

Minerals Council South Africa



Chamber of Mines of South Africa



EXAMINATION PAPER

MEMMORANDUM

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA: INTERMEDIATE CERTIFICATE IN MINE ENVIRONMENTAL CONTROL PAPER 1 SUBJECT CODE: COMIMEC1 EXAMINATION DATE: 12 OCTOBER 2018 TIME: 14:30 – 17:30	Examiner: Mervin van Rooyen Moderator: Inus Labuschagne TOTAL MARKS: [100] PASS MARK: [60%]
---	---

Formatted: Font: (Default) Arial

Formatted: Font color: Auto

Formatted: Font: (Default) Arial

NUMBER OF PAGES: 7

Formatted: Font: (Default) Arial

SPECIAL REQUIREMENTS: THIS IS NOT AN OPEN BOOK EXAMINATION. THERE IS NO FORMULA HANDOUT INSTRUCTIONS TO CANDIDATES: 1. Answer all 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. 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. Answers must be given to an accuracy which is typical of practical conditions. 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
--

Formatted: Font: (Default) Arial, 11 pt

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 are **NOT** allowed in the examination room.

Formatted: Font: (Default) Arial

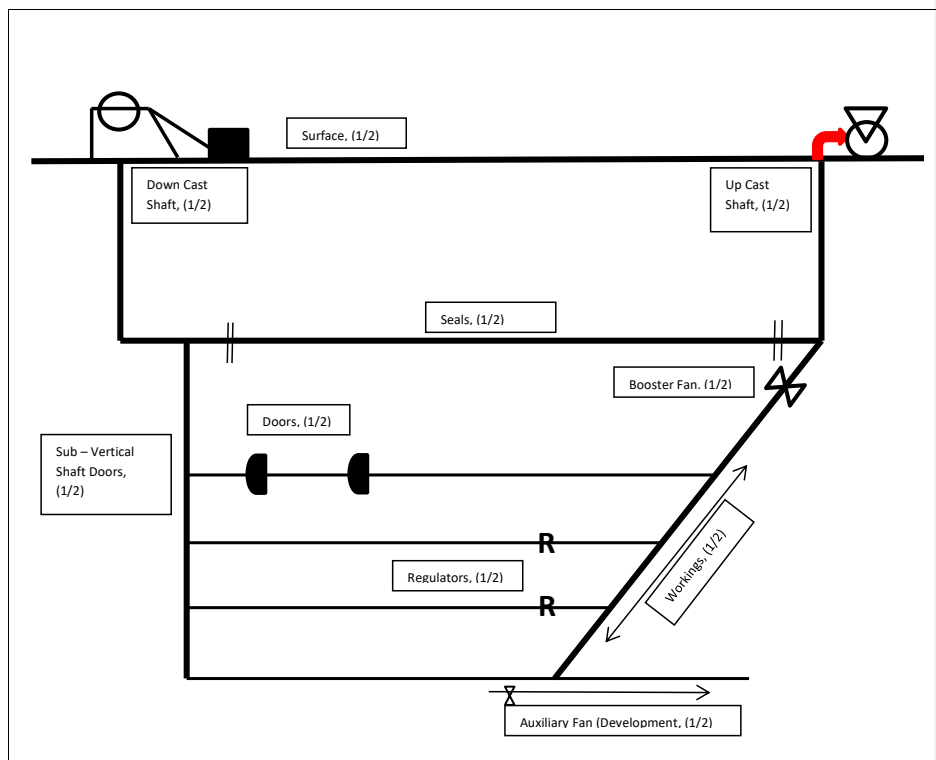
1. **Question 1**

[20]

- (1.1) For what purpose do we ventilate an underground mine, where people are required to travel and work? (4)

1. **Supply Oxygen for breathing** purposes and must be above 19% by volume.
2. **Remove heat** and provide comfortable working conditions and hence improve production.
3. **To dilute and remove noxious and flammable gases** that may be encountered during mining operations.
4. **To dilute and remove hazardous airborne pollutants** created by the various mining operations underground. (dust, fumes, aerosols vapours etc.)

- (1.2) Draw a typical ventilation circuit for a deep gold mine. (5)

