UNISA university of south africa

EXAMINATION PAPER

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA CERT. IN ROCK MECHANICS COAL OPTION – PAPER 2 **SUBJECT CODE:** COMRME **EXAMINATION DATE:** 26 OCTOBER 2005 **TIME:** 09h00 - 12h00	**EXAMINER:** Prof JN van der Merwe **MODERATOR:** Dr BJ Madden **TOTAL MARKS: [100]** **PASS MARK: 60%**

NUMBER OF PAGES INCLUDING COVER: 15

SPECIAL REQUIREMENTS:

1. **ANSWER *ALL* QUESTIONS.**
2. References other than those provided may not be used.
3. Hand-held electronic calculators may be used.
4. Put 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. Write on one side of the paper only.
6. Show all calculations on which you base your answers.
7. In answering these questions, take full advantage wherever necessary of your practical experience as well as of the data given.
8. Graph paper is available from the invigilator.
9. A list of formulae and any other essential charts and tables will be issued at the time of the examination.

HINT: Read all questions very carefully and think before you rush into an answer.

QUESTION 1: **Pillar Design (30 Marks)**

An Eskom power line has to be relocated to allow for expansion of a strip mine. The power line would have to be operational for several decades. The most economical route would for the pylons to be erected over an area that had been mined with bord and pillar 20 years ago, see Figure 1.1. The mining parameters are summarized in Table 1.1. The borehole logs for holes A and B, drilled at the positions indicated in Figure 1.1, are shown in Figure 1.2. The mechanical properties of the rock types are shown in Table 1.2.

Table 1.1: **Mining parameters**

Parameter	Panel 1	Panel 2
Bord width (m)	6.5	6
Centre distance (m)	12.5	13
Mining height (m)	3.8	3.5
Panel width (m)	81	110

Table 1.2: **Mechanical properties (laboratory values)**

Rock type	UCS (MPa)	UTS (MPa)	Shear Strength (MPa)	E (GPa)	Density (kg/m^3)
Sandstone	75	5	15	13	2 480
Shale	75	5	7	15	2 480
Siltstone	70	6	8	1	2 510
Mudstone	40	5	8	7	2 480
Dolerite	190	24	20	100	3 000
Coal	25	5	8	5	1 500

You have been requested to make a recommendation regarding the suitability of this proposed route.

(a) Briefly discuss the risks the pylons could be exposed to in general. [10]
(b) What are the probabilities that the risks you mention in (a), could materialize in this particular case? [10]
(c) What would your preliminary recommendation be? [5]
(d) List the additional work you would want to do before making a final recommendation. [5]

NOTE: You have to substantiate your opinions and supply quantified arguments.

