Chamber of Mines of South Africa

EXAMINATION PAPER

SUBJECT: CHAMBER OF MINES CERTIFICATE IN ROCK MECHANICS: PAPER 2 **SUBJECT CODE:** COMRMC2 **EXAMINATION DATE: 12 October 2016** **TIME:** 14:30 – 17:30	**EXAMINER:** B VAN DER KEVIE **MODERATOR:** P GREYLING **TOTAL MARKS:** [100] **PASS MARK:** 60%

NUMBER OF PAGES: 11(including answer sheet)

SPECIAL REQUIREMENTS:

1. Answer all questions.
2. Write your **answers for Question 1 on the answer sheet provided** at the back of the question paper and submit this with your script.
3. **Only 1 (one) correct answer for all questions in Question 1.**
4. References other than those provided are not permitted.
5. Hand-held electronic calculators may be used.
6. 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.

7. **Write in ink on the RIGHT HAND SIDE of the paper only (only the right hand pages will be marked).**
8. Show all calculations on which your answers are based.
9. Illustrate your answers by sketches of diagrams wherever possible.
10. In answering these questions, full advantage should be taken wherever necessary of your practical experience as well as of the data given.
11. Answers must be given to an accuracy that is typical of practical conditions.
12. Cell phones are **NOT** allowed in the examination room.

QUESTION 1

TICK THE MOST CORRECT ANSWER ON THE ATTACHED SHEET PROVIDED AND HAND IN WITH YOUR EXAM BOOK. ENSURE ID NUMBER IS ON THE SHEET.

Only 1 (one) most correct answer for all questions in Question 1. If more than one is ticked no marks will be given

1.1 Which **one** of the following rocks are not Igneous rocks?

a) Syenite
b) Gabbro
c) Gneis
d) Kimberlite
e) Trachyte (1)

1.2 Which **one** of the following rocks are not sedimentary rocks?

a) Mudstone
b) Shales
c) Coal
d) Hornfels
e) Limestone (1)

1.3 Which **one** of the following rocks are not Metamorphic rocks?

a) Quartzite
b) Shale
c) Slate
d) Migmatite
e) Marble (1)

1.4 Which **one** of the following statements is in**correct?**

a) There are many **normal faults** in the goldfields with throws exceeding 100 m. The largest inferred fault system strikes NS, west of the Klerksdorp goldfield, and has an estimated throw of 10 000 m (Strydom 1971). To the south of this area is a post-Transvaal fault with a well-stablished throw of 2 000 m and another of 5 000 m estimated from drilling. In the Free State goldfields, the largest fault exposed has a throw of 1 700 m. The northern limit of the Carletonville fault is a horst structure bounded by faults with throws of over 2 000 m. In the Evander goldfield, which is an extension of the main Witwatersrand basin and is intensely faulted, the largest fault has a throw of 300 m.

b) Bedding plane faults, as the name implies, strike and dip essentially perpendicular with the stratification but can locally cross-cut up or down through the succession. They are not present in all the major goldfields. Where they occur close to the reef horizon they not only complicate mining by displacing the reef, but the presence of secondary horsetail shears, splaying off the main fault, can cause difficult strata control problems (Roberts et al 1972).

c) The Witwatersrand Basin has experienced at least nine episodes of dyke and sill intrusion. Most of the intrusions are basic in composition, reflecting the major magmatic events that have occurred in Southern Africa. The oldest, associated with the mainly andesitic Ventersdorp lavas, are altered and relatively weak, UCS 140 – 180 MPa; whilst the more recent dolerite intrusions can be exceptionally strong, having UCS values of 300 – 750 MPa.

d) a and b
(4)

1.5 Which **one** of the following instruments measure opening of discontinuities?

a) Petro-scope

b) Doorstopper

c) Geophone

d) Wire extensometer

e) GPR (1)

1.6 Which **one** of the following statements is in**correct?**

The greater the burden on a hole:

a) The longer will be the back–cracking away from the free face
b) The further the gases will penetrate any jointing in the rock mass
c) The greater will be concussion in the excavation, blasting out support damaging ventilation columns and shaking down relaxed rock from the side and hangingwall.
d) The higher will the velocity of detonation (VOD) be. (1)

