Minerals Council South Africa

EXAMINATION PAPER

SUBJECT: MINERALS COUNCIL SOUTH AFRICA - CERTIFICATE IN MINE ENVIRONMENTAL CONTROL PAPER 1 - FLOW DYNAMICS, AIRFLOW, FANS, MINE WATER **SUBJECT CODE: COMMEC1** **EXAMINATION DATE:** 07 OCTOBER 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	75	82	85	98	105	118
Pressure (Pa)	450	430	380	320	240	150

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

i) Plot the new fan and system curves on the graph paper provided. Provide as much information about the system on the graph as possible (6)

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 Describe 3 different ways which may be used to determine fan total pressure (FTP) in a circular duct. Illustrate your answer with sketches indicating how these methods may be used.

(10)

2.2 List the advantages and disadvantages of four different methods of performing mine pressure surveys. (10)

2.3 Three airways, connected in parallel, have the following resistances:

A: 0.085 Ns^2/m^8

B: 0.162 Ns^2/m^8

C: 0.024 Ns^2/m^8

i) Calculate the overall resistance of these airways if the total air flowing through the system is 260 m^3/s (2)

ii) Calculate the quantity of air flowing in each of the airways (3)

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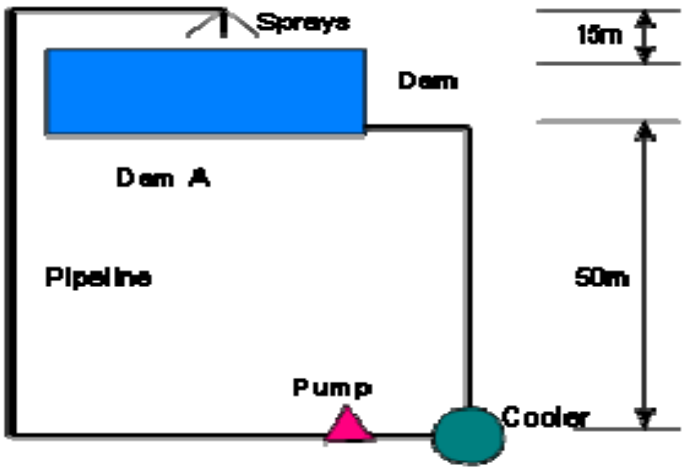
QUESTION 3

3.1 The water reticulation system below has a total piping length of 150 m. The pipe diameter is 203mm. There are three gate valves and 15 elbows in the pipe line. The spray pressure is 220kPa and the head loss through the cooler is 40 kPa. The water quantity to be circulated is 60l/s. The vertical lift above the water level in the dam is 15 m. One gate valve head loss = loