Minerals Council South Africa

EXAMINATION PAPER

SUBJECT: CERTIFICATE IN STRATA CONTROL (COAL)	**EXAMINER:** C SELAI
SUBJECT CODE: COMSCC	**MODERATOR:** R MALOGWA
DATE: 3 OCTOBER 2023	**TOTAL MARKS:** [100]
TIME: 14H30 TO 17H30 (3 HOURS)	**PASS MARK:** [60%]

NUMBER OF PAGES: 7

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 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 by means of sketches or diagrams wherever possible.
7. **Final answers** must be given to an accuracy which is 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. GENERAL

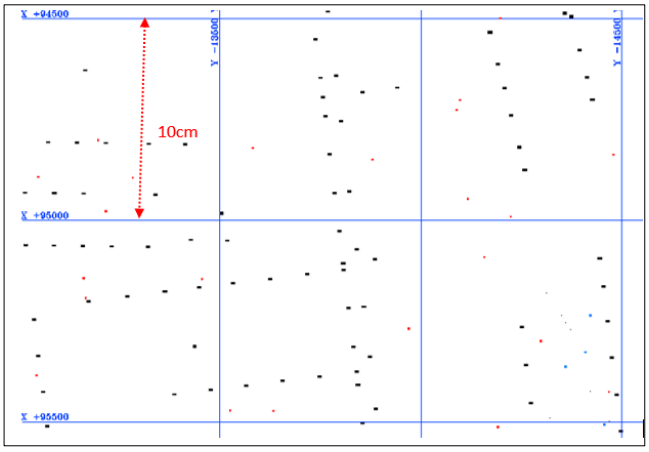
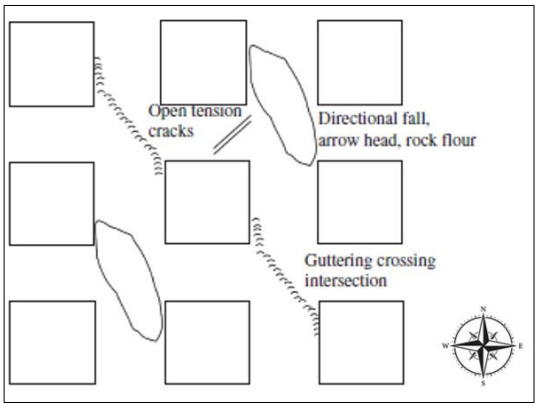
1.1	If a 10N force is imposed on a 200kg coal sample, placed on flat surface, what is the normal downward force experienced by the flat surface?	(3)
1.2	What is the field stress, if a virgin stress of 20MPa and induced stress is 10MPa.	(2)
1.3	Given the distance of 10cm between successive grid lines on a mine plan below, calculate the scale of the plan and determine the north direction based on the LO29 Survey System. 	(3)
1.4.	What is the possible direction of the principal stress based on the observations mapped in **Figure 1-1** below:  **Figure 1-1:** Sketch showing mapped observations.	(2)
1.5.	An underground panel is planned to mine through a dolerite dyke to access an existing block of coal as indicated in the **Figure 1-2** below. Show through a rough sketch how you would navigate through the dyke considering the ground conditions associated with the dyke.	(6)

Figure 1-2: Plan showing mining against the dyke.

1.6. Define Normal and Reverse Faults and show by means of rough sketches how these would affect the coal seam.	(4)
	[20]

QUESTION 2. ROOF SUPPORT

2.1. An insitu Short Encapsulation Pull Test was conducted in an underground coal section. Some of the information used for the test is contained in **Table 2-1**. The resulting load-deformation curve is presented in **Figure 2-1**. Answer the questions that follow.

Table 2-1: Pull Testing information.

Parameter	**Value/description**
Roof bolt diameter (mm)	20
Roof bolt length (m)	1.8
Hole diameter (mm)	26.76
Resin Capsule diameter (mm)	23
Drilled hole depth (m)	1640
Bond length (mm)	300
Roof bolt steel Modulus (GPa)	206
Roof composition	Coal/mudstone

