Minerals Council South Africa

EXAMINATION PAPER

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA: INTERMEDIATE CERTIFICATE IN MINE ENVIRONMENTAL CONTROL PAPER 1 **SUBJECT CODE:** **COMIMEC1** **EXAMINATION DATE:** **XX OCTOBER 21** **TIME**: **14:30 17:30**	**Examiner:** Mervin van Rooyen **Moderator:** Inus Labuschagne **TOTAL MARKS:** [100] **PASS MARK:** [60%]

NUMBER OF PAGES: 3

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.

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, diagrams and tables wherever possible.
7. Answers must be given to an accuracy which is typical of practical conditions.

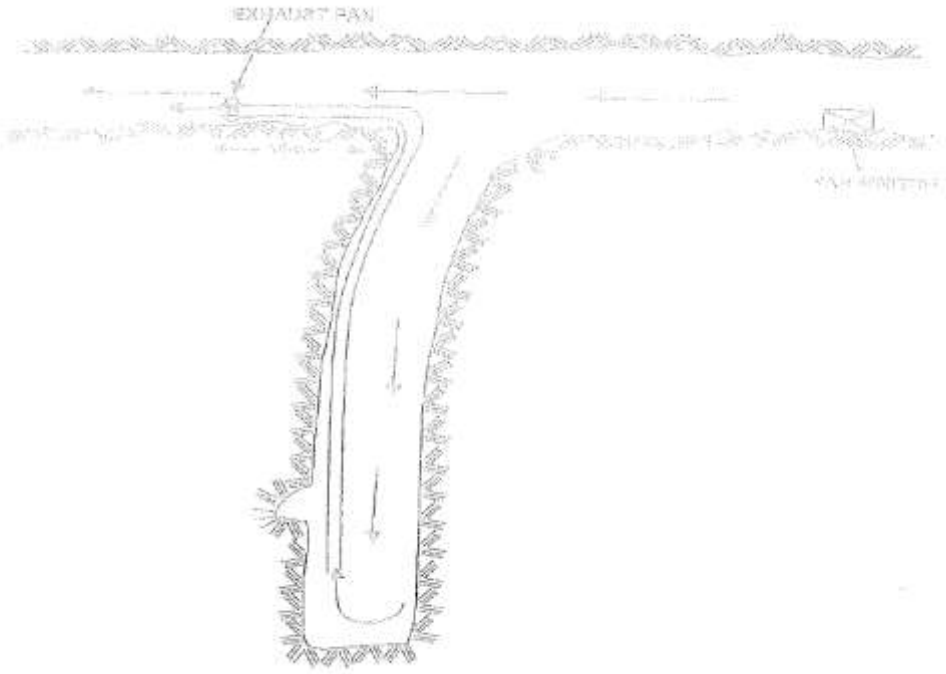
   NB Ensure that the correct unit of measure (SI unit) are recorded as marks will be deducted from answers if the incorrect unit is used. (Even if the calculated value is correct).

   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 Draw the exhaust ventilation system for a development end and list the advantages and disadvantages. (13)

Drawing (6)



Advantages (3)

- Persons working in or travelling in the end, away from the face derive maximum benefit from fresh air
- Return air can be controlled
- Single fan and column is required

Disadvantages (4)

- Face is not effectively ventilated, therefore a gas build up at the face can easily occur
- Fan is situated in return air, increasing changes of methane ignition and results more wear and tear on the fan
- Leakage on the column is inward and not easily detected

1.2 Define the characteristics of an ideal dust filter (7)

- Filter out all dust, both fine and coarse, (efficient)
- Be unaffected by humidity or moisture, and should not require much maintenance (reliable)
- Have a low resistance to airflow, Small filter yet able to handle large volumes of air)
- Easy to install
- Easy to maintained and clean
- Have low capital costs (excavation required for housing the filter)
- Low running costs

[20]

QUESTION 2

2.1 What factors are to be considered before selecting a Self-Contained Breathing Apparatus? (8)

- Distance to be travelled
- Duration of the apparatus
- Work-space available
- Size and weight of apparatus
- Type of atmosphere with regards to toxicity and oxygen content
- Restrictions that may have been imposed on the apparatus under the conditions of approval
- After – sales service, training and maintenance
- Life-span (rack life) or shelf life

