Chamber of Mines of South Africa

EXAMINATION PAPER

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA – INTERMEDIATE CERTIFICATE IN MINE ENVIRONMENTAL CONTROL PAPER 2	**EXAMINER:** F. NADARAJU **MODERATOR:** N. KRUGER
SUBJECT CODE: **COMIMEC2**	
EXAMINATION DATE: 12 MAY 2017	**TOTAL MARKS:** 100
TIME: 14:30 – 17:30	**PASS MARK:** 60

NUMBER OF PAGES: 5

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. **Psychrometric charts at 85 kPa, 115 kPa and 120 kPa are provided**

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 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.

QUESTION 1

1.1 Define the term Occupational Hygiene in terms of MHSA (29 of 1996). (2)

1.2 Define Natural Acclimatization Underground [NAU]. (2)

1.3 Define wet-bulb globe temperature [WBGT] and state the formula to calculate WBGT. (2)

1.4 Define wind-chill equivalent temperature [WCET] and state the formula to calculate WCET. (2)

1.5 Define the terms Dust and Gas. (2)

[10]

QUESTION 2

2.1 Give four hazards of over exposure to heat stress and briefly explain each condition. (4)

2.2 Heat flow from rock is a major source of heat in mines. How would you go about minimising the heat-flow from rock into the workings (5)

2.3 Heat stress can impact on the health of workers, reduce productivity and increase accident rates. State ways in which heat stress can be controlled (4)

2.4 List four reasons or objectives for sampling airborne pollutants. (4)

2.5 A risk assessment of an underground pump station has identified noise as one of the hazards. What hierarchy of controls would you use to limit the workers' exposure to noise? Give an example of each control measure. (3)

[20]

QUESTION 3

3.1 Give three reasons for sampling mine water. (3)

3.2 Name and describe three routes of entry of toxic substances into the human body. (3)

3.3 Silica and coal dust are generally classified according to the particle size. Define "inhalable" and "respirable" dust and the potential health risk of each type of dust on workers. (4)

3.4 Supply the required properties and hazards of the following gases: Record the answers in your book from item (1) to (10). (10)

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

[20]

QUESTION 4

4.1 What is the depth at which the virgin rock temperature is 38.6°C? The thermal gradient is 0.023°C per metre and the surface rock temperature is 23.7°C. (2)

4.2 At a deep-level mine, ice is produced on surface and sent to an ice-melting dam underground. The cooling capacity of the ice when it melts and supplies chilled water at 5.3°C is 10.0 MW. What quantity of ice is produced on surface? Ignore the effects of auto compression and the heat loss through the shaft pipes. (2)

4.3 At a mine the underground cooling required is 15 000 kW; chilled water will be produced on surface and sent to underground bulk air coolers and cooling cars.

4.3.1 Calculate the outlet water temperature if the total chilled water flow sent underground is 245 l/s and the temperature of the water entering the underground coolers is 8.4°C. (2)

4.3.2 If the chilled water on surface is 5.0°C, at what depth will the underground coolers be installed? Ignore the heat loss through the shaft pipes. (2)

4.4 Water at a flow of 75 l/s enters a bulk air cooler at 6.1°C and leaves at 16.2°C. What is the cooling duty of the air cooler? (2)

4.5 The air velocity downstream of a surface bulk air cooler was measured at 18 km/hour at a temperature of 5.0 / 6.5 °C. Calculate the Wind chill equivalent temperature (WCET). (3)

4.6 A worker in an open pit is exposed to a temperature of 27.8 / 35.1°C and a globe temperature of 31.6 °C. Calculate the WBGT index. (2)

4.7 The wet kata reading in a stope is 7.3 and the temperature of the air flowing across the stope face is 31.5 / 32.5°C, what is the air velocity? (2)

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QUESTION 5

5.1 150 m^3/s of air enters an underground condenser cooling tower [CCT] at 28.0 / 30.0°C [barometric pressure 120 kPa] and is designed to reject 9 500 kW of condenser heat. The air leaves the top of the tower on a level where the barometric pressure is 115 kPa. The condenser water flow is 300 l/s and leaves the condenser at 42.0°C. Calculate the following:

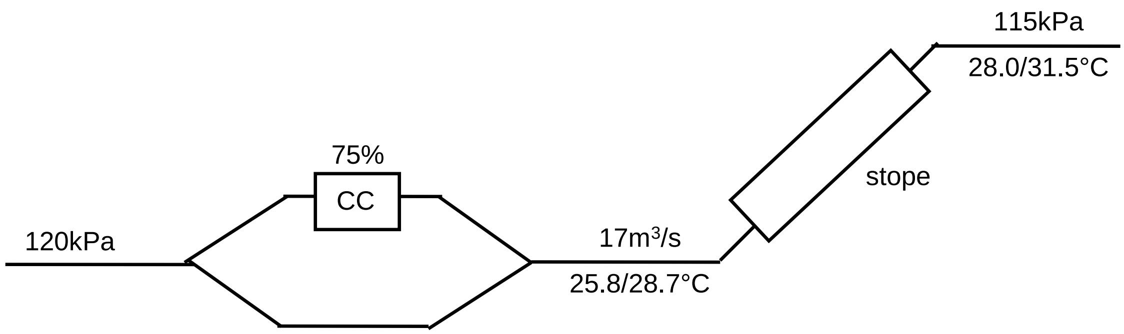
5.1.1 The temperature of the air leaving the CCT (4)

5.1.2 The air quantity leaving the CCT. (2)

5.1.3 The amount of water evaporated or condensed in litres per day (3)

5.1.4 The water temperature leaving the CCT. (2)

5.2 17 m^3/s of air enters a stope at a temperature of 25.8/28.7°C on a level where the barometric pressure is 120 kPa and exits the stope on a level where the barometric pressure is 115 kPa. A cooling car is installed upstream of the stope and cools 75% of the air that enters the stope. A sketch is provided below.



5.2.1 Calculate the heat added to the air if the temperature of the air leaving the stope is 28.0/31.5°C. Ignore the effects of auto compression. (6)

5.2.2 Calculate the air temperature leaving the cooling car if the air temperature upstream of the cooler is 27.3/29.4°C. (4)

5.2.3 Calculate the cooling car duty. (2)

5.2.4 6.0 l/s of chilled water at 7.0°C is supplied to the cooling car. Calculate the temperature of the water leaving the cooling car. (2)

5.3 A surface bulk air cooler (design duty of 7.5 MW) cools 300 m^3/s of ambient air at 18.0/30.0°C before being sent down the main shaft. The barometric pressure is 85 kPa.

5.3.1 What is the temperature of the air leaving the bulk air cooler? (4)

5.3.2 Will condensation or evaporation take place in the bulk air cooler? Confirm this with a calculation. (2)

5.3.3 If the temperature of the chilled water supplied to the bulk air cooler is 5.1°C and the warm water leaves at 11.1°C, what is the water flow leaving the bulk air cooler? (2)

[33]

TOTAL MARKS: [100]