1.7 What is the ideal w:h ratio of squat pillars ?

a) 10
b) 5
c) 2-3
d) 15
e) 4 (1)

1.8 The results obtained from pull tests done on a capsulated grout from 200mm steel pipes are

1. 2.8 tons 2. 3.2 tons 3. 3.0 tons

What is the critical bond length based on the above results, when used in conjunction with 22mm diameter tendons produced from 500MPa steel.

a) 2.3m
b) 1.291m
c) 500mm
d) 300mm
e) 1.5m (4)

1.9 What is the most suitable mining method for a reef-body dipping at 80 degrees with a stoping width of 2m at shallow depth?

a) Scattered mining
b) Longwall mining
c) Longhole open stoping
d) Cut and fill mining
e) Block caving (1)

1.10 What is typical stope closure rates (mm/m face advance) for breast panel stoping in intermediate mining depths (1000m 2250m - B.S.)

a) 5mm
b) 10-30mm
c) 30mm
d) >30mm
e) <10mm (1)

1.11 With respect to the mine health and safety act Chapter 14 which one of the following statements is incorrect:

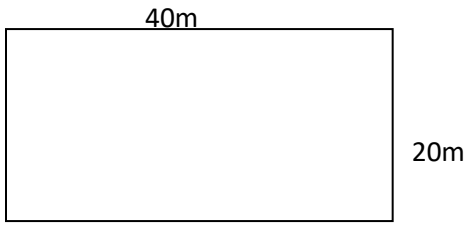
At any underground mine where a risk of rock burst, rock falls or reef falls exists and at every other mine where a significant risk of rock burst, rick falls or roof falls exists, the employer may not permit any person, other than those persons examining and making safe, to enter any of the following areas at the mine until such areas are declared safe by a competent person:

a) The area between the face and the nearest line of permanent support; and
b) Access ways, travelling ways or places where persons need to travel or work;
c) Must ensure that only competent persons install, maintain and remove any support unit;

d) Must ensure that the input of a competent person is properly and timeously considered and integrated into the mine design, planning and operations

e) This competent person means a person who is at least in possession of either the Chamber of Mines certificate in Rock Engineering or a Chamber of Mines Strata Control Certificate in Rock Engineering. (2)

1.12 Calculate the hydraulic radius for the following shape:



a) 6,67
b) 2,00
c) 13,33
d) 10,00
e) 0,500 (2)

1.13 The typical width to height ratio for an elastic pillar would be:

a) ≤ 5 b) ≥ 5

c) ≥ 3 d) < 10

e) >5

(1)

1.14 $Log_{10}L \equiv 1 + M/2$ estimates, in meters, the source dimension

resulting to a
specific magnitude of seismic event. What is the estimated event magnitude if the source dimension is 1 000m?

a) 3,5 b) 4,0

c) 3,0 d) 5,0 (2)

1.15 What is the effective pillar width for a pillar measuring 7m x 4m?

a) 4m
b) 6m
c) 3m
d) 5m
e) 7m (2)

[25]

QUESTION 2 (Mine Design, Support and instrumentation)

A new platinum mine is being planned in the Western Bushveld. The average depth of this single tabular orebody is 250m below surface. The dip of the orebody is 29 ° and the planned stoping width is 1,1m. The orebody is totally payable and is disrupted by only a few steep and flat dipping faults and dykes with displacements ranging from 3 to 5m. The host rock is jointed with 3 joint sets and a random joint set. This random joint set is normally flat dipping (<45°) and consist of a cohesion less soft Serpentinite infilling.

The hangingwall of the reef is Pyroxenite with a strength of 250 MPa. The orebody is Chromotite with a UCS of 50 MPa. The footwall is Anorthosite with a UCS of 100MPa. A Undulating Calcite Break (UCB) is in the hangingwall and the distance from TRC ranges from 0m to 6m into the hangingwall. The contact of the UCB is approximately 2cm thick with soft cohesion less Calcite as the infilling. The frequency and amplitude of the UCB varies significantly and is totally unknown and unpredictable.

2.1 What mining method would you consider to mine this orebody?
Give reasons for your answer

(4)

2.2 What regional and local pillar system would you consider?
Give reasons for your answer.

(4)

2.3 What in-stope support system would you use?

Give reasons for your answer

(3)

2.4 What are the possible risks and challenges you would encounter with the UCB in the hangingwall ? Give possible actions and solutions for these challenges.

