



EXAMINATION PAPER

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA – CERTIFICATE IN STRATA CONTROL – METALLIFEROUS SUBJECT CODE: COMCSC EXAMINATION DATE: TIME: 14:30 – 17:30	EXAMINER: Y Jooste MODERATOR: DA Arnold TOTAL MARKS: [100] PASS MARK: (60%)
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NUMBER OF PAGES:

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

SPECIAL REQUIREMENTS:

1. Answer all the questions. Answer questions 1,2,3,4,5 and 8 and select one of question 6 and 7. Write **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. 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) are 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.
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11. Cell phones are **NOT** allowed in the examination room.

QUESTION 1

Use the table supplied at the end of the exam paper and hand it in with your answer sheet.

1.1 GCD stands for:

- a. Grout control district
- b. Ground cycle district
- c. Ground control district
- d. Ground control database

1.2 A right angled triangle has one side of length 3m and a hypotenuse of length 10m. What is the length of the remaining side?

- a. 9.52m
- b. 9.54m^2
- c. 9.54m
- d. 9.58m^2

1.3 What is the stress called before any mining takes place?

- a. Original stress
- b. Virgin strength
- c. Virgin stress
- d. Pre-mining stress

1.4 Stemming is used in a blast hole as a plug to prevent the blowout of a blasthole.

- a. True
- b. False

1.5 What will the average pillar stress be if the virgin stress is 81 Mpa and the extraction ratio is 85%?

- a. 540 Kpa
- b. 531 Mpa
- c. 540 Mpa
- d. 580 Mpa

1.6 An elongate (180mm in diameter) yields at 20 tons. If units are installed on a 2,0m x 1,5m skin-to-skin spacing, what is the support resistance offered by the system? To get the correct answer, assume that $g = 10 \text{ m/s}^2$.

- a. 54.6 kN/m^2

- b. 212.2 kN/m²
- c. 66.67 kN/m²
- d. 52.5 kN/m²

1.7 A loco with a full span of hoppers travels at a velocity of 15km/h. The operator applies the break and the loco decelerate at a rate of 0.2m/s². The loco will stop within?..m.

- a. 24.23m
- b. 28.21m
- c. 43.47m
- d. 44.21m

1.8 It is generally accepted within the industry that the standard support system should prevent at least 80% of all observed fallouts.

- a. True
- b. False

1.9. Name the testing machine in the figure below:



- a. Closure meter
- b. Tri-axial testing machine
- c. UCS testing machine
- d. Point load testing machine

1.10 A cylindrical rock sample is placed in a press and loaded with a 100 000 N force. The rock sample has a diameter of 0.065m. Calculate the stress on the sample.

- a. 30.14 GPa
- b. 30 Mpa
- c. 32.14 Mpa

d. 30 GPa

[10]

QUESTION 2 – DEFINITIONS

Define the following terms:

- 2.1 Energy release rate
- 2.2 Geophone
- 2.3 Gully
- 2.4 Subsidence
- 2.5 Tensile stress

[10]

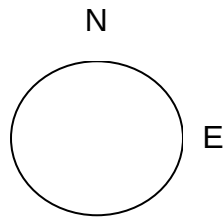
QUESTION 3 – GEOLOGY

- 3.1 Sketch and describe a normal fault, a reverse fault, strike, true dip and apparent dip. (10)
- 3.2 Explain sedimentary, metamorphic and igneous rocks and give an example of each one. (10)

[20]

QUESTION 4 – FORCES AND STRESSES

- 4.1 The attached plan represents a flat, tabular stope at a depth of 2 000m below surface. Sketch and annotate the hangingwall fracture orientations. (4)
- 4.2 Describe with an annotated sketch how “dog-earing” forms in underground development ends. (2)
- 4.3 A vertical raise bore hole (3m in diameter) is planned to be used as an orepass. The field stress is estimated to be 40MPa in the east-west direction and 60MPa in the north-south direction. Make use of analytical equations to calculate the radial and tangential stress in the side wall of the raise bore hole in the east west direction at the following distances: $r=R$, $r=2R$ and $r=3R$. Assume the theta angle is 0 degrees to the east. Draw a graph showing schematically the radial and tangential stresses.



