

Minerals Council South Africa

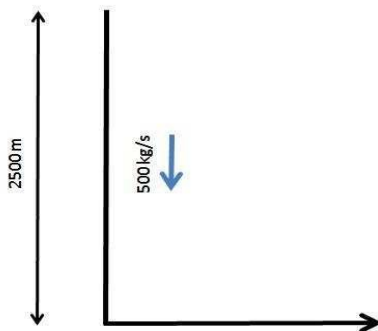


EXAMINATION PAPER

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA – CERTIFICATE IN MINE ENVIRONMENTAL CONTROL PAPER 2 - THERMAL ENGINEERING SUBJECT CODE: COMMEC2 EXAMINATION DATE: 13 MAY 2026 TIME: 14:00 – 17:00	EXAMINER: Tsietsi B Letanta MODERATOR: A Oosthuizen TOTAL MARKS: [100] PASS MARK: (60%)
NUMBER OF PAGES: 5 (including this page)	
<u>SPECIAL REQUIREMENTS:</u> <i>All candidates are advised to read the below instructions/requirements and adhere to them. Not adhering to them could lead to the loss of marks.</i> THIS IS <u>NOT</u> AN <u>OPEN BOOK EXAMINATION</u>. FORMULA HANDOUTS AVAILABLE - Answer all 4 questions <u>legibly</u> in English. - 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. Your name must not appear on any answer book or loose sheets. - Show all calculations and check calculations on which the answers are based. - Hand-held electronic calculators may be used for calculations. - Write <u>legibly</u> in ink on the <u>right-hand page</u> only – <u>left hand pages will not be marked</u>. - Illustrate your answers by means of sketches or diagrams wherever possible. - Answers must be given to an accuracy which is typical of practical conditions. <u>NB:</u> Ensure that the correct unit of measure (SI unit) is recorded as marks will be deducted from answers if the incorrect or no units are used. (Even if the calculated value is correct). - Please note that you are not allowed to contact your examiner or moderator regarding this examination. - Cell phones and any other electronic devices are <u>NOT</u> allowed in the examination room. <u>Only Calculator</u> - 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 <u>COMCert@tip-offs.com</u>. This tip-off hotline and tip-off email is managed anonymously and confidentially through an independent service provider. A 107,5kPa Psychrometric chart is included for your reference.	

QUESTION 1

- 1.1 List two (2) major sources of heat in a mine and briefly describe each of these heat sources. (2)
- 1.2 Briefly describe the process of auto-compression which occurs when ventilating air descends into a mine. Why is auto-compression of air of greater significance in deeper mines than in shallow mines? (2)
- 1.3 The sketch below represents a vertical shaft down which 500kg/s of fresh ventilating air descends 2500m from surface into a mine:



- Calculate at which rate the heat would be added to the downcasting air volume. (4)
- 1.4 Calculate the Virgin Rock Temperature (VRT) when given the following information: (4)
- Depth below surface = 2500m
 - Surface rock temperature = 21.4°C
 - Thickness of Karoo diabase = 830m
 - Thickness of lava = 350m
 - Thickness of quartzite = 1320m
- 1.5 In an underground section, there are two front end loaders. Each produce 45kW of work when fully loaded. One of these loaders is diesel driven and consumes 13.5litres of fuel per hour under full load. The other is similarly sized and is electrically powered. The overall efficiency of the electric loader is 95%. Assuming that the calorific value of the diesel fuel used is 38MJ/l, determine the following:
- 1.5.1 The heat production rate of the diesel loader. (4)

- 1.5.2 The heat production rate of the electric loader. (4)
- 1.5.3 Compare the heat production rate of the two loaders and comment on the difference in heat produced. (4)
- 1.5.4 Give a brief description of how wetness of the rock surfaces affects the wet bulb temperature of passing ventilation air. (2)

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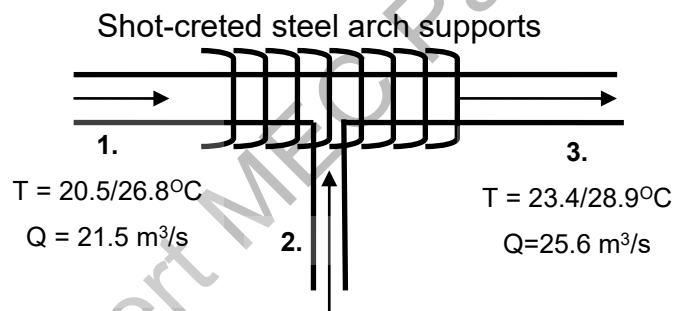
QUESTION 2

