Minerals Council South Africa

EXAMINATION PAPER

SUBJECT: CERTIFICATE IN STRATA CONTROL (COAL) **SUBJECT CODE: COMSCC** **DATE: 08 OCTOBER 2024** **TIME**: **14H30 TO 17H30**	**EXAMINER:** R. GONSALVES **MODERATOR:** O. SWAKAMISA **TOTAL MARKS:** [100] **PASS MARK:** [60%]

NUMBER OF PAGES: 8

THIS IS NOT AN OPENBOOK EXAMINATION – ONLY REFERENCES PROVIDED ARE ALLOWED

SPECIAL REQUIREMENTS:

1. **Answer All the Questions**. Answer the questions **legibly** in English.
2. Write your **ID 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.

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 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 to an 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 recorded as marks will be deducted from answers 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 data given.
9. Please note that you are not allowed to contact your examiner or moderator regarding this examination.
10. Cell phones AND OTHER SMART DEVICES are **NOT** allowed in the examination room.

QUESTION 1. STRESSES AND BEAM STABILITY

1.1.	With the saying that “Mining does not create stresses; it merely redistributes the existing ones” in mind, describe and demonstrate (*through diagrams*) how the stresses are redistributed around the common coal mine roadway corners and clearly show the magnitude of stresses for the following K-ratios. 1.1.1. K-ratio = 1 1.1.2. K-ratio > 1 1.1.3. K-ratio < 1	 (2) (2) (2)
1.2.	What do we call the phenomenon resulting from the stress redistribution and concentration on the corners of the roadways when the K-ratio > 1?	(1)
1.3.	What are the characteristics of the phenomenon mentioned in Question 1.2? Describe its mode of formation taking into consideration the stress distribution. *You can also use sketches to demonstrate the mode of formation.*	(3)
1.4.	A 15 cm thick, competent, unjointed sandstone layer forms the immediate roof of the No. 4 coal seam. Determine if the layer of sandstone will be self-supporting over a standard bord width of 7.2 m? Assume the correct density and tensile strength of sandstone.	(5)
1.5.	Show through calculations how the presence of a joint in the sandstone layer mentioned in Question 1.4 would increase the tensile horizontal stresses in the roof six-fold?	(5)
		[20]

QUESTION 2. ROOF SUPPORT

2.1.	A roofbolter can install roof bolts using either wet- or dry-drilling. Explain which method you would use for: (a) relatively weak roof consisting of laminated shales and mudstones? (b) strong, competent roof consisting of a thick sandstone layer? Name some of the advantages and disadvantages of each method.	(6)
2.2.	Explain the difference between the spin-to-stall and spin-and-hold support installation methods. Discuss the differences between the bolts and the installation process.	(6)
2.2.	Mine Z mines the No. 4 coal seam. The immediate roof of the seam consists of 1.2 m of weakly bonded interlaminated shales and siltstones, each 50 mm thick. This layer of interlaminated material has a density of 2200 kg/m^3. It is overlain by a strong, competent sandstone layer of 5 m thickness. Design a stable roof support strategy with a SF of 1.5. Each bolt has a proven load capacity of 15 tons. Discuss the support method, length of bolts required and the support pattern. *Show all your calculations and state all your assumptions. You can also use sketches to show your roof support design.*	(10)
2.3.	Determine the required length of a resin capsule for a full-column resin installation of a 1.8 m long, 20 mm diameter shear-pin roof bolt. The drill bit diameter is 25.6 mm. The diameter of the resin capsule is 23 mm. *State all your assumptions.*	(3)
		[25]

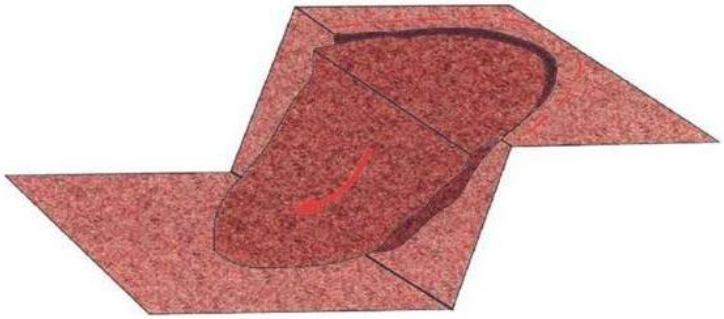
QUESTION 3. PILLAR DESIGN

Mine XYZ is situated in the Highveld Coalfield. It mines the No.4 coal seam at a depth of 176 m below surface using the bord-and-pillar mining method. The seam has an average thickness of 2 m.	
3.1. What pillar strength formula would you use for this mine and why?	(3)
3.2. As an SCO, you have been tasked to design the pillars for one of its new primary developments using the pillar strength formula mentioned in Question 3.1. Determine the percentage area extraction for your pillar design. *State all your assumptions.*	(10)
3.3. Would you use the CM adjustment for your safety factor calculations on this mine? Explain why or why not.	(2)
	[15]