(14)

[20]

QUESTION 5 – PILLARS AND MINING

- 5.1 Name and describe the function of any two types of regional support pillars typically used in underground mines. (4)
- 5.2 Explain the meaning of the factor of safety in pillar design and comment on acceptable factors of safety for stable pillar systems. (3)
- 5.3 Use a sketch and show clearly with annotation the difference between an overhand and underhand mining configuration. (3)

[10]

QUESTION 6 – SUPPORT

- 6.1 Backfill is a support system that is used to address various rock engineering problems. List the advantages of backfill when used for a) local and b) regional mining conditions. (4)
- 6.2 Describe what happens with the fracturing of a rockmass when a panel is stopped for an extended period of time. (2)
- 6.3 What special rock engineering precautions would you implement and recommend for a stopped panel? (2)
- 6.4 Define areal coverage. Under what conditions would you recommend this characteristic of support as being important? (2)

- 6.5 With the aid of annotated sketches, describe the extraction stages and the support sequence you would recommend for long (>10m), wide (>4m) chamber that is to be 4m high. (10)

[20]

QUESTION 7 – MASSIVE MINING

- 7.1 List 5 factors that need to be considered for the selection of a mining method. (5)

- 7.2 Sketch and describe any 3 of the following massive mining methods:

- Shrinkage mining
- Sublevel stoping
- Sublevel caving
- Drift and fill
- Room and pillar

(15)

[20]

QUESTION 8 - Monitoring

You are a rock engineer appointed on a new medium depth mine. What types of rock engineering monitoring would you recommend to management and explain shortly why?

[10]

TOTAL MARKS: [100]

ANSWER SHEET

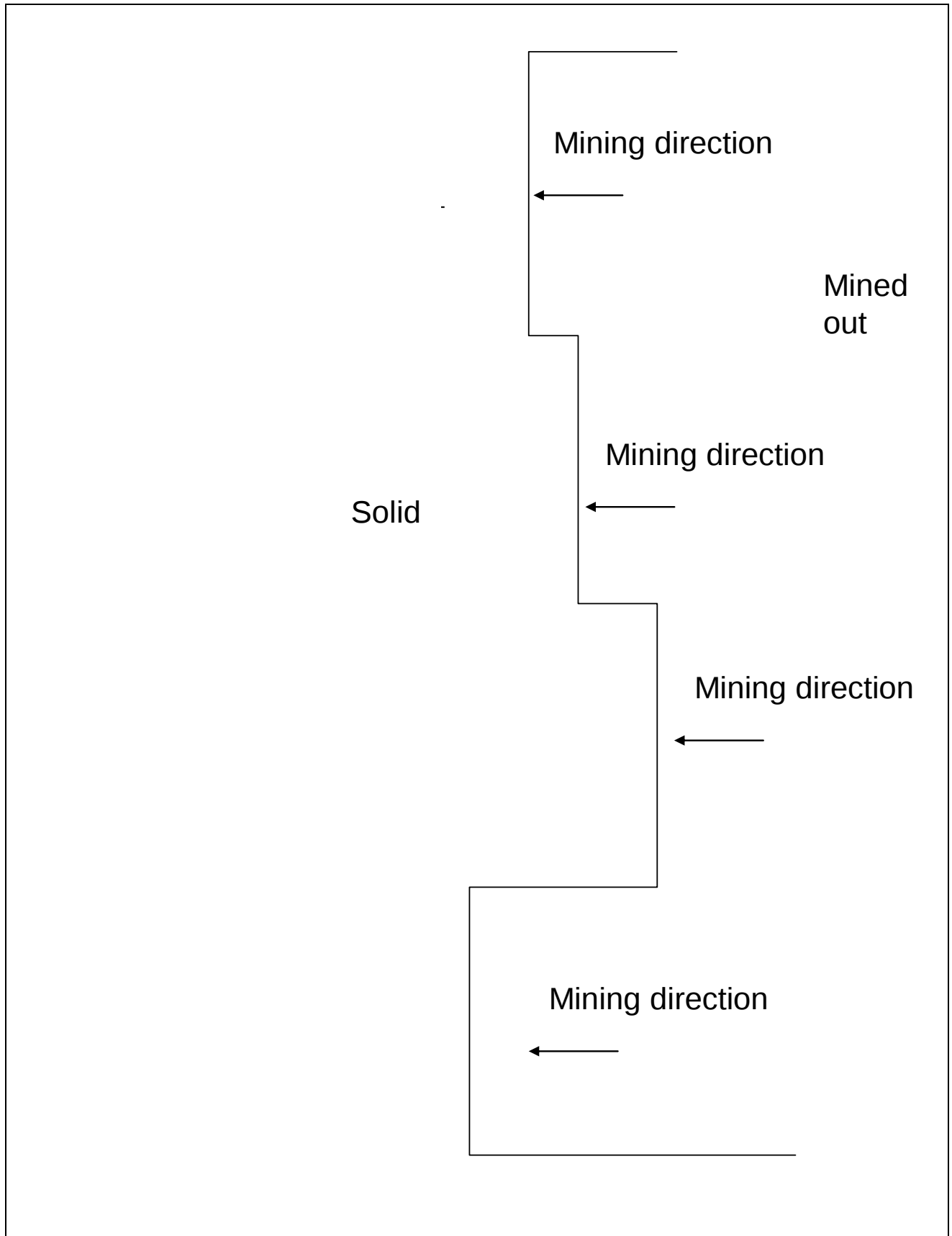
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Mark the correct answer only