(6)

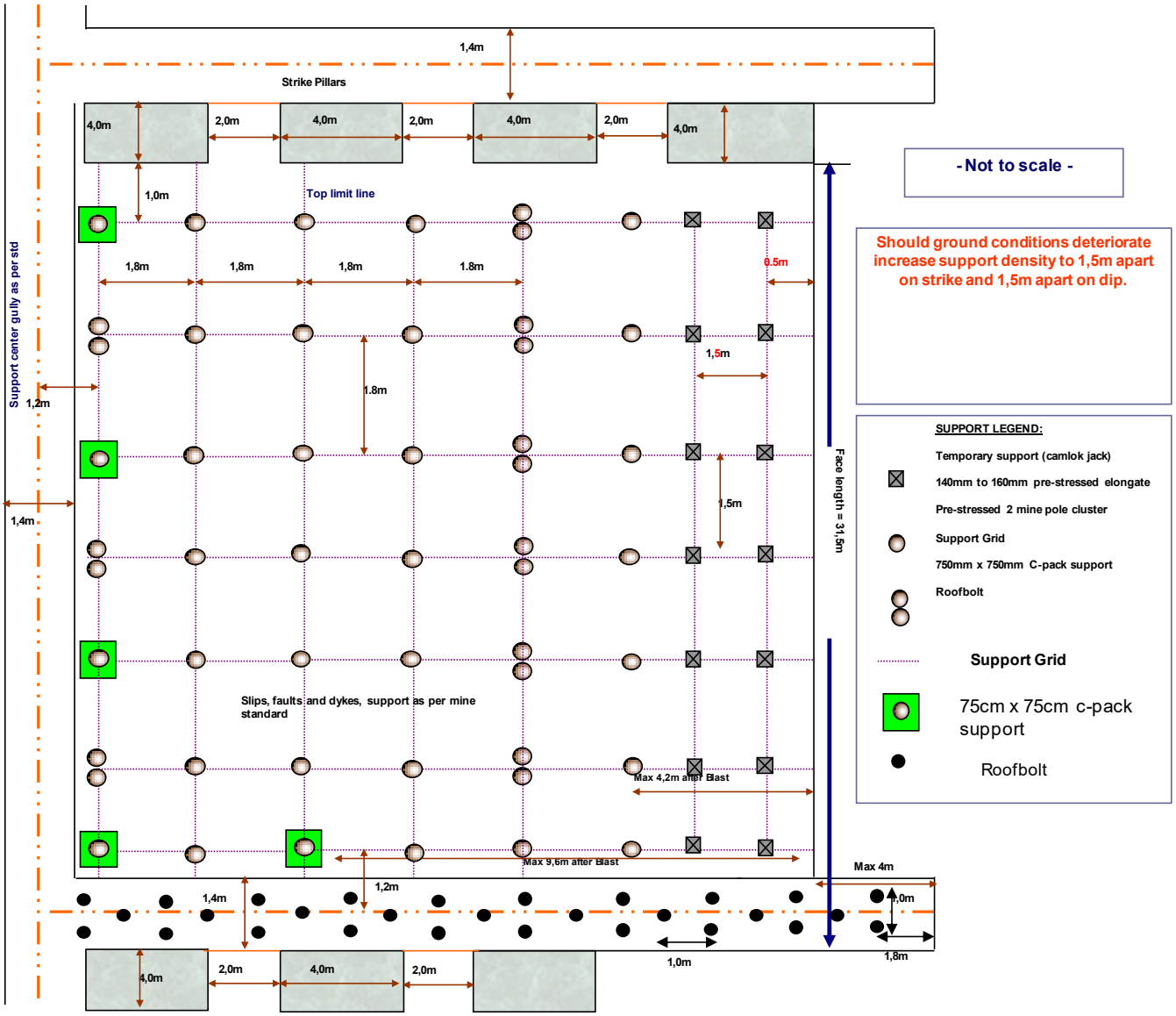
2.5 Name four possible Strata control/Geotechnical challenges to be expected and possible actions to minimize the risk of these challenges

(8)

[25]

QUESTION 3 (Mine support and design)

You are the Senior rock Engineer on a Bushveld Mine. The mining method is scattered mining with a raise line spacing of 200m. Panels are 32m long, breast and with elastic (stable) pillars on the gullies. The layout and support standard is depicted in the sketch below. The average depth is 150m below surface the stoping width is 1.1m and the dip of the reef is 20°. The host rock is jointed with 2 joint sets and a random joint set. This random joint set is normally steep dipping (>70°) and consist of a cohesion less soft pegmatoidal infilling .



