Minerals Council South Africa

MEMORANDUM

SUBJECT: MINERALS COUNCIL OF SOUTH AFRICA CERTIFICATE IN STRATA CONTROL – METALLIFEROUS **SUBJECT CODE**: COMSC **DATE**: 12 MAY 2026 **TIME:** 14H00 TO 17H00 (3 HOURS)	**EXAMINER**: MW WIGGINS **MODERATOR**: R ARLOW **TOTAL MARKS**: [100] **PASS MARK:** (60%)

NUMBER OF PAGES: **10 (including this one)**

EXAMINATION FORMAT: CLOSED BOOK. NO REFERENCES OTHER THAN WHAT IS PROVIDED ARE ALLOWED.

SPECIAL REQUIREMENTS:

1. Answer ALL the questions in legible English.
2. Write your ID number (no names) on the outside cover page of each script used and on any graph paper or other loose sheets handed in.
3. Show all calculations and check the calculations on which the answers are based.
4. Hand-held electronic calculators may be used for calculations. Reference notes may not be programmed into calculators.
5. Write legibly in black ink on the right-hand page only. ***Left-hand pages will not be marked.***
6. Illustrate your answers using sketches or diagrams wherever possible.
7. Final answers must be given with accuracy typical of practical conditions; however, be careful not to use too few decimal places during your calculations, as rounding errors may result in incorrect answers.

   NB: Ensure that the correct unit of measure (SI unit) is used as marks will be deducted if the incorrect unit is used even if the calculated value is correct.
8. In answering the questions, full advantage should be taken of your practical experience as well as the data given.
9. You are not allowed to contact your examiner or moderator regarding this examination.
10. Cell phones and other smart devices are not allowed on your person and must be handed to the invigilators or left in your vehicle.
11. You are encouraged to make use of the **CoMCert Tip-off Hotline** whenever you witness or suspect any wrongdoing related to the CoMCert Examinations on landline **0800 118 998** or alternatively you can use email **COMCert@tip-offs.com**. This tip-off hotline and tip-off email is managed anonymously and confidentially through an independent service provider.

QUESTION 1. GENERAL KNOWLEDGE - DEFINITIONS

Define the following terms and state the applicable SI unit or formula where relevant. (2 marks each)

1.1 Pore pressure

1.2 Effective stress

1.3 Cohesion

1.4 Uniaxial tension

1.5 Residual strength

1.6 Ductile deformation

1.7 Gravity

1.8 Mass

1.9 Gouge

1.10 Striations

TOTAL [20 Marks]

QUESTION 2: MULTIPLE-CHOICE

Select the correct answer. (1 mark each)

2.1. The specific fracturing pattern found due to the interaction of stopes and gullies at great depth is:

a) Radial fracturing
b) Interaction of stope-parallel and gully-parallel fractures
c) No fracturing occurs in gullies
d) Horizontal bedding separation only

2.2. The main purpose of stemming in a blast hole is to:

a) Increase drilling speed
b) Waterproof explosives
c) Confine detonation gases to improve rock breakage
d) Mark the hole after blasting

2.3. In very shallow mining, the main excavation stability concern is:

a) Rock bursting
b) Interaction of mining stresses with the ground surface
c) Plastic closure
d) High temperature

2.4. Which of the following best describes the relationship between vertical and horizontal stress in deep mining?

a) Horizontal stress is always zero
b) Horizontal stress is independent of depth
c) Horizontal stress is often proportional to vertical stress
d) Vertical stress is independent of density

2.5. The shear box test is used primarily to determine:

a) UCS
b) Joint shear strength
c) Young's modulus
d) Poisson's ratio

2.6. Which mining method is suited to extracting wide reefs using mobile machinery?

a) Scattered mining
b) Up-dip mining
c) Trackless mining
d) Breast mining

2.7. Ore passes in highly stressed ground commonly deteriorate into a shape that is:

a) Circular
b) Square
c) Elliptical or dog-eared
d) Triangular

2.8. Joint strength is reduced by:

a) High friction angle
b) Increased roughness
c) Thick, soft infill
d) High wall strength

2.9. An instrument used to monitor bedding separation in the hangingwall is a:

a) Geophone
b) Extensometer
c) Stress cell
d) Schmidt hammer

2.10. Mechanical anchor bolts function mainly through:

a) Full-column resin bond
b) Friction along full length
c) Point anchoring and tensioning
d) Grouting under pressure

2.11. The Brazilian test is used to estimate:

a) Compressive strength
b) Density
c) Shear modulus
d) Indirect Tensile strength

2.12. A horst is:

a) A down-faulted block
b) An up-faulted block between two normal faults
c) A thrust plane
d) A folded syncline

2.13. In the Ozbay and Ryder pillar concept, a crush pillar during re-compaction:

a) Loses all load-bearing capacity
b) Regains load-bearing capacity during compression
c) Becomes elastic only
d) Cannot absorb energy