QUESTION 1

Question	Select correct answer			
1.1	a	b	c	d
1.2	a	b	c	d
1.3	a	b	c	d
1.4	a	b	c	d
1.5	a	b	c	d
1.6	a	b	c	d
1.7	a	b	c	d
1.8	a	b	c	d
1.9	a	b	c	d
1.10	a	b	c	d

Question 4.1



FORMULE SHEET

1. Total Energy = $\frac{1}{2} m v^2 + mgh$
2. $s_z = \frac{2(1-\nu)q}{G} \sqrt{l^2 - x^2}$
3. $l_c = \frac{s_m G}{2(1-\nu)q}$
4. $\sigma_s = 7.2 \frac{R_0^{0.5933}}{V^{0.0667}} \left\{ \frac{0.5933}{\varepsilon} \left[\left(\frac{R}{R_0} \right)^\varepsilon - 1 \right] + 1 \right\} MPa$
5. $e = 1 - \frac{w_1 w_2}{C_1 C_2}$
6. $ERR = \frac{\Delta U_m}{\Delta A} = \frac{\pi(1-\nu)lq^2}{2G}$
7. $\nu_p = \sqrt{\frac{\lambda + 2G}{\rho}} \quad \nu_s = \sqrt{\frac{G}{\rho}}$
8. $RCF = \frac{3\sigma_1 - \sigma_3}{F \sigma_c}$
9. $RQD = \frac{\sum \text{lenght of core pieces} > 10cm}{\text{total lenght of core}} \times 100$
10. $\frac{h}{s} = \frac{1}{\sqrt{\frac{8h}{s} - 6}}$
11. $Q = RQD/Jn \times Jr/Ja \times Jw/SRF$
12. $G = \frac{E}{2(1+\nu)}$
13. $\tau = \sigma n \tan(\emptyset + JRC \ 10 \log \tan(\frac{JCS}{\sigma n}))$
14. $APS = q_v/(1-e)$
15. $\varepsilon = \Delta l / L$
16. $E = \sigma/\varepsilon$
17. $\nu = \varepsilon_r / \varepsilon_a$
18. $Ps = K w^{0.46} / h^{0.66}$
19. $Ps = K w^{0.5} / h^{0.75}$

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

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