

Minerals Council South Africa



EXAMINATION PAPER

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA INTERMEDIATE CERTIFICATE IN MINE ENVIRONMENTAL CONTROL INT. PAPER 2 - OCCUPATIONAL HYGIENE SUBJECT CODE: ICOMMEC 2 EXAMINATION DATE: 14 OCTOBER 2024 TIME: 14:30 17:30 (3 Hours)	EXAMINER: FS Bergh MODERATOR: Navarre Kruger TOTAL MARKS: 100 PASS MARK: 60%
NUMBER OF PAGES: 8 (including this page)	
SPECIAL REQUIREMENTS: THIS IS NOT AN OPEN BOOK EXAMINATION. NO <u>FORMULA HANDOUT TO BE HANDED OUT</u> INSTRUCTIONS TO CANDIDATES: 1. Answer all questions <u>legibly</u> in English. 2. Write your <u>ID number</u> on the outside cover of each book used and on any graph paper or other loose sheets handed in. NB: Your name <u>must not</u> appear on any answer book or loose sheets. 3. Show all calculations <u>and check calculations on which the answers are based.</u> 4. Hand-held electronic calculators may be used for calculations. 5. Write <u>legibly</u> in ink on the <u>right-hand page</u> only – <u>left hand pages will not be marked.</u> 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 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 <u>NOT</u> allowed in the examination room. 11. You are encouraged to make use of the CoMCert Tip-off Hotline whenever you witness or suspect any wrongdoing related to the CoMCert Examinations on landline 0800 118 998 or alternatively you can use email COMCert@tip-offs.com. This tip-off hotline and tip-off email is managed anonymously and confidentially through an independent service provider.	

QUESTION 1 (Definitions)**(Total marks: 25)**

Comprehensively define the following terms, and indicate their correct unit of measure where applicable:

- a) Gases (4 Marks)
 - b) Temperature (2 Marks)
 - c) Absolute Temperature (4 Marks)
 - d) Wet-Bulb Temperature (3 Marks)
 - e) Joule (4 Marks)
 - f) Thermal Capacity (4 Marks)
 - g) Watt (4 Marks)
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QUESTION 2 (Heat Theory and Calculations)**(Total Marks: 30)**

- a) List and briefly discuss the types of latent heat, as well as the latent heat values (4)
- b) Kindly list the thermal capacity values of the following:
 - Quartzite
 - Ice
 - Dry air
 - Water(4)
- c) A mine utilises an ice plant as part of its cooling strategy. The net cooling capacity of the plant is 10 MW. Calculate the required ice production, in kg/s, required to deliver this cooling duty. (3)
- d) Chapter 9 of the Mine Health and Safety Act Regulations (MHSA, Act. 29 of 1996) states the employer must establish and maintain a system of Occupational Hygiene Measurements where certain hazard limits prevail. State at what levels monitoring will be required for the following thermal criteria:

Hazard / stressor	Limits
Thermal stress: Heat	i) Wet Bulb? ii) Dry Bulb? iii) Mean Radiant Temperature?

(3)

- e) The air intake temperature to a working area underground is 23.0/27.0°C. Electrical installations in the area have a combined motor input power of 2 MW. Upon inspection it is found that all electrical installations have a motor efficiency of 85%. Calculate the heat given off by these installations (3)

- f) Given the parameters below, calculate the quantity of air that must be passed through these same workings (refer to Question e), to ensure the temperature does not exceed 25.0°C

Sigma Heat In	60 kJ/kg
Sigma Heat Out	80 kJ/kg
Apparent Specific Volume	0.95 m ³ /kg

(5)

- g) A chilled water storage tank on surface has the details, as listed below. Calculate the heat pick up, in kW, from 07:00 am – 11:00 am:

Capacity	5 Mega Litre
Water temperature at 07:00 am	2.3 °C
Water temperature at 11:00 am	5.3 °C
No water was consumed/ no leakage during this period	Not applicable

(5)

- h) Two LHD's, both having a rated engine capacity of 350 kW are loading rock in a development section of a mine. Assuming a diesel efficiency factor of 35% and a utilisation factor of 25%, calculate the heat released into atmosphere, by these machines. (3)

QUESTION 3 (Psychrometry)**(Total Marks: 20)**

A mine in Africa has contacted you to carry out a heat load study of their workings.

The following ambient conditions exist on surface:

Barometric Pressure	87.5 kPa
Temperature Wet Bulb	22.0°C
Temperature Dry Bulb	30.0°C

The barometric pressure in the underground production zone is measured as 105 kPa. Calculations indicate the sigma heat at depth to be 98.5 kJ/kg. A total of 100 m³/s is flowing through the production zone at an apparent specific volume of 0.877m³/kg. Calculate, and where applicable, use the attached psychrometric charts to determine, the following parameters:

- a) Sigma Heat content of ambient air (1)
- b) Mass flow available in the production zone (2)
- c) Free cooling capacity of air / net air-cooling duty (2)
- d) Calculations indicate the total heat load for the operation is 5MW, excluding heat due to auto compression. Calculate the heat contributed by auto compression, in kW, if the total available downcast is 100m³/s. In this case, the depth of the workings to be calculated by observing the difference in surface and underground barometric pressures. (5)
- e) Using the calculations and information above, indicate the amount of mechanical cooling required at the operation. (2)
- f) If the bulk air cooler, as calculated in question e) above, is 100% efficient, and the chilled water temperature is 5.0°C whilst the return water temperature is 17.0°C, calculate the required chilled water flow rate. (5)