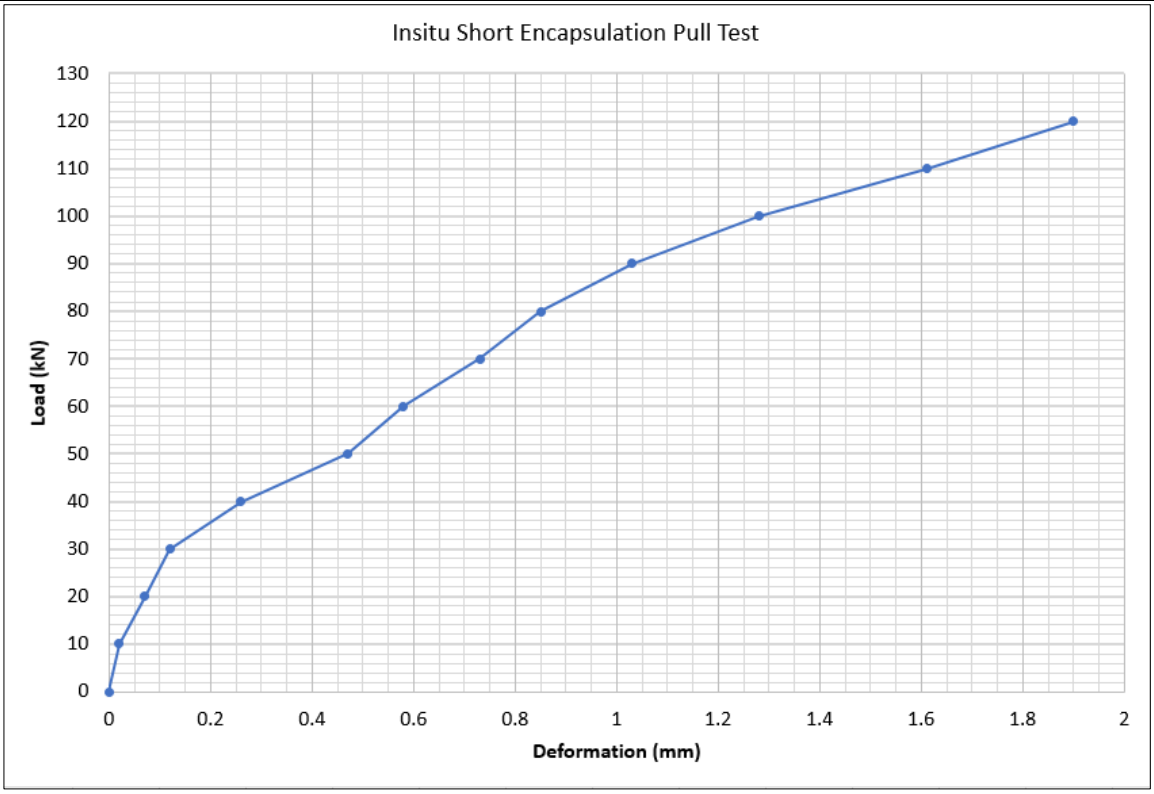
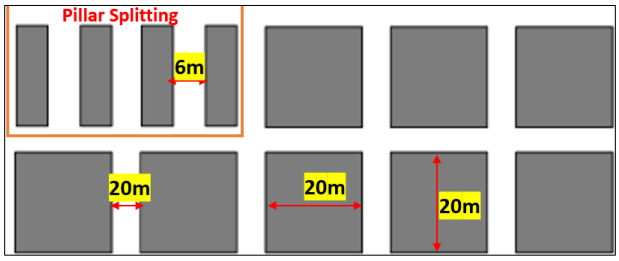


Figure 2-1: Insitu Short Encapsulation Pull Test Load-deformation curve.

**Note that this data has been calibrated to take into account the stretch in the steel.*

2.1.1.	What is the maximum load applied during this test?	(1)
2.1.2.	Calculate the resin capsule length required to achieve the bond length of 300mm required for insitu short encapsulation pull test to produce the results above.	(3)
2.1.3.	Derive an expression to calculate roof bolt (steel) extension.	(5)
2.1.4.	Calculate roof bolt (steel) extension at 10 tones.	(5)
2.1.5.	Calculate the bond displacement.	(3)
2.1.6.	Calculate the bond strength.	(3)
2.2.	The mine rockfall data indicates a 95% cumulative fall out thickness of 0.5m comprising of a shale layer with density of 2500kg/m³ and average tensile strength of 3MPa. The falls occur before support installation in a coal mine section with bord width of 6.8m. Further investigation indicates approximately 0.3m water head above the roof. What is the cause of these falls? Show all your calculation to justify your answer.	(5)
		[25]