2.14. The SI unit of density is:

a) kg/m^2
b) kg/m^3
c) N
d) MPa

2.15. Mylonite is associated with:

a) Sedimentary bedding
b) Intense shearing in fault zones
c) Reef replacement
d) Igneous cooling only

2.16. The primary function of yielding support in deep-level mining is to:

a) Prevent all movement in the rock mass
b) Absorb and dissipate energy from rock failure
c) Increase drilling rates
d) Reduce blasting costs

2.17. Spalling in underground excavations is most commonly associated with:

a) Tensile failure parallel to excavation surface
b) Shear failure along joints
c) Plastic deformation at low stress
d) Weathering of rock surfaces

2.18. Which instrument is used to measure changes in stress within a rock mass?

a) Extensometer
b) Closure meter
c) Stress cell
d) Schmidt hammer

2.19. **A decrease in pillar width-to-height ratio will generally result in:**

a) Increased pillar strength
b) Decreased pillar strength
c) No change in pillar strength
d) Increased density

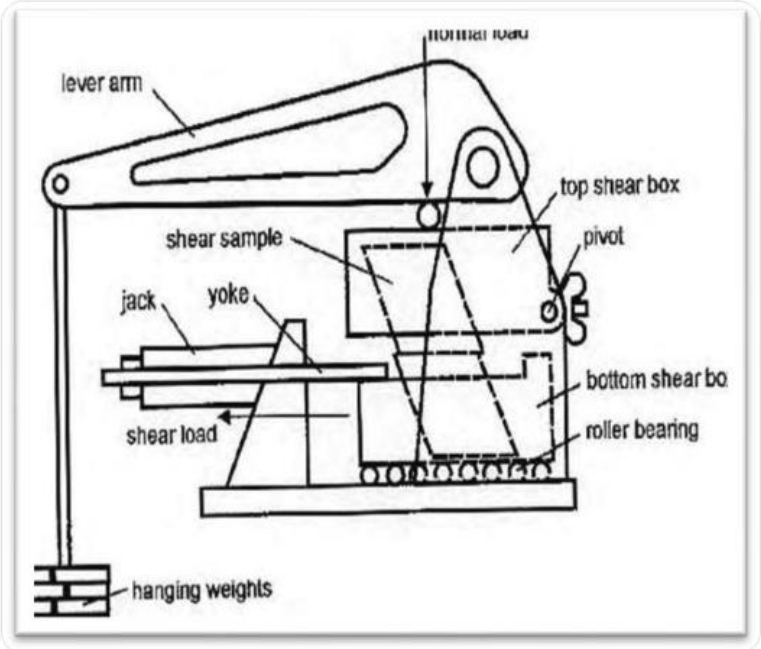
2.20. In the Q-system of rock mass classification, which parameter represents the degree of joint alteration or infilling?

a) RQD
b) Jn
c) Jr
d) Ja

TOTAL [20 Marks]

QUESTION 3: ROCK MASS PROPERTIES AND TESTING

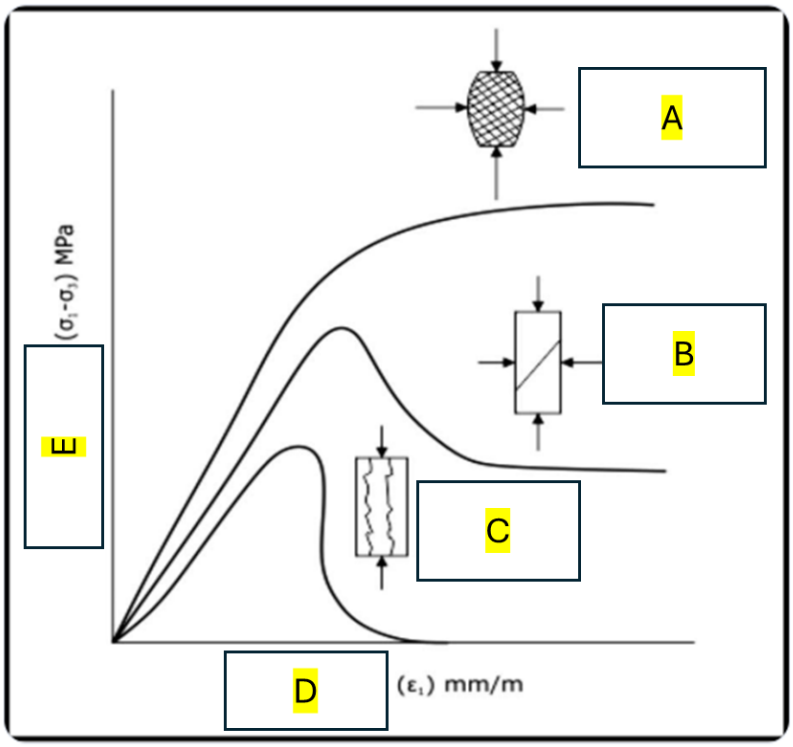
3.1 Describe the **principle and procedure** of the **shear box test** (diagram below) for joint strength determination. [4 marks]