- g) Use the attached 87.5 kPa psychrometric chart to determine the following parameters:

i)Total Heat	(1)
ii)Relative Humidity	(1)
iii)Moisture content	(1)

QUESTION 4 (Gases)

(Total Marks: 10)

4.1 Analyse the table below and provide answers for all the “greyed-out” blocks below.

Gas	Sources (at least one)	Explosive Range	Specific Gravity	Occupational Exposure Limit
Carbon Monoxide	4.1.1	12.5-74.2%	0.97 Lighter than air	30 p.p.m or 0.003%
Methane	Decay of vegetable and organic matter	5-15%	4.1.2	<1.4%
Nitrogen Dioxide	4.1.3	None	4.1.4	4.1.5
Hydrogen	Charging of electrical accumulators occur in conjunction with methane	4-74%	4.1.6	Nil
Carbon Dioxide	4.1.7	0	1.53 Heavier than air	5000 p.p.m pr 0.5%
Sulphur Dioxide	4.1.8	4.1.9	4.1.10	2 p.p.m

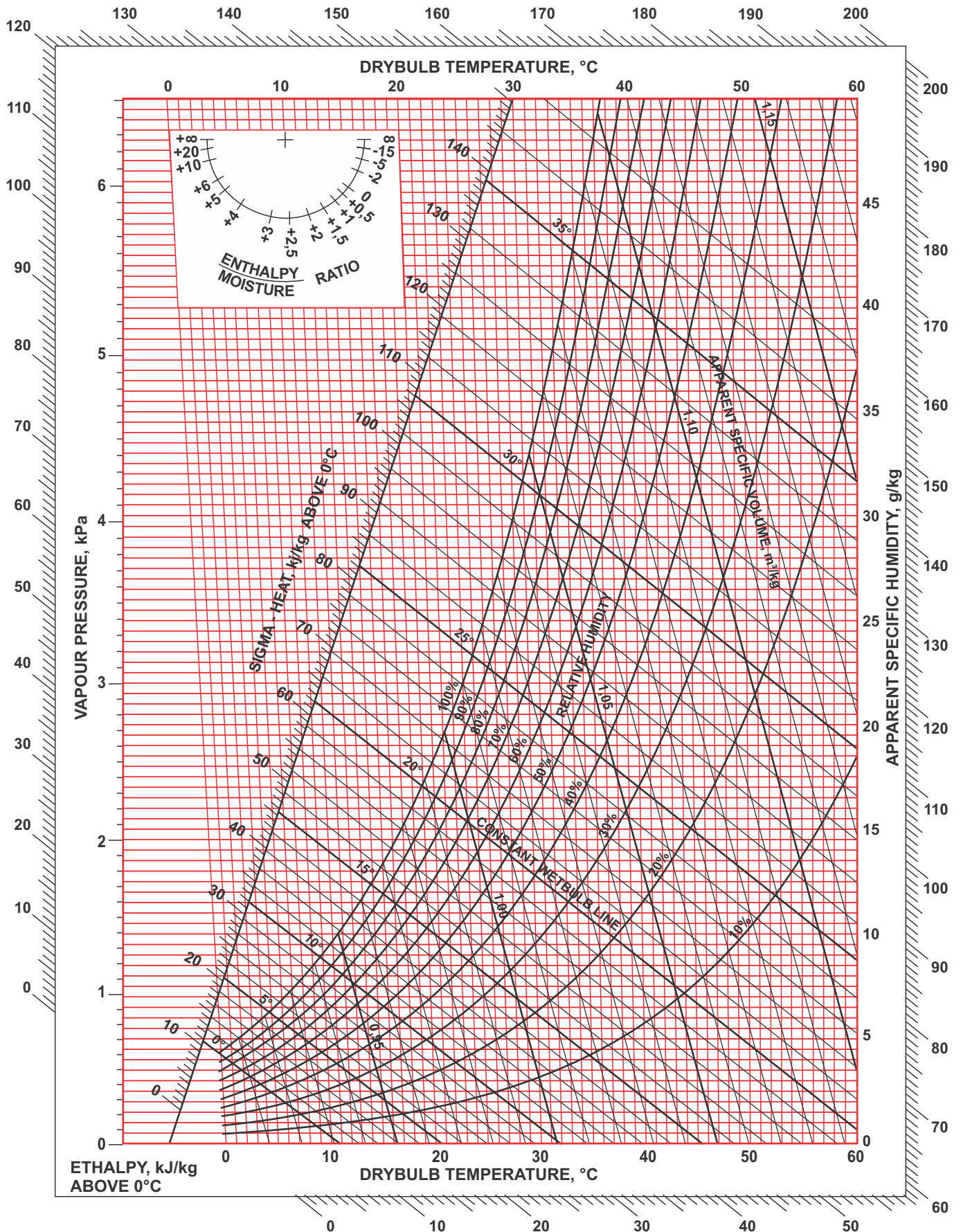
QUESTION 5 (Theory)

(Total Marks: 15)

- a) List the four diseases commonly associated with exposure to Asbestos and Silica. (2)
- b) Name the four types of noise and give an example of each. (4)
- c) List four primary factors that has an influence on the formation of a flammable gas roof layer. (2)
- d) List two types of disorders or illnesses due to over exposure to cold stress conditions. (2)
- e) When must globe temperature be considered. (1)
- f) List two categories of vibration and offer an example of each. (4)

PSYCHROMETRIC CHART

87,5 kPa



PSYCHROMETRIC CHART

105,0 kPa