QUESTION 4. DYKE DEVELOPMENT

You are the appointed SCO on an underground (UG) coal mine. One of the main developments intersects a dyke.	
4.1. Define the term 'dyke'. How does the hardness (UCS) of the dyke compare to the surrounding sedimentary rocks and why would this pose a challenge to development? *Use realistic UCS values when comparing the dyke material with the surrounding sedimentary rock types.*	(4)
4.2. Explain what ground conditions you would normally encounter before, while developing through, and after the dyke? What risks would these ground conditions pose to the safety of the mining personnel and stability of the excavation?	(5)
4.3. As the SCO, what recommendations would you provide to the mining personnel to safely develop through the dyke and ensure long-term stability of the development?	(6)
	[15]

QUESTION 5. OPENCAST

5.1.	Explain the following opencast terminology: 5.1.1. Highwall 5.1.2. Low wall 5.1.3. Buffer blasting *You may use sketches to assist with your explanations (definitions).*	 (2) (2) (2)
5.2.	Identify and discuss the following opencast failure mode: 	(3)
5.3.	Name one numerical modelling programme (software) that you would use to analyse the stability of an opencast slope, especially for preventing and/or predicting the failure mode mentioned in Question 5.2. Also explain how the following input parameters and rock mass properties will affect the slope stability: (a) Slope angle (b) Slope height (c) Material type (d) Pore water pressure (e) Cohesion (f) Coefficient of friction	(13)
5.4.	Name three methods to monitor for the failure mode mentioned in Question 5.2.	(3)
		[25]

Total Mark = [100]

Strata Control (Coal) Formula sheet

$$S = 7.2\frac{w^{0,46}}{h^{0,66}}$$

$$e\% = 1 - \frac{w_1 w_2}{C_1 C_2}$$

$$\sigma_{OR} = 5.47\frac{w^{0.8}}{h}$$

$$\sigma_{ML} = 6.61\frac{w^{0.5}}{h^{0.7}}$$

$$L = \frac{25HC^2}{w^2}$$

$$L = \frac{[25(H-T)+30T)]C^2}{w^2}$$

$$\eta = \eta_o(1 + \frac{2\Delta w_0}{w})^{2,46}$$

$$n = SF\frac{\rho.g.t}{Pf}$$

$$A = \frac{1}{n}$$

$$Lb = \frac{d_c^2 \ \ Lc}{D^2 - d^2}$$

$$\tau = \frac{Pf}{\pi.D.Lb}$$

$$\eta = \frac{\gamma \ L^4}{23 \ E \ t^2}$$

$$\sigma_{nj} = \frac{\gamma L^2}{2t}$$

$$\sigma_j = \frac{3\gamma L^2}{t}$$

$$FS = 288\frac{w^{2.46}}{Hh^{0.66}(w+b)^2}$$

$$\sigma_s = 7.2\frac{R_0^{0.5933}}{V^{0.0667}}\{\frac{0.5933}{\varepsilon}[(\frac{R}{R_o})^{\varepsilon} - 1] + 1\} \quad , \varepsilon = 2.5$$

$$d_c = w - [0.00714 S_m HhC^2]^{0.333}$$

$$R = m[\frac{h}{T}]^x \quad \text{(m/yr)}$$

$$T_L = [\frac{d}{mh^x}]^{\frac{1}{1-x}} \quad \text{(years)}$$

m = 0.1799

x = 0.7549

$$L_c = 2T\sqrt{k_s + \frac{\beta}{D}} + 2(H - D)tan\emptyset$$

$$\beta = \frac{1.53}{\gamma_m} - 0.8$$

$$\gamma_m = 0.025\frac{D-T}{D} + 0.03\frac{T}{D}$$

$$S_m = 0.39h(\frac{W}{H})^{0.32}$$

$$T_m = 21.6S_m + 7\ mm/m$$

$$\varepsilon_{m+} = 4.2S_m + 1.7\ \text{mm/m}$$

$$\varepsilon_{m-} = -9.1S_m - 2.8\ \text{mm/m}$$