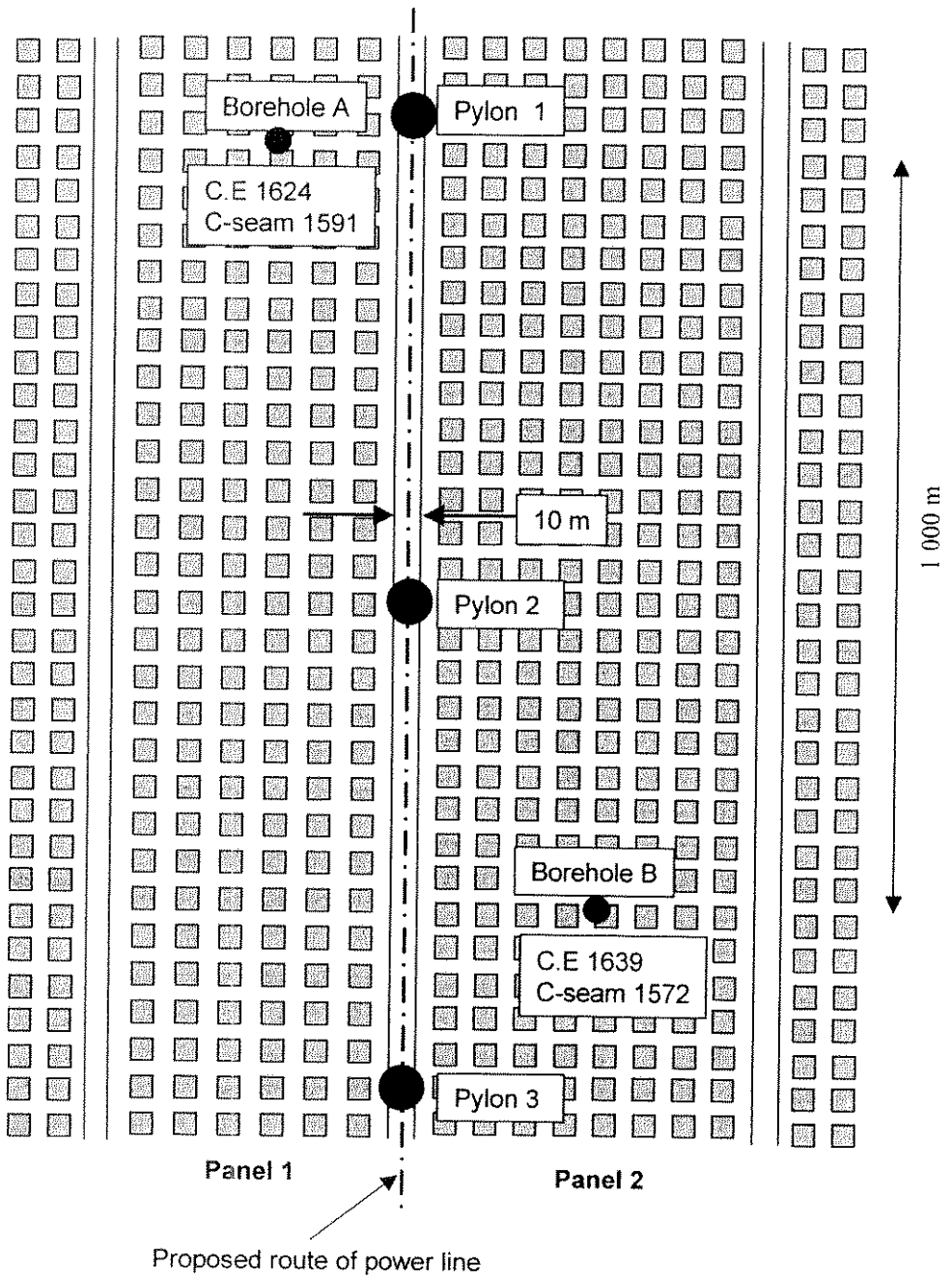

Figure 1.1. Sketch of the mine plan showing the proposed position of the power line. The sketch is not to scale. For dimensions, refer to Table 1 in Question 1.

