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:** 08 OCTOBER 2018 **TIME**: 14:30 – 17:30	**EXAMINER:** Tsietsi B Letanta **MODERATOR:** Frank von Glehn **TOTAL MARKS:** [100] **PASS MARK:** (60%)

NUMBER OF PAGES: 5

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 The following measurements were made at an axial flow fan:

Fan Total Pressure	1200 Pa
Fan Velocity Pressure	400 Pa
Quantity	8.4 m^3/s
Motor Input Power	15 kW
Fan Input Power	12.4 kW

Determine:

i) The overall fan efficiency (2)

ii) The total fan total efficiency (2)

iii) Fan static efficiency. (2)

1.2 It is required to speed a fan up from 8.4 r/s to 10.5 r/s. The motor pulley diameter is 180 mm and the fan pulley diameter is 208 mm.

Use two accepted methods of achieving the desired speed and give the necessary pulley diameters. (5)

1.3 The resistances of three airways that are connected in series are:

i) A = 0.075 Ns^2/m^8
ii) B = 0.049 Ns2/m^8
iii) C = 0.06 Ns^2/m^8

A quantity of 60 m^3/s is measured in airway B. Calculate the pressure loss in each airway, the overall resistance and the overall pressure loss of the system. (7)

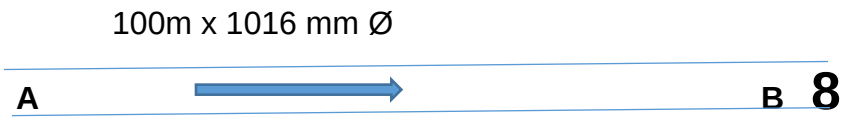
1.4 Give reasons why an evaseé is fitted to the outlet of a ventilation system. (3)

1.5 Mention 4 causes of shock losses in an airway. (4)

[25]

QUESTION 2

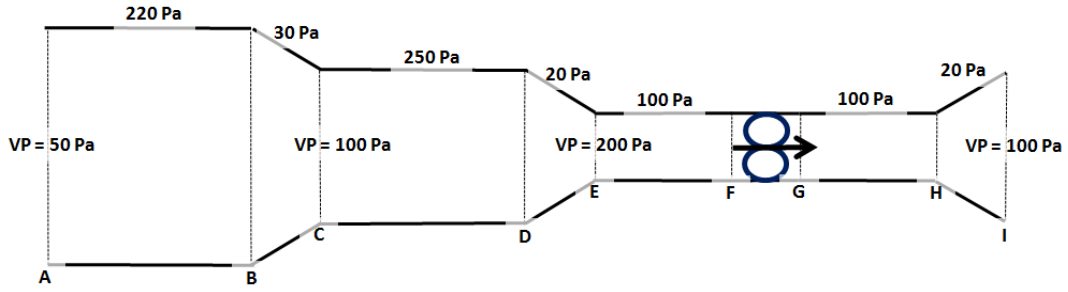
2.1 These measurements were taken from a fan/duct system depicted in the sketch below:



Side tube reading at position A	-275 Pa
Facing tube reading at position B	-513 Pa
Quantity of air	14 m^3/s
Air density	0.98 kg/m^3

Calculate the k factor for the vent column (12)

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)

[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 Briefly describe 5 ways you can control scaling in water reticulation systems (5).

3.3 A pipe column is planned for a new section of a mine. The column will be installed in a portion of a vertical shaft for a distance of 150m and will then be installed in a horizontal haulage to a point 1600m away from the shaft. The vertical pipe will be of 200mm internal diameter, and the horizontal pipe will be 150mm internal diameter. The required water flow rate is 100l/s at a discharge pressure of 20 meters head. (Ignore pressure losses due to bends, valves, etc.).

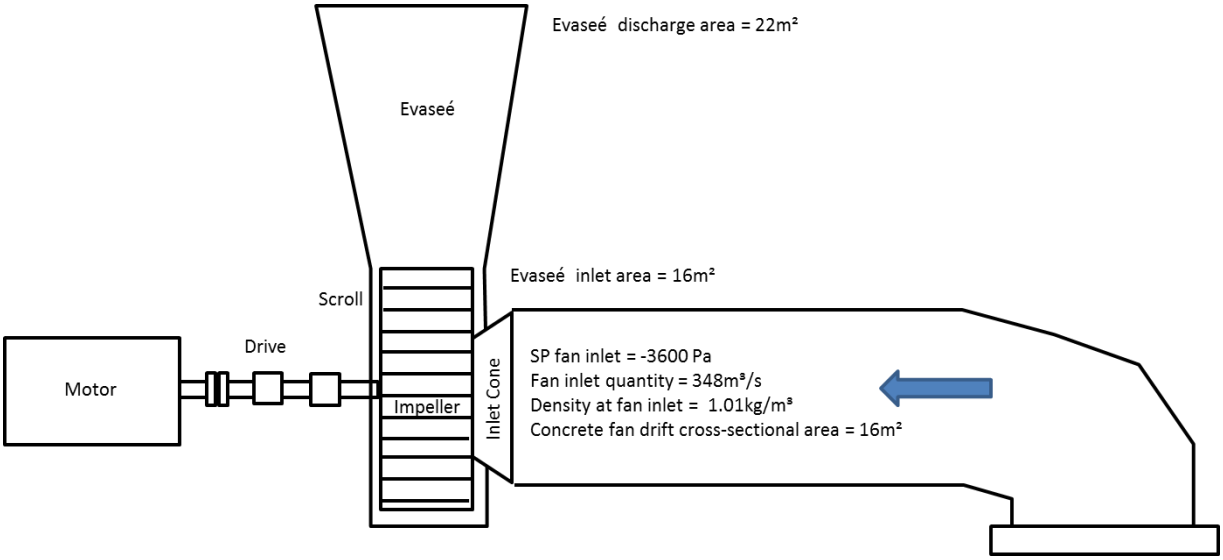
i)	Will this column be adequately sized, given that the dynamic viscosity of water is 10^{-3} kg/ms?	(12)
ii)	If not, what pressure would a pump have to supply to overcome the friction?	(3)

Hint: Assume that the water is delivered at the top of the column at 0m pressure.

[25]

QUESTION 4

4.1 The sketch below represents a main surface fan on a large mine.



Given;

- The quantity measured at the fan inlet = 348 m³/s.
- The air density at the fan inlet = 1.01kg/m³ (assume no change in air density across the fan).
- The cross-sectional area of the concrete duct leading to the fan inlet = 16m².
- The static pressure measured at the fan inlet = -3600 Pa.
- The evaseé efficiency = 93%the answer uses 93%
- The inlet and discharge areas of the evaseé are 16m² and 22m² respectively.

Determine the total pressure (FTP) at which this fan is operating. (9)

4.2 For a constant volume flow at the same pressure loss over identical lengths and friction factors, what percentage of excavation size can be saved if a square airway is replaced with a circular airway? Make any assumptions you deem necessary. (10)

4.3 Name 5 hazards you will consider when conducting a risk assessment for a workplace (5)

[24]

TOTAL MARKS: 100