

Minerals Council South Africa

EXAMINATION PAPER

**SUBJECT:**

CHAMBER OF MINES OF SOUTH AFRICA –
INTERMEDIATE CERTIFICATE IN MINE
ENVIRONMENTAL CONTROL

PAPER 2

SUBJECT CODE: COMIMEC2

EXAMINATION DATE: 13 MAY 2019

TIME: 14:30 – 17:30

EXAMINER: JJ PIENAAR

MODERATOR: N. KRUGER

TOTAL MARKS: 100

PASS MARK: 60

NUMBER OF PAGES: 6

SPECIAL REQUIREMENTS:

THIS IS **NOT** AN OPEN BOOK EXAMINATION. THERE IS **NO** FORMULA HANDOUT

INSTRUCTIONS TO CANDIDATES:

1. Answer all questions **legibly** in English.

Write your **ID number** on the outside cover of each book used and on any graph paper or other loose sheets handed in. **Psychrometric charts at 87.5 kPa and 115.0 kPa, are provided for Question 3.**

NB: Your name **must not** appear on any answer book or loose sheets.

2. Show all calculations **and check calculations on which the answers are based.**

3. Hand-held electronic calculators may be used for calculations.

4. Write **legibly** in ink on the **right hand page** only – **left hand pages will not be marked.**

5. Illustrate your answers by means of sketches or diagrams wherever possible.

6. 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).

7. In answering the questions, full advantage should be taken of your practical experience as well as data given.

8. Please note that you are not allowed to contact your examiner or moderator regarding this examination.

9. Cell phones are **NOT** allowed in the examination room.

QUESTION 1

- 1.1. Define Wet Bulb Globe Temperature Index. (2)
- 1.2. Define the term Wind Chill Equivalent Temperature. (2)
- 1.3. Define the term Heat Stress. (2)
- 1.4. Define the term Thermal Capacity. (2)
- 1.5. Define Psychrometry. (1)
- 1.6. Define and give the formula of Boyle`s Law. (3)
- 1.7. Define “Exposure” as per toxicology Principles. (3)
- 1.8. Define the term “Fibre”. (2)
- 1.9. Define Natural Acclimatization Underground (NAU). (2)
- 1.10. Define Heat intolerant employees. (1)

[20]**QUESTION 2**

- 2.1. Supply the required properties and hazards of the following gases: Record the answers in your answer sheet from item (1) to (10). (10)

Gas	Sources of gas	Dangers	Explosive range	Occupational Exposure limit (OEL)
Hydrogen		(1)	(2)	
Ammonia	(3)			(4)
Carbon monoxide	(5)		(6)	
Carbon dioxide		(7)		
Methane			(8)	
Hydrogen Cyanide	(9)	(10)		

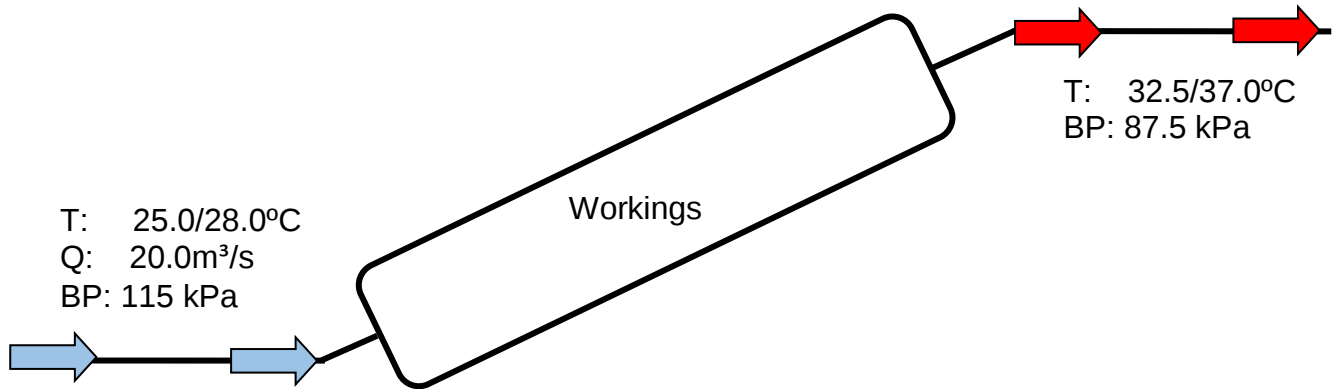
- 2.2. State the Thermal Capacity of water including the SI Unit. (1)
- 2.3. State the Thermal Capacity of ice including the SI Unit. (1)
- 2.4. List the six major sources of heat in underground mines. (3)
- 2.5. State six control measures before exposure to cold stress conditions. (6)
- 2.6. List and describe the three types of defective vision. (6)
- 2.7. List and describe the four types of noise. (8)

[35]

QUESTION 3

NOTE! - Ensure that the correct units of measure (SI unit) are recorded as answers will be marked wrong if the incorrect unit is used, even if the value calculated is correct.