2.2 Breathing apparatus are divided into 3 main groups, name them. (2)

- Self-contained
- Supplied air
- Filter type

2.3 List the advantages and disadvantages of Chemical and Pressurised Oxygen type Self-Rescuers. (10)

Chemical Self-Rescuer
Advantages

- Generally, a small unit

Disadvantages

- Moisture affects the rack life
- High breathing rate decrease the duration
- The chemical reaction generates heat
- Difficult to inspect (Leak tests required)
- Chemicals are expensive and hazardous

Pressurised Oxygen Self-Rescuer
Advantages

- Inhaled air is cool (not re-circulated)
- Reliable
- Easy to inspect

Disadvantages

- Heavy and bulky

[20]

QUESTION 3

3.1 Simply describe what “Refrigeration” is. (5)

Refrigeration is a process of cooling, whereby heat is removed from a substance(air), where it is not wanted (working place), and put back where it does not affect workers (return airways). It is important to remember that heat is a form of energy and cannot be destroyed, (indestructible), but however can be transferred from one point to another.

3.2 Name the different refrigeration systems available that are commonly used. (5)

- Vapour Compressor System most common
- Absorption System
- Steam-Jet System
- Ice making System
- Water Vapour System

3.3 Complete the table below on the comparison between Condenser Cooling Towers and Cooling Coils. (12)

CONDENSER COOLING TOWERS	COOLING COILS
Air side: • Air leaving the tower is at a Higher Temperature than air entering the tower • Air volume (m^3/s) leaving the tower is Bigger / Higher than air volume entering the tower • Water Evaporated into the air	**Air Side:** • Air leaving the Cooling Coil is at a Lower Temperature than air entering the Coil • Air volume (m^3/s) leaving the Cooling Coil is Smaller / Lower than air volume entering the coil • Water Condensed into the air
Water side: • Water Entering the cooling tower is at a Higher temperature (hotter) than the water leaving the tower	**Water side:** • Water entering cooling coils is at a Lower Temperature than the water leaving the coil

[20]

QUESTION 4

4.1 State the SI units and definition for the following;

4.1.1 Force (2)

Force (N)

- Force is that which changes or tends to change a body's state of rest or of uniform motion expressed in Newton's. (N)

4.1.2 Power (2)

Power (w or kW)

- Power is the timed rate of energy released or the timed rate at which work is done, expressed in watt.

4.1.3 Efficiency (2)

Efficiency (%)

- Is that portion of the original input energy, which is usefully converted into output energy, expressed as a percentage

4.2 The energy input to a winch motor is 210 kW and the output power is 181 kW. Determine the efficiency of a winch motor? (3)

Efficiency = $\frac{\text{Output power}}{\text{Energy input}} \times \frac{100}{1}$ %

= $\frac{181}{210} \times \frac{100}{1}$

= 86.2%

4.3 Complete the table below, including the SI units. (4)

	Atmospheric Pressure	Density
SI Unit	kPa	kg/m^3
Gauteng area	83.5	0.96
Free State / Klerksdorp	87.5	1.00
Sea Level	101.5	1.20

4.4 2.5 m^3/s flows through a 150m galvanised duct with a resistance of 59.91 Ns^2/m^8. Determine the diameter of the duct that must be installed in millimetres. (7)

Given that : L = 150m

R = 59.91 Ns^2/m^8

K = 0.0037 Ns^2/m^4

C = πD

A = $\frac{\pi D^2}{4}$

Now $R = \frac{KCL}{A^3}$

$59.91 = \frac{0.0037 \times 3.14 \times D \times 150}{(\frac{3.14D^2}{4})}$

Thus $59.91 \times \frac{3.14D^2}{4} = 0.0037 \times 3.14 \times D \times 150$

$28.98D^6 = 1.743D$

$D^6 = \frac{1.743D}{28.98}$

$\therefore D5 = \frac{1.743}{28.98}$

$\therefore D = \sqrt[5]{\frac{1.743}{28.98}}$ or $(\frac{1.743}{28.98})^{1/5}$ or $(\frac{1.743}{28.98})^{0.2}$