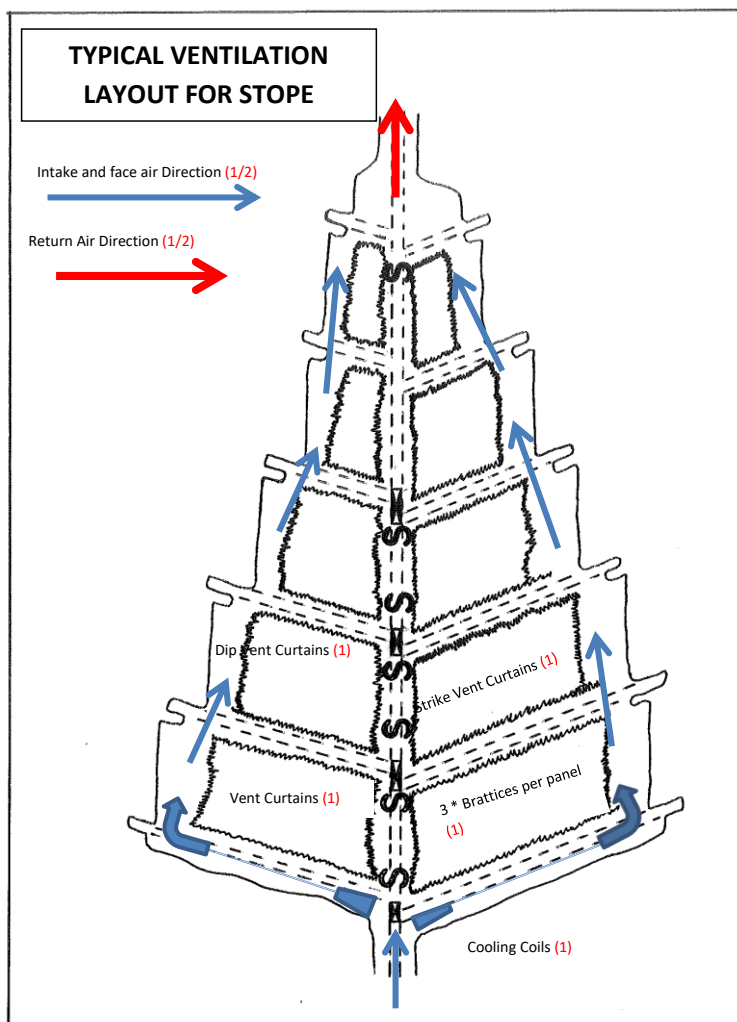


- (1.3) List the requirements for an ideal Ventilation Door airlock. (5)

- 1 It should not leak excessively
- 2 It must be SELF-Closing and kept closed at all times
- 3 The installation must be such that only one door can open at any time
- 4 It must be economical, efficient and require minimum maintenance
- 5 It should be robust, strong and easy to open
- 6 Each door to be equipped with a proper handle on both sides, a pressure release flap and an effective water trap
- 7 It should be painted black and yellow chevron lines (or any colour as required as per your mine standard) to ensure visibility

(1.4) Stope lay out

(6)



2. Question 2

[20]

2.1 List the requirements for a Refuge Bay

(11)

1. **Location** – On route, Distance not exceeding 750m, Close to main stations, Free of combustible areas
2. **Access Routes** – Demarcated, Accessible from working place, Shortest possible route
3. **Design and Construction** – Materials to be fire resistant, Size – allow 0.6m² per person, provide seating, cater for stretchers
4. **Air Supply and Ventilation** - compressed air to be evenly distributed in the refuge bay
5. **Air Whistle / Flashing Light** – equipped and operational
6. **Entrance (Front Wall)** – Access for Stretcher, Weighted door to maintain pressure, prevent toxic gases from entering, Drain pipe, White washed and illuminated, Demarcated and Numbered
7. **Portable Water** – sufficient supply
8. **Toilet Facility** – to be provided
9. **Equipment** – Provide essential equipment – First Aid, Communication system (Radios or telephones), Refuge Bay procedure
10. **Inspections and Maintenance** – Responsible Supervisor to inspect weekly and logged, detailed monthly / quarterly inspections by Ventilation department
11. **Training** – regular fire drills in accordance with your mine standards and COP Guidelines

2.2 List the factors to be considered when selecting a Self-Contained Self Rescuer (SCSR) (6)

1. Distance to travel
2. Duration of apparatus
3. Work-space available
4. Size and weight of apparatus
5. Type of atmosphere with regarding to toxicity and oxygen content
6. Restrictions that may have been imposed on the apparatus under the conditions of approval
7. After-sales service
8. Life-span (rack life)

2.3 Breathing apparatus may be divided into three main groups (3)

- 1 Chemical Self-Rescuer
- 2 Supplied Air Self-rescuer
- 3 Filter Type Self-Rescuer

3. Question 3

(20)

3.1 List the types of refrigeration systems available and identify the most common

(5)

- 1 Vapour Compressor System – most common
- 2 Absorption System
- 3 Steam-Jet System
- 4 Ice making System
- 5 Water Vapour System`

3.2 Name and discuss methods of Mine Cooling (15)

1. Surface Cooling (8)

- a. To Bulk air cool the air before entering the downcast shaft
- b. Cool the mine service water before sending it underground

It is the **cheapest and easiest application** of refrigeration, because of **maintenance and supervision are easy**. The heat that is removed from the air or water can be **rejected into the atmosphere**. **Inefficient due to its position**. Located far away from the work place, “**Positional Efficiency**”

2. Underground Cooling (7)

- a. Bulk cool large volumes of air at one or more convenient places
- b. Work place cooling that cools the air entering a work place
- c. Chilled service water that is used for drilling, cleaning and allaying dust

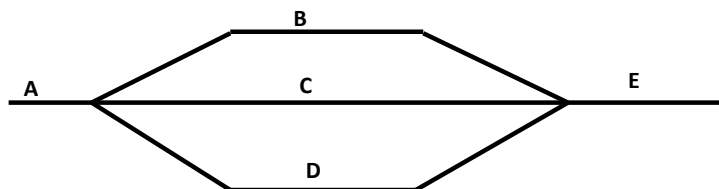
Underground cooling has a much **better “Positional Efficiency”** as it is located closer to the work place. **Heat rejection is much more difficult and expensive**, because of the **heat absorbed from the air and / or water has to be transferred to a limited flow** up cast air, which is already **hot and humid**. High pumping costs, with extensive maintenance costs.