3.1 The sketch below represents an underground working section.



- By using psychrometric charts determine how much heat is produced in the workings. Ignore the effects of auto-compression. (3)
- If in-stope cooling of 500 kW is installed in the workings, determine what will be the expected wet-bulb and dry-bulb temperatures in the return airway. Assume the Relative Humidity in the return airway increased to 80%. (3)
- State if the cooling will be adequate to reduce the temperature to below 28.5°C wet bulb. (2)

3.2. A Bulk Air Cooler (BAC) was installed in the main intake to an underground section.

An air volume of 100 m³/s enters the BAC at 27.5 / 33.0 °C. The barometric pressure is 115 kPa and the total heat removed from the air is 3 200 kW. The water flow rate through the BAC is 90 l/s and the temperature of the water entering the BAC is 10 °C.

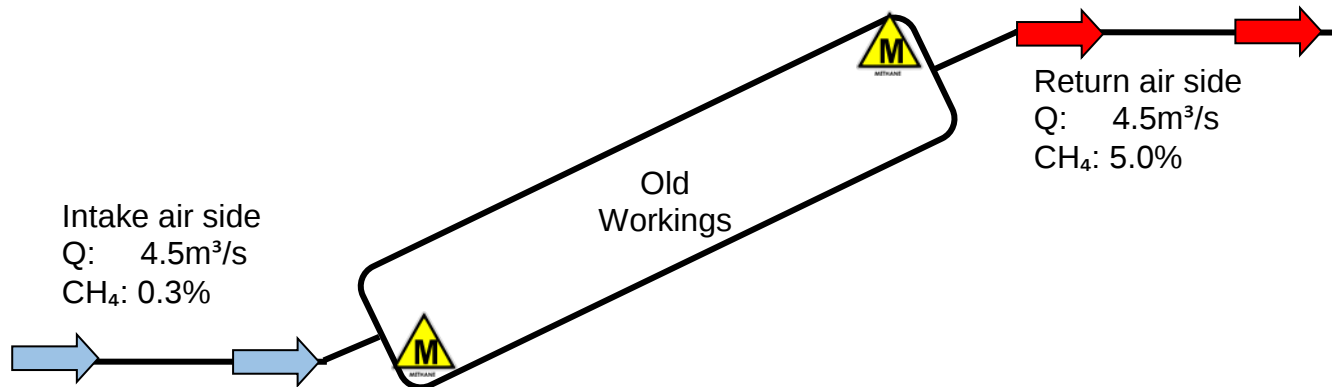
Calculate the following:

- The temperature of the air leaving the BAC (state assumptions). (4)
- The air quantity leaving the BAC. (2)
- Has water evaporated or condensed. (1)
- How much water has evaporated or condensed in litres per 24 hour day. (3)
- The temperature of the water leaving the cooler (state assumptions). (2)

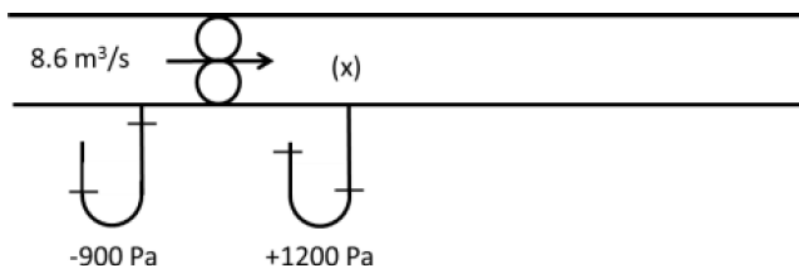
[20]

QUESTION 4

- 4.1 An air volume of $4.5\text{ m}^3/\text{s}$ is returning from old workings and contains 5% flammable gas (CH_4) and the intake air contains 0.3% flammable gas (CH_4). What must the intake air volume be changed to, to ensure that the flammable gas (CH_4) on the return side of the old workings do not exceed the legal limit of 1.4%? (See sketch). (4)