= 0.57m

$\therefore$ pipe diameter = 0.57 x 1000

= 570mm

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QUESTION 5

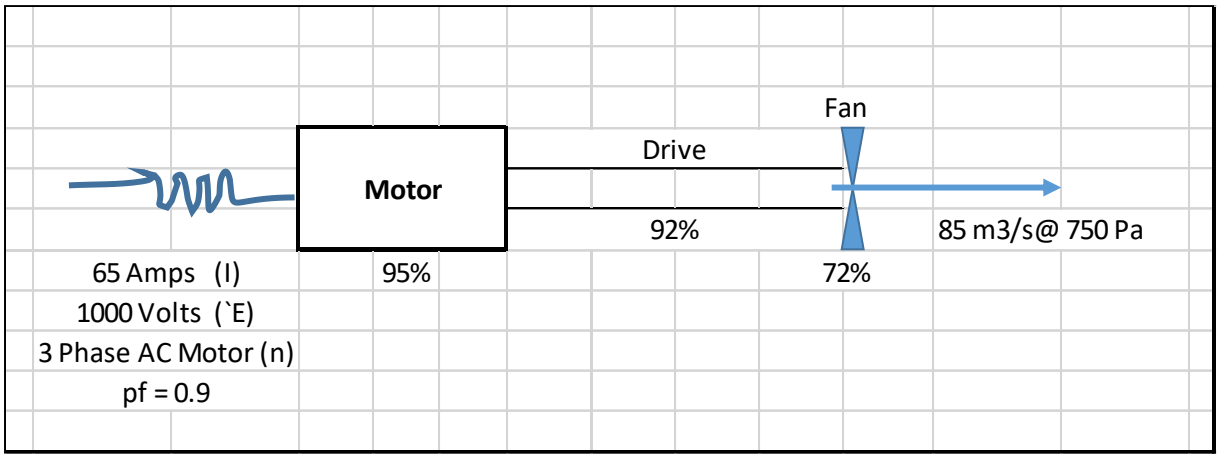
5.1 Table the Effects of Reversal of rotation for a fan. (4)

	Pressure	Quantity	Efficiency	Direction of Flow
Axial	Reduced	Reduced	Reduced	Opposite
Centrifugal	Reduced	Reduced	Reduced	Same

5.2 A fan handles 85 m^3/s @ 750 Pa. The fan is driven by a 3 – phase AC motor that consumes 65 amps from a 1000-volt supply and the power factor is 0.9. The motor efficiency is 95%, the drive efficiency is 92% and the fan efficiency is 72%. (12)

Calculate:

i) The motor input power
ii) The motor output power
iii) The drive output power
iv) The fan air power



The motor input power = EIpfVn

= 1.0 x 65 x 0.9 x $\sqrt{3}$ (remember E = Kilovolts = $\frac{1000}{1000}$ = 1.0)

= 101 kW

Motor output power = Motor input x $\frac{\text{motor Eff}}{100}$

= 101 x $\frac{95}{100}$

= 96 kW (also drive input power)

Drive output power = Drive input x $\frac{92}{100}$

= 89 kW (also fan input power)

Fan output power = Fan input x $\frac{\text{Fan Eff}}{100}$

= 89 x $\frac{72}{100}$

= 64 kW

OR

Airpower = $\frac{PQ}{1000}$ = Fan output power

= $\frac{750 \times 85}{1000}$

= 64 kW

5.3 When deciding on where to site main fans, what points are to be considered? (4)

- Heat: A fan is a machine and therefore inefficient. This inefficiency appears as heat and as a result, main fans should be situated in the RAW
- Accessibility: Fans should be easily accessible in case of breakdowns or routine maintenance
- Noise: Fans should be sited where noise levels create the least disturbance
- Leakage: High pressure should be avoided to minimise air leakage

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TOTAL MARKS: 100