4. Question 4 [20]

4.1 Complete the table below on Frictional Factors (2)

Airway Type	K-Factor (Ns ² /m ⁴)
Underground haulage: Rock lined	0.0110
Concrete lined shaft: Empty	0.0037 (Shaft)
Concrete lined shaft : streamlined buttons	0.0250 (Shaft)
Raise Bore Hole	0.0024

4.2 The sketch below shows diagrammatically the layout of a section of a mine where there is a combination of airways in series and parallel. (18)



Airway	Airway Resistance Ns ² /m ⁸	Air Flow per Airway m ³ /s
--------	--	--

A	0.009	90.0
B	0.200	
C	0.180	
D	0.150	
E	0.010	90.0

Determine the following given the information above

- The overall resistance of the section,
- The overall pressure required,
- The volumes in each airway

$$a) \frac{1}{\sqrt{R_p}} = \frac{1}{\sqrt{R_B}} + \frac{1}{\sqrt{R_C}} + \frac{1}{\sqrt{R_D}} \quad (1)$$

$$= \frac{1}{\sqrt{0.200}} + \frac{1}{\sqrt{0.180}} + \frac{1}{\sqrt{0.150}} \quad (1/2)$$

$$= \frac{1}{0.447} + \frac{1}{0.424} + \frac{1}{0.387} \quad (1/2)$$

$$= 7.18 \quad (1)$$

$$R_p = (1 / 7.18)^2$$

$$= 0.0194 \text{ N s}^2/\text{m}_8 \quad (1)$$

And

$$R_T = R_A + R_p + R_E \quad (1)$$

$$= 0.009 + 0.0194 + 0.010$$

$$= 0.0384 \text{ N s}^2/\text{m}_8$$

$$\text{Therefore overall resistance} = 0.0384 \text{ N s}^2/\text{m}_8 \quad (1)$$

$$b) P_T = R_T Q_T^2 \quad (1)$$

$$= 0.0384 + (90)^2 \quad (1)$$

$$= \underline{311 \text{ Pa}}$$

$$\text{Therefore overall pressure required} = 311 \text{ Pa} \quad (1)$$

$$c) P_p = R_p Q_p^2$$

$$= 0.0194 \times (90)^2$$

$$= 157 \text{ Pa} \quad (1)$$

$$\text{But } P_p = P_B = P_C = P_D \quad (1)$$

$$\text{Also } P_B = R_B Q_B^2$$

$$Q_B = \sqrt{P_B / R_B}$$

$$= \sqrt{150 / 0.20} \quad (1)$$

$$\begin{aligned}
 &= 28.0 \text{ m}^3/\text{s} && (1) \\
 Q_c &= \sqrt{P_c/R_c} && (1) \\
 &= \sqrt{150/0.18} && (1) \\
 &= 29.6 \text{ m}^3/\text{s} \\
 Q_D &= \sqrt{P_D/R_D} && (1) \\
 &= \sqrt{150/0.15} && (1) \\
 &= 32.4 \text{ m}^3/\text{s} \\
 \text{Check} &Q_B + Q_C + Q_D = 90.0 \text{ m}^3/\text{s} \\
 &28.0 + 29.6 + 32.4 = 90.0 \text{ m}^3/\text{s} && (1)
 \end{aligned}$$

5 Question 5 [20]

5.1 Complete the table below listing the advantages and disadvantages when comparing the following types of fans: (10)

	Axial Flow Fans	Centrifugal Fans
Advantage	Easy to install	Operates at a lower speed
	More flexible	Less Noisy
	Cheaper and smaller	Less wear and tear
Disadvantage	Bad stall zone	Difficult to install – Large excavation required
	Noisy	Require complicated pipe layouts
		Bulky

5.2 In order to change the ventilation system, a number of conditions may be altered, name them.

1. Increase Resistance
2. Increase volume
3. Increase pressure
4. Change in air density

5.3 What methods can be used to change a Axial Flow Fan Performance (3)
Any 3

1. Change the speed of the fan (relative simple with indirect drive)
2. Change the pitch of the blades (balance must be maintained)
3. Remove one or more stages (if multi stage)
4. Change the pitch of guide vanes (if possible)
5. Baffling the fan (inefficient and expensive)
6. Fitting diffuser or evasee'

5.4 What method can be used to change a Centrifugal Fan Performance (3)
Any 3

1. Change the speed of the fan (relative simple with indirect drive)
2. Altering damper control (if provided)
3. Baffling the fan (inefficient and expensive)

4. Altering the length of blades (variable tip)
5. Fitting diffuser or evasee'

-----END-----