QUESTION 3. PILLAR DESIGN

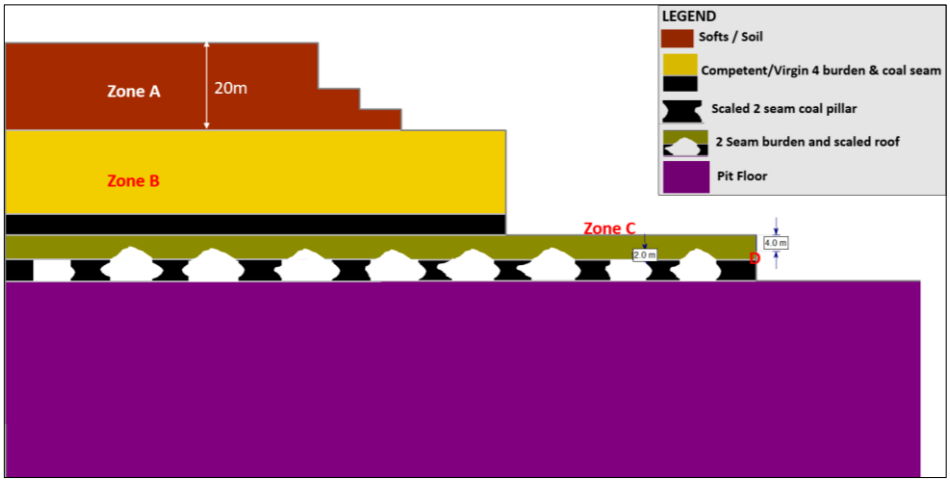
3.1. Mining of a 2m coal seam using drilling and blasting is proposed at a depth of 160m using bord and pillar mining method with 6m bord width. Answer the following questions:	
3.1.1. Using an appropriate safety factor for a production panel, calculate the pillar width for the production panel.	(8)
3.1.2. Calculate the aerial percentage extraction.	(3)
3.1.3. Calculate the safety factor if a continuous miner was used and comment on your answer.	(3)
3.2. A production panel with 20m square pillars mined with 6m bords at a mining height of 4m and depth of 150m is earmarked for secondary extraction. The pillars will be mined on retreat and splitting by 6m wide cut through the centre (**Figure 3-1**). Answer the questions that follow:  **Figure 3-1:** Sketch showing pillar splitting.	
3.2.1. What is the appropriate design pillar safety factor for secondary extraction?	(1)
3.2.2. Calculate the pillar factor of safety after splitting. *Use van der Merwe and Mathey's overall reduction strength formula.*	(10)
	[25]

QUESTION 4. ROCK STRENGTH

4.1. Describe the following types of laboratory rock testing by answering the questions that follows. • Uniaxial Compressive Strength Test (UCS). • Uniaxial Compressive Strength Test with Moduli (UCM). • Triaxial Compressive strength (TCS).	

4.1.1.	Brief description on testing principles and fundamental differences.	(8)
4.1.2.	Mechanical properties derived from the tests.	(6)
4.1.3.	Typical stress-strain or similar curves showing how peak strength, elastic range and residual strength, where relevant.	(6)
		[20]

QUESTION 5. OPENCAST

5.1.	**Figure 5-1** depicts a cross section layout of an opencast coal strip mine with various zones. The No.2 coal seam was previously mined out using bord and pillar method. Scanning of the old workings indicates roof falls of up to 2m, resulting in approximately 4m beam below the working bench.  **Figure 5-1:** Strip mine layout.	
5.1.1.	Comment on the blasting method appropriate for zones B (virgin) and C (UG workings)	(4)
5.1.2.	Name the risk and control of working in Zone C.	(2)
5.1.3.	List factors you will note during your strata control inspections in A, B and D.	(3)
5.1.4.	Describe the plausible failure mechanism in Zone A.	(1)
		[10]

Total Mark = [100]

Strata Control (Coal) Formula sheet

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

$$S = 7{,}2\frac{w^{0,46}}{h^{0,66}}$$

$$S = 3.5\left(\frac{w}{h}\right)(MPa)$$

$$\sigma_{OR} = 5.47\frac{w^{0.8}}{h}\ (\text{MPa})$$

$$\sigma_{ML} = 6.61\frac{w^{0.5}}{h^{0.7}}\ (\text{Mpa})$$

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

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

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

$$n = SF\ \frac{pgt}{Pf}$$

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

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

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

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

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

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

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

$$Young's\ Modulus\ (E) = \frac{Stress}{Strain}$$