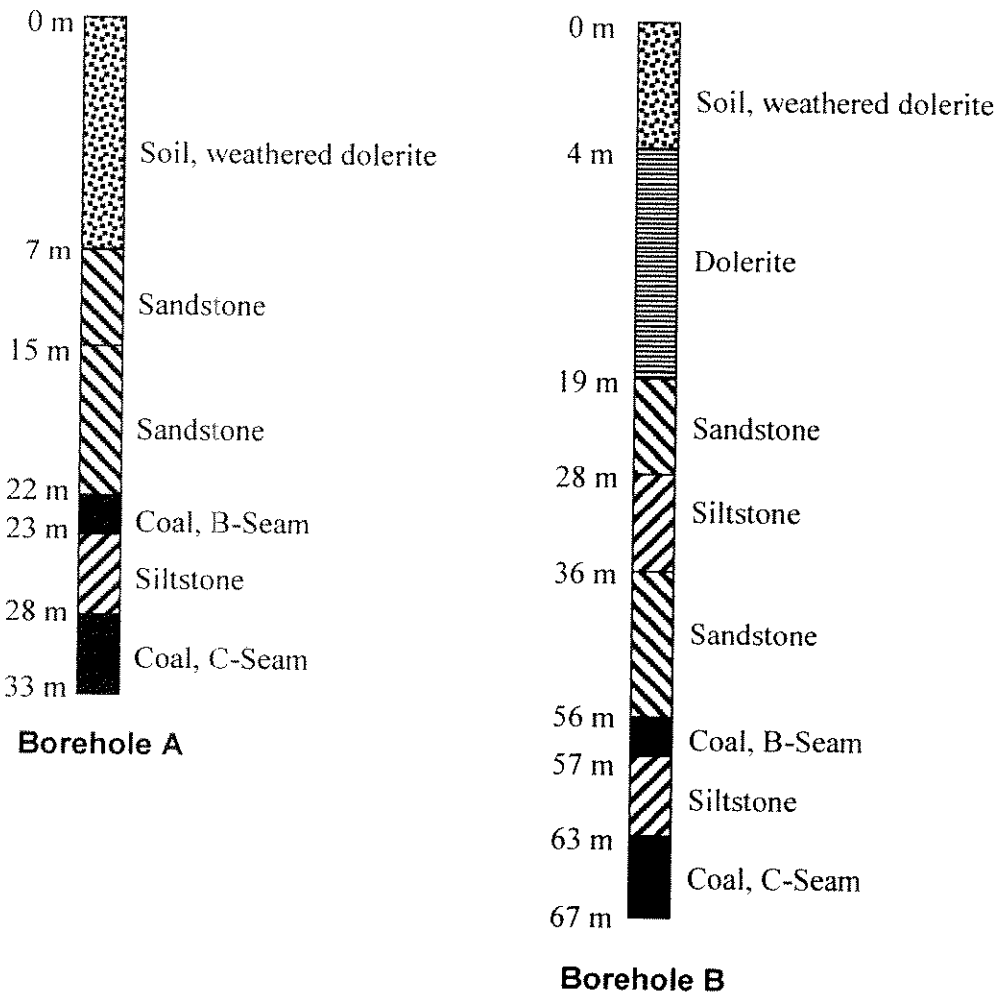

Figure 1.2. Simplified borehole logs of Hole A and Hole B, as indicated on Figure 1.1.

QUESTION 2: Roof Support (30 Marks)

You have to design a support system for a part of a mine that has been plagued by roof falls. Figure 2.1 is a sketch diagram of the type of falls that occur. The roof consists of mudstone (density 2480 kg/m3) up to 6 m above the coal. Due to the coal seam only being 1.8 m thick, no coal can be left in the roof.

There are a number of other constraints on this particular mine. Using the beam creation philosophy is not an option as the equipment in use does not allow consistent torque to be applied to bolts. Long anchor support can also not be installed as the mine does not have the necessary equipment and the manager does not want to appoint contractors to do the work. The longest hole that can be drilled, is 1.5 m.

The best idea you can think of, is to create a "basket" by installing bolts that are inclined over the ribsides, complemented by wiremesh and W-straps.

A test program using SEPT, yielded results shown in Table 2.1. It was found that in all the cases, the bolts with the resin still attached to them pulled out of the holes. You decide to use M25 rebar, 600 MPa yield load, in 32 mm holes as the basic element in the system. The safety factor of the system should be 1.5.

Table 2.1: SEPT Test Results

Test No	Hole Diameter (mm)	Bolt Diameter (mm)	Anchor Length (m)	Yield Load (kN)	Remarks
1	25	18	0.31	51	OK
2	25	18	0.32	5	Crimp failed prematurely
3	25	18	0.28	46	OK
4	25	18	0.33	53	OK
5	25	15	0.27	41	OK
6	25	15	0.29	50	Valve leaked
7	25	15	0.33	51	OK
8	25	18	0.34	51	OK
9	25	18	0.28	47	OK
10	25	18	0.29	46	OK
11	28	18	0.29	51	OK
12	28	18	0.31	8	Bad mixing
13	28	22	0.29	49	OK
14	28	22	0.31	54	OK
15	28	22	0.34	62	OK
16	28	22	0.34	57	OK
17	28	22	0.33	56	OK
18	28	22	0.28	52	OK
19	28	22	0.29	50	OK
20	28	22	0.27	5	Crimp failed prematurely

(a) Using the information in Table 2.1, what is the average unit shear resistance of the resin/rock contact surface? [15]
(b) What is the weight of rock to be supported per linear metre? [3]
(c) What length of bolt would you recommend, how far from the ribside should the bolts be installed and what should the bolt spacing be? [12]