3.1 Recently progressive pillar failures are being experienced and it is becoming more common in the back areas in certain areas. These failures take the form of pillar spalling, hour-glassing and sometimes violent bursting.

3.1.1 Briefly name 4 possible reasons (Mining and/or Rock Engineering) for this pillar scaling in the back area?

(4)

3.1.2 How will this affect the current stoping and why ?

(2)

3.1.3 What corrective measures will you take to ensure the future stability of the panels?

You can use the support standard to mention the possible support changes and why as a guideline.

(2)

3.1.4 Name 2 types of instrumentation you can install to monitor or measure factors or conditions that can affect future stability once corrective action has been taken to give early warning to prevent a possible re-occurrence?

(2)

3.1.5 The instrumentation listed in 3.1.4: Explain with sketches how this instrumentation work and the outputs/results you obtain from it.

(4)

3.2 In a second geotechnical area different conditions are being experienced. The pillars are stable and not scaling or failing but the in-stope support (mine poles and Packs) are buckling and failing due to excessive closure. The area is dominated by a large amount of shear-zones being intersected. These shear zones are areas of ntense jointing superimposed on the existing joint sets.

3.2.1 Briefly discuss the possible reasons for this support failing in the back area?

Use sketches to illustrate failure mechanisms

(4)

3.2.2 What corrective measures will you take to ensure the future stability of the panels? You can use the support standard to mention the possible support changes and why as a guideline.

(2)

3.2.3 The conditions and failures as described in 3.2 above is not always present in all areas and management requested you to pro-actively determine the areas where these conditions may prevail in future during the development stages before stoping commence. Discuss and describe the strategy you will follow to determine this and how you will implement this.

(5)

[25]

QUESTION 4 (Mining support and Mining Support Design)

A wide range of materials are used in hydraulic backfilling operations and the pipeline flow behaviour of these mixtures varies considerably. It is shown that despite the large differences in constituent materials and flow behaviour, a common approach can be applied to analysing the flow of all hydraulic backfills. This is extended to include a rational design approach for backfill distribution systems.

4.1 Backfill is transported by pipeline from surface to stopes underground. There are two basic types of backfill distribution systems—free fall and full flow.

4.1.1 Briefly describe these 2 distribution systems (2)

4.1.2 Discuss and describe 4 disadvantages of a free fall system (4)

4.1.3 Discuss and describe 2 advantages of a full flow system

(2)

4.2 Rockburst Hydraulic props are extensively used in the deep level gold mining.

4.2.1 Discuss and describe with the aid of sketches the integral parts of a Hydraulic Rockburst prop. Also name and describe 2 accessories that can be used.

(7)

4.2.2 Discuss the principles of operation of a Hydraulic Rockburst prop. (4)

4.2.3 Give 3 pro's and 3 Con's of Hydraulic rockburst props as a support system

(6)

[25]

TOTAL MARKS: 100

Answer sheet multiple choice (Question 1)
October 2016 Paper 3.2

ID Number ☐☐☐☐☐☐☐☐☐☐☐☐☐

	a	b	c	d	e
1.1	☐	☐	☐	☐	☐
1.2	☐	☐	☐	☐	☐
1.3	☐	☐	☐	☐	☐
1.4	☐	☐	☐	☐	☐
1.5	☐	☐	☐	☐	☐
1.6	☐	☐	☐	☐	☐
1.7	☐	☐	☐	☐	☐
1.8	☐	☐	☐	☐	☐
1.9	☐	☐	☐	☐	☐
1.10	☐	☐	☐	☐	☐
1.11	☐	☐	☐	☐	☐
1.12	☐	☐	☐	☐	☐
1.13	☐	☐	☐	☐	☐
1.14	☐	☐	☐	☐	☐
1.15	☐	☐	☐	☐	☐