- 2.1 Discuss three forms of heat transfer and list the factors which affect each of these forms of heat transfer. (9)
- 2.2 A clerk in a metallurgical plant complains that the office in which she works is “hot”. One wall in particular appears to radiate heat into this office, this wall separates the office from an adjoining furnace room.
- The wall adjoining with the furnace room measures 4m(W) x 2m(H).
- This wall comprises of a 200mm thick, double-brick wall with a 15mm thick layer of plaster on either side of the wall.
- The surface temperature of this wall is measured to be 115°C (on the furnace side of the wall and 55°C (on the office side of the wall).
- An air conditioner maintains the air temperature inside the office at a constant 26.5°C.
- Given that:
- The thermal conductivity of brick is 0.7W/m°C.
 - The thermal conductivity of plaster is 0.93W/m°C.
 - The surface (skin and clothes) temperature of the clerk averages 28°C.
 - That side of the clerk’s body facing the “hot” wall has a surface area of 0.8m².
 - That side of the clerk’s body facing the “hot” wall has an emissivity and view factor with the wall of 0.95.
- Determine:
- 2.2.1 At what rate does heat pass through the wall by means of conduction?
- 2.2.2 The convective heat transfers co-efficient for the wall.
- 2.2.3 How much radiated heat is received by the clerk. (10)

- 2.3 Briefly discuss factors that can contribute towards heat intolerance in an underground worker. (5)
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QUESTION 3

- 3.1 Define the following terms and state the units in which each term is expressed: (7)
- 3.1.1 Wet Bulb temperature.
 - 3.1.2 Relative humidity.
 - 3.1.3 Superheat.
 - 3.1.4 Enthalpy.
 - 3.1.5 Sigma heat.
 - 3.1.6 Sensible heat.
 - 3.1.7 Latent heat.
- 3.2 The sketch below shows $21.5 \text{ m}^3/\text{s}$ of fresh air mixing with “hot air” leaking through a damaged seal.



Note: the prevailing barometric pressure between points (1) and (3) is 107.5 kPa.

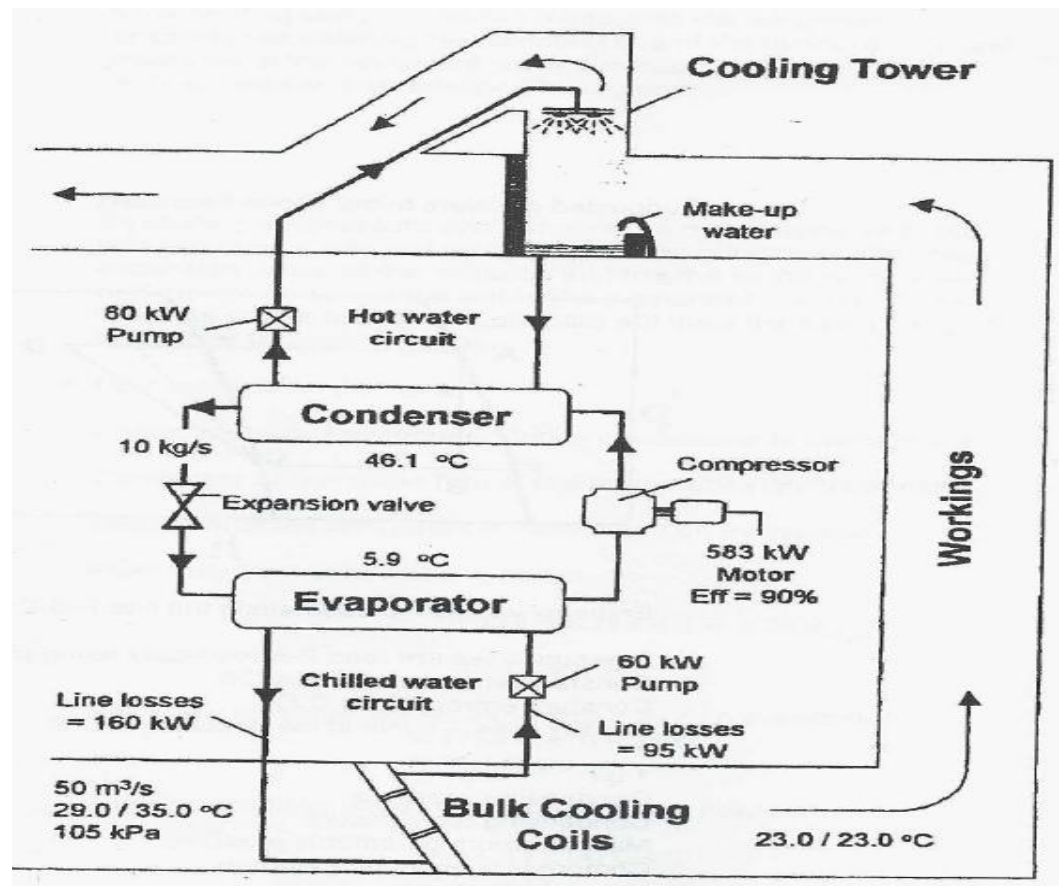
- 3.2.1 Determine the quantity and temperature of the air leaking through the damaged seal. (10)
- 3.2.2 As the two air streams mix, will any condensation take place? Please explain and justify your answer. (6)

- 3.3 In the air-conditioning industry, extensive use is made of evaporative coolers. (6)
Briefly explain the principle of operation of an evaporative cooler.

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QUESTION 4

The sketch below shows the layout of an underground cooling plant.



Determine the following:

- 4.1 The plant duty. (6)
4.2 The plant positional efficiency. (4)
4.3 The motor COP. (2)
4.4 The amount of heat rejected in the cooling tower. (3)
4.5 The Carnot COP. (3)
4.6 The cycle efficiency. (3)

[21]

TOTAL MARKS: [100]

107,5 kPa