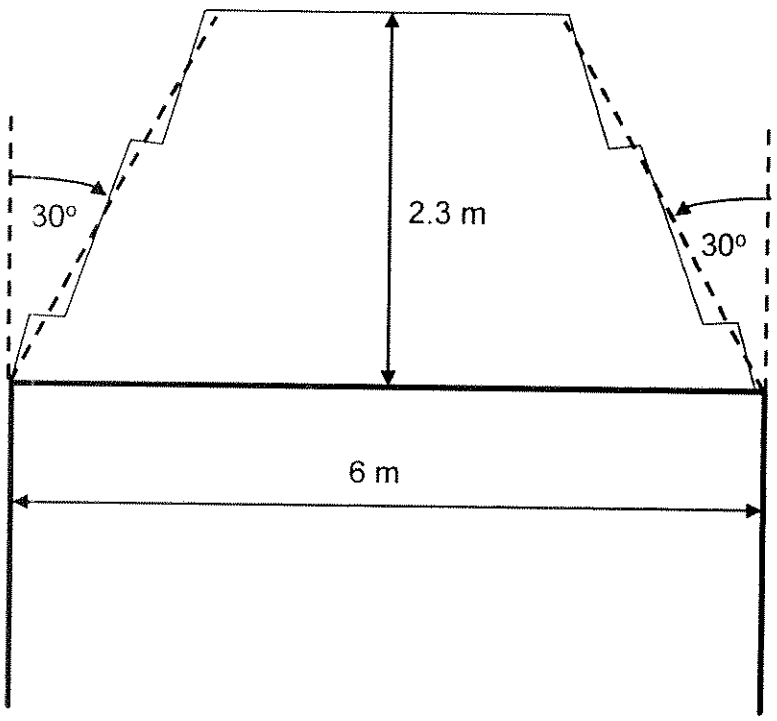

Figure 2.1. Simplified borehole sketch of cross section of roof falls. The sketch is not to scale.

QUESTION 3: **Subsidence (20 Marks)**

You receive a complaint from a farmer that his house has been damaged by subsidence. The mining was done more than 60 years ago at a depth of 60 m. The mining height was 3.3 m, the bord width was 6 m and the pillars were 6 m wide. The panel that was mined underneath the house was 138 m wide.

Describe how you would go about doing a first order visual examination to determine if further, more detailed investigation is required.

Provide your answer in the following manner:

(a) Mark your points of inspection clearly on the attached Figure 3.1 using letters, A, B, C, etc

(b) Then provide a description of what you would expect to see at those inspection points. The descriptions must be provided in the answer script (and not on the Figure) to avoid cluttering. You must indicate very clearly which inspection points you are referring to in your answer.

(c) Figure 3.1 with your marked points of inspection must also be handed in.

Remember to fill in your examination number on Figure 3.1

QUESTION 4: General (20 Marks)

All questions must be answered by marking either the True or False column on the attached sheet. Note that a box has to be ticked for each question, not just the correct answer. Please make sure that your exam number is written clearly on the answer sheet, detach it and hand it in with your examination script

Note that marks will be deducted for incorrect answers and unanswered questions.

(a) The SIMRAC organisation
- (i) is responsible for conducting mine safety audits
- (ii) regulates funds for safety related research
- (iii) regulates funds for health related research
- (iv) works closely together with the CSIR

(b) Acidic Dolerite
- (i) is an igneous metamorphous rock type
- (ii) is stiffer than Basic Dolerite
- (iii) restricts subsidence to a greater extent than Basic Dolerite
- (iv) only occurs as sills, never dykes

(c) The difference between violent and non violent pillar failure is influenced by the
- (i) presence or absence of a stiff layer in the overburden
- (ii) safety factor
- (iii) depth of mining
- (iv) width-to-height ratio of pillars

(d) Roof support systems can be stiffened by
- (i) decreasing road widths
- (ii) restricting panel widths
- (iii) increasing the number of bolts
- (iv) increasing pre-tension

(e) The following can be undermined without permission from the Principal Inspector of Mines:
- (i) illegally erected structures
- (ii) derelict graves of unknown persons
- (iii) structures belonging to the mining company
- (iv) dam walls less than 3 m high