel			
Shallow tunnel			

2.6 Interpret the RCF values in terms of expected tunnel stability. (4)

2.7 Comment on the applicability of the RCF values for tunnel design and what can be done to ensure correct application of these values in tunnel design. (2)

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QUESTION 3. Mining layouts (20 marks)

View the information in the table and answer questions 3.1 to 3.3 using the information in the table:

Mine	Description	Depth below surface (m)	Average fault spacing (m)
A	Narrow tabular hard rock	4000	500
B	Massive soft rock	100	500

Transfer the answer table to your answer sheet and complete the empty cells

3.1 Describe the most likely mining strategy for mines A and B. In your answers refer to likely mining spans and pillar types and sizes. (6)

3.2 Describe the most likely placement of access development (4)

3.3 List the hazards associated with a fault in the stoping area for mines A and B. Highlight the differences in hazards where applicable. (2)

3.4 List the risk management strategies for stoping associated faults that you will implement at mines A and B. (4)

3.5 List the risk management strategies for access ways associated with faults that you will implement in mines A and B (4) [20]

	Mine A	Mine B
3.1 mining strategy		
3.2 Access development		
3.3 Hazard associated with faults		
3.4 Risk management strategies for stoping		
3.5 Risk management strategies for access ways		

QUESTION 4.Mining support design (20 marks)

4.1 In an ultra-deep level narrow tabular mine using hydraulically placed classified tailings backfill placed in geotextile bags, a large number of bag failures have been reported. Discuss the potential causes that you would investigate to solve this problem. (10)

4.2 In a shallow open stoping mine it is decided to use backfill. Describe the most likely fill strategy and fill type and motivate your answers. (5)

4.3 Draw a load-deformation graph for a rebar support unit and describe the conditions where such a support unit will be used and the conditions where this support unit will not be appropriate. (5)

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QUESTION 5. Monitoring, numerical modeling and risk assessment (20 marks)

5.1 A massive mine with a limited ore body in a hard, competent host rock with several intrusions recently expanded from open pit to u/g operation.

5.1.1 What could be the purpose of operating a seismic network on this mine? (3)

5.1.2 Describe a rough network design to cover the objectives (2)

5.1.3 Which type of ground motion sensor would be suitable? (2)

List the general challenges faced by networks around massive ore bodies? (2)

5.1.4 List the input parameters / variables related to rock mass that need to be quantified (2)

5.2 For network configuration, in which way could calibration blasts assist and where would they have to take place? (3)

Numerical modelling.

5.3 What is the objective / purpose of conducting numerical modelling? (3)

5.4 Name existing and commonly used numerical modelling codes to conduct the following analyses (3)

a) A detailed assessment of expected fracture patterns in a single pillar in a typical mine

b) An assessment of expected block fallout size in a highly jointed shallow mine.

c) Assessing seismic risk on several sections in a deep level hard rock mine.

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