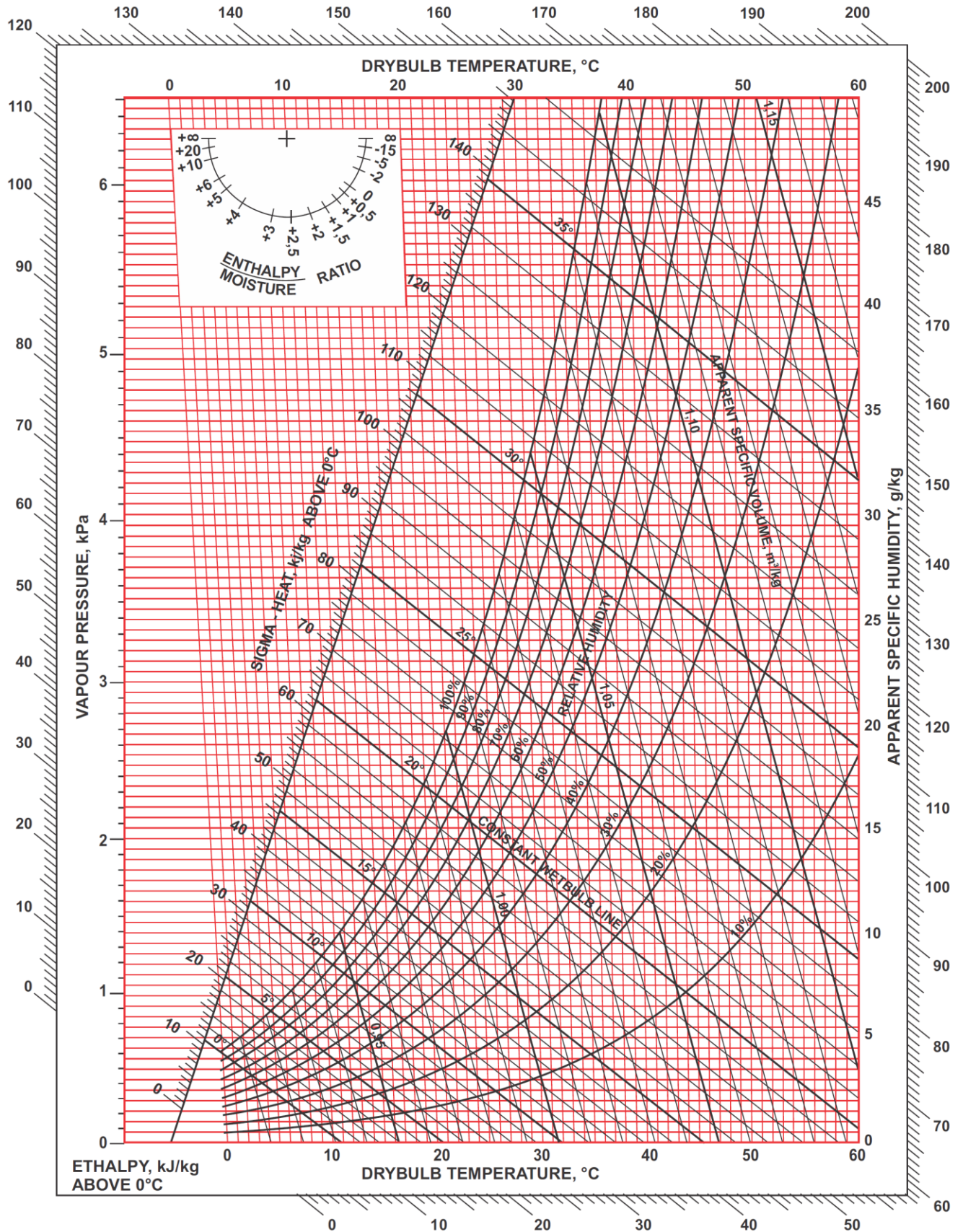
- 4.2. A quantity of $585\text{ m}^3/\text{s}$ enters a downcast shaft of a mine at a barometric pressure of 88.2 kPa and a temperature of $20.0/27.5^\circ\text{C}$. At the bottom of the shaft the barometric pressure is 115.8 kPa and the temperature is $25.3/36.2^\circ\text{C}$. Assuming no leakage, calculate the quantity at the bottom of the shaft. (4)
- 4.3. An axial flow fan is installed in a vent column, with the static pressure readings taken by means of a vertical manometer. The measured barometric pressure at the locality of this installation is 102.5 kPa . If the fan intake quantity is $8.6\text{ m}^3/\text{s}$ calculate the quantity at the fan discharge (x), assuming the temperature remains constant. (4)



- 4.4. A filter bag filter has to be installed at a tip. The tip is 4 m long and 2 m wide. Each of the bags is 2 m long and has a diameter of 200 mm . Determine the number of bags required for the filter. (8)
- 4.5. A worker in a shaft timber yard is exposed to a wet bulb temperature of 28.5°C , a dry bulb temperature of 32.5°C and a globe temperature of 30.6°C . Calculate the WBGT index and comment. (2)
- 4.6. Air enters a surface downcast shaft at an average velocity of 50 km/h and a temperature of $0.0 / 5.0^\circ\text{C}$. Calculate the wind chill equivalent temperature (wind chill factor). (2)

PSYCHROMETRIC CHART

87,5 kPa



PSYCHROMETRIC CHART

115,0 kPa

