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: **04 November 2020** TIME: **14:00 – 17:00 (3 HOURS)**	EXAMINER**: Marthinus v/d Bank** MODERATOR: **Dave Farlam** TOTAL MARKS: **[100]** PASS MARK: **(60%)**

NUMBER OF PAGES: 5

SPECIAL REQUIREMENTS:

THIS IS **NOT** AN **OPEN BOOK EXAMINATION**. FORMULA HANDOUTS AVAILABLE

INSTRUCTIONS TO CANDIDATES:

1. Answer all 4 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) is recorded as marks will be deducted from answers if the incorrect unit is used. (Even if the calculated value is correct).

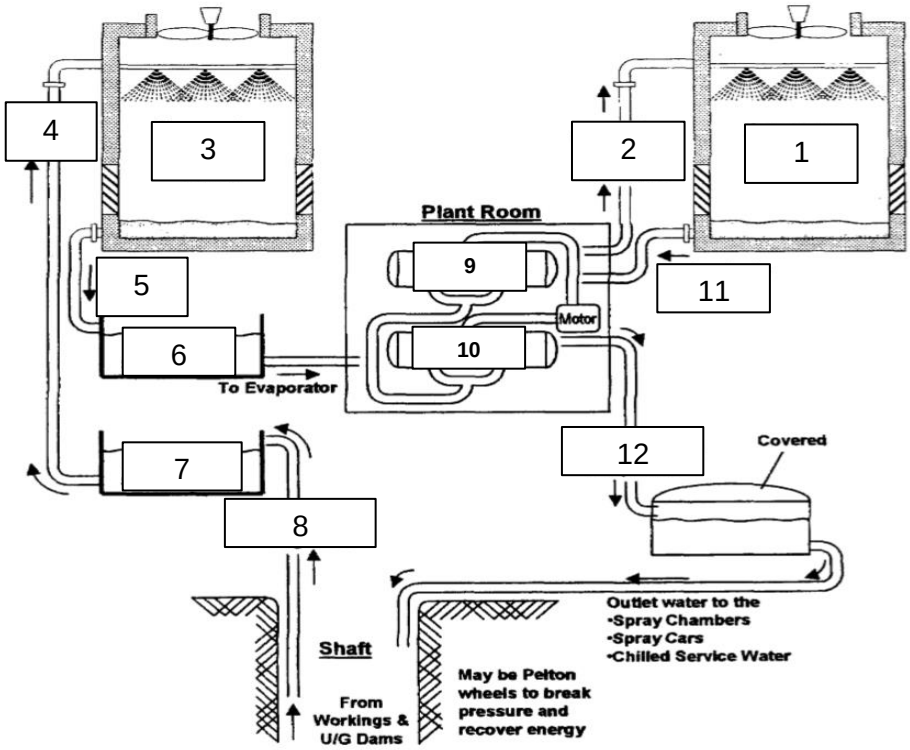
8. Please note that you are not allowed to contact your examiner or moderator regarding this examination.
9. Cell phones and any other electronic devices are **NOT** allowed in the examination room. **Only Calculator**
10. **The following charts to be included: Psychrometric charts: .0kPa and 120.0kPa.**

QUESTION 1

1.1 The diagram below indicates the typical layout of a surface refrigeration plant.

1.1.1 Identify the typical components of a surface cooling plant as indicated in the diagram below which are numbered from 1 to 12.

1.1.2 When all components are identified explain the full function of the pre-cooling towers and the condenser cooling towers.



(16)

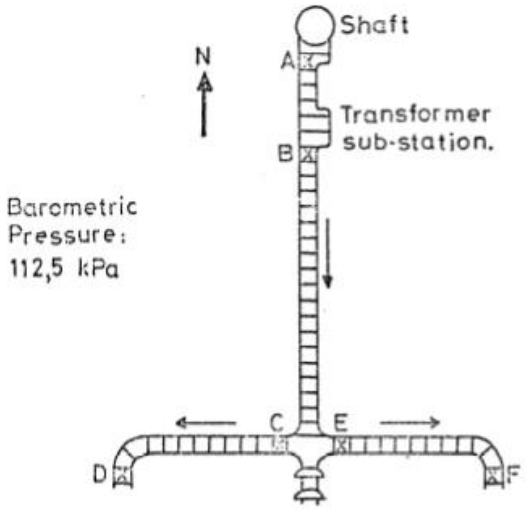
1.2 Give a brief explanation for the following terms:

- Normal temperature and pressure (N.T.P.) (1)
- Standard vair (2)
- Temperature of adiabatic saturation (2)
- Enthalpy (total heat) (2)
- Humid thermal capacity of vair (1)

(24)

QUESTION 2

The sketch below shows measurements taken in a crosscut and footwall drive system where an air split has been established to supply air to a stope from a sub-vertical shaft.



Point	Air temperature		Q
	wet-bulb (°C)	dry-bulb (°C)	(m^3/s)
A	28,5	37,7	-
B	29.0	39,7	16,8
C	29,8	34,5	8,1
D	32,1	33.0	-
E	29,8	34,5	7,8
F	31,1	33.0	

Answer the following questions:

2.1 Do a mass flow of air calculation for the air at points B, C and E and comment on your answer. (7)

2.2 Calculate the rate at which the air gains heat and moisture (in kW and litres/second respectively):

2.2.1 At the transformer sub-station; (1)

2.2.2 In the crosscut (2)

2.2.3 In the footwall drive east and (2)

2.2.4 In the footwall drive west. (2)

2.3 At what temperature would you expect the air to reach the ends of the footwall drives should the air split be increased from 16.8 m^3/s to 28.0 m^3/s? This change is not likely to affect the temperature of the air at the shaft station. (18)

(32)

QUESTION 3

3.1. The air in an intake airway has the following temperature and specific humidity:

Temperature 25.0/30.0ºC

Specific humidity 18.2 g/kg

Calculate (i.e. do not use psychrometric charts) the following:

3.1.1 The Sigma heat (kJ/kg) (6)

3.1.2 The total heat content of the air (kJ/kg) (2)

3.2. A quantity of 75m³/s flows along an airway. The barometeric pressure is 100kPa. The temperature is 24.0/29.0°C.The temperature at the first stope entrance is 28.5/30.0°C.

3.2.1 If the maximum permissible wet-bulb temperature is 32.0°C, what rate of heat pick-up (kW) can the air absorb in the stope? (5)

3.2.2 If the dry-bulb temperature entering the first stope remains at 30.0°C, but the quantity of water evaporated between the station and the stope entrance is reduced by 50%, what will the wet-bulb temperature of the air entering the stope be? (4)

3.2.3 What will the new rate of heat pick-up (kW), for the same maximum permissible wet-bulb temperature be in the stope? (3)

(20)

QUESTION 4

4.1 What are the symptoms of condenser tube fouling? (3)

4.2 What requirements are to be met for materials to be used for insulation of pipes? (6)

4.3 A quantity of 75.0 m^3/s of air enters a bulk air cooler at 29.5/33.8°C. The barometric pressure is 112.5 kPa and the total heat removed from the air is 3 850 kW. The water flow rate through the bulk air cooler is an amount of 80.0 litres/second and the temperature of the water entering the cooler is 9.5°C.

Calculate the following:

4.3.1 The temperature of the air leaving the bulk air cooler. (State assumptions) (5)

4.3.2 The quantity of air leaving the bulk air cooler. (2)

4.3.3 How much water has evaporated or condensed in litres per day. (6)

4.3.4 The temperature of the water leaving the cooler. (2)

(24)

Theo: Add psychrometric charts 100.0 and 112.5