Minerals Council South Africa

EXAMINATION PAPER

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA - CERTIFICATE IN MINE ENVIRONMENTAL CONTROL PAPER 1 - FLOW DYNAMICS, AIRFLOW, FANS, MINE WATER **SUBJECT CODE: COMMEC1** **EXAMINATION DATE:** 06 MAY 2019 **TIME**: 14:30 – 17:30	**EXAMINER:** Tsietsi B Letanta **MODERATOR:** Frank von Glehn **TOTAL MARKS:** [100] **PASS MARK:** (60%)

NUMBER OF PAGES: 4

SPECIAL REQUIREMENTS:

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

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 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 An area of a mine is served by a fan that operates at a duty of 80 m^3/s and 256 Pa. The fan inlet density is 1.10 kg/m^3. A new section is to start up and an additional 30 m^3/s will be required. The fan will need to be replaced, and a used fan is available with performance figures as shown below (at the same density and 12 r/s).

Quantity (m^3/s)	70	80	90	100	110	120
Pressure (Pa)	460	440	400	340	260	160

The proposed replacement fan is belt driven and the speed can be increased.

i) Plot the new fan and system curves on the graph paper provided. (4)

ii) Determine the speed at which the fan must run to meet the new requirements of the mine (3)

iii) The replacement fan is supplied with a 55 kW motor. In your opinion, will the motor need to be replaced in order to run at the new speed? Justify your answer. (2)

1.2 Briefly define shock losses and list five sources of shock losses in a ventilation duct. How is the amount of shock loss usually stated? (7)

1.3 Describe laminar and turbulent flow. Where might you find laminar flow in a mine? (3)

1.4 State Bernoulli's equation (in terms of pressure) for the ideal incompressible fluid in full. List all the symbols which form this equation and give their units. (5)

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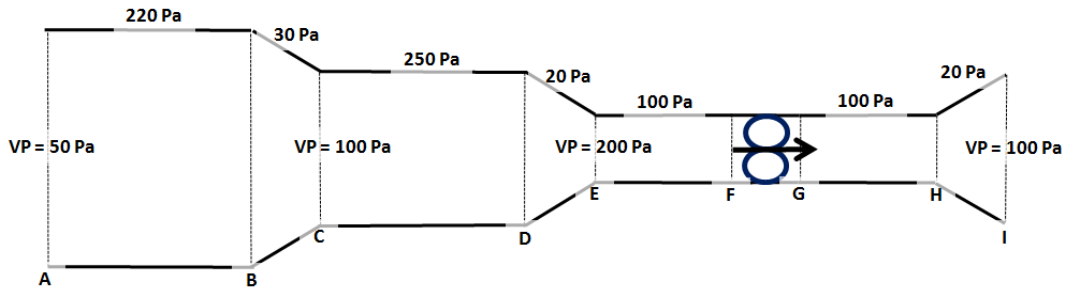
QUESTION 2

2.1 Compare the characteristics of axial-flow and centrifugal fans and give reasons why you would select one type ahead of the other in different applications. Discuss aspects such as size, ease of installation, flexibility, efficiency, volume, pressure, reliability, stall characteristics and noise. (10)

2.2 The sketch below depicts a fan handling air in a ventilation column. The various velocity pressures within the ventilation column are indicated on the sketch. Pressure losses in each section of the ventilation column are also indicated on the sketch. Assume there is no leakage throughout the entire duct.



At each point along the ventilation column, determine;

Total pressure, static pressure, velocity pressure. (10)

Tabulate your answer (in a table similar to that shown below):

	A	B	C	D	E	F	FAN	G	H	I
VP										
SP										
TP										

2.3 Determine the Fan Total Pressure and Fan Static Pressure. (3)

2.4 How can the resistance on this system be reduced? (1)

2.5 What are the effects upon pressure and quantity when fans are installed in series? (2)

[26]

QUESTION 3

3.1 Briefly describe the following water reticulation systems for an underground mine:

i) Open system (2)

ii) Closed system (2)

iii) Integrated system (1)

3.2 250l/s of water chilled to a temperature of 5ºC on surface, enters a vertical shaft through a 15-year-old, 305mm diameter pipe. This water is discharged through a turbine station (situated 1500m below surface) into an underground storage dam. At a flow rate of 250 l/s, the turbine has an efficiency of 75%.

i) Determine the amount of energy recovered by the turbine. (7)

ii) Determine the temperature of the water discharged into the storage dam. (4)

iii) If this turbine were to be removed, what would the temperature of the water discharged into the storage dam be? (4)

[20]

QUESTION 4

4.1 Name five criteria that you need to satisfy when planning ventilation requirements for a mechanised mine. (5)

4.2 Mention five factors that influence fouling of mine water. (5)

4.3 Name 5 hazards you will consider when conducting a health hazard identification for a workplace (5)

4.4 Explain the concept “Residual Fan Curve”, when applied to fan curves (2)

4.5 52.5 m^3/s of air, at a density of 1.05 kg/m^3 and 720 Pa flows in an airway. It is required to reduce the quantity to 30 m^3/s by installing a regulator.
Calculate the size of the regulator required. (6)

4.6 List the advantages and disadvantages of the full volume- reduced volume method of pressure surveys. (7)

[30]

TOTAL MARKS: 100