3.2.1. Explain the significance of **JRC** in the **Barton-Bandis** shear strength relationship. [3 marks]

3.2.2. Explain the **difference** between **JRC** and **basic joint friction angle**. [2 marks]

3.3. In order to determine the effect of confinement on the stress-strain behaviour of rock mass, various tri-axial compressive tests are carried out on samples in a laboratory. The rock specimen is placed in a sealed pressure cell, and confining stress is achieved by pressurising oil in the cell. **Annotate (A-E)** the below diagram associated with this and **what** does it measure or is called? [6 Marks]



3.4. Explain the **procedure** and **purpose** of the Point Load Test. [2 marks]

3.5. A core specimen was tested in the **Point Load Test**. The failure load was **45 kN** and the equivalent core diameter was **50 mm**:

3.5.1. Calculate the **Point Load Index**, I_S. [1 mark]

3.5.2. If the specimen diameter is already **50 mm**, determine the **size-corrected Point.** [2 marks]

3.6. If the lump specimen failed under a load of **32 kN** and had an equivalent diameter of **40 mm**, calculate the:

3.6.1. Point Load Index as well as

3.6.2. The size-corrected Point Load Index. [3 marks]

3.7. Explain the **procedure** and **purpose** of the Brazilian Indirect Tensile Strength Test. [2 marks]

TOTAL [25 Marks]

QUESTION 4: PILLAR EQUATIONS

A bord-and-pillar layout has **square pillars of width 10 m**, **bord width 6 m**, and **mining height 3 m**.

4.1. Calculate the **areal** percentage extraction. [2 marks]

4.2. Calculate the **volumetric** percentage extraction at 3.0m stoping width. [2 marks]

4.3. Briefly **compare** the Hedley and Grant pillar strength concept with the Ozbay and Ryder approach. [6 marks]

TOTAL [10 Marks]

QUESTION 5: MINING AND LEGAL RESPONSIBILITIES

5.1. Describe the detonation methods commonly used in:

a) development ends

b) stopes [5 marks]

5.2. State five important responsibilities of mine management or strata control personnel in ensuring legal and safe excavation conditions. [5 marks]

TOTAL [10 Marks]

QUESTION 6: SUPPORT DESIGN AND CALCULATIONS

6.1. Distinguish between the support principles of:

a) arch formation

b) suspension [2 marks]

6.2. An excavation requires support bolts at **1.0 m × 1.2 m spacing** over an area **12 m long × 6 m wide**.

- Calculate the approximate number of bolts required. Ignore edge staggering and assume a regular grid. [2 marks]

6.3. Explain how the **mean dip and strike** of a seam can be determined from peg elevations on a mine plan. [2 marks]

6.4. Using the following data, **calculate** the **mean dip** of the seam:

- Peg A elevation = 1250 m
- Strike line elevation = 1200 m
- Horizontal distance perpendicular to strike = 150 m [4 marks]

6.5. Explain the difference between **elastic convergence** and **inelastic convergence**.

[2 marks]

6.6. Complete the following in **short, tabulated form** for the **three main rock** types and give for each: [3 marks]

- *How was it formed*
- *Key properties,*
- *Commodity commonly associated with it.*

TOTAL [15 Marks]

TOTAL [100]

FORMULAE SHEET

$$e = \frac{A_{T-}A_P}{A_T}$$

$$PS = k.\frac{w^{0.46}}{h^{0.66}}$$

$$PS = k.\frac{w^{0.5}}{h^{0.75}}$$

$$APS = \frac{\rho g h}{1-e}$$

$$e = \frac{(b+w)^2 - w^2}{(b+w)^2}$$

$$F_s = \frac{\sigma_s}{APS}$$

$$Q = \frac{RQD}{J_n} \cdot \frac{J_r}{J_a} \cdot \frac{J_w}{SRF}$$

$$\tau_{\theta r} = \frac{1}{2} q(1-k)\left(1 + \frac{R^2}{r^2} - \frac{2R^4}{r^4}\right)\sin 2\theta$$

$$\tau = \sigma_n \tan\left(\theta_b + JRC\log_{10}\left(\frac{JCS}{\sigma_n}\right)\right)$$

$$E = \frac{\sigma}{\varepsilon}$$

$$v = \frac{\varepsilon_r}{\varepsilon_a}$$

$$RQD = \frac{\sum L}{T}\ x\ 100$$

$$RCF = \frac{3\sigma_1 - \sigma_3}{F.\sigma_c}$$

$$I_s(50) = F \cdot I_s$$

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$$\sigma_1 = \sigma_3 + \sigma_c(m.\frac{\sigma_3}{\sigma_c} + s)^{0.5}$$

$$C_i = \tau - \sigma_n tan\phi_i$$

$$\sigma_{rr} = \frac{1}{2} q(1+k)\left(1 + \frac{R^2}{r^2}\right) - \frac{1}{2} q(1-k)\left(1 + \frac{4R^2}{r^2} + \frac{3R^4}{r^4}\right)\cos 2\theta$$

$$F = \left(\frac{D_e}{50}\right)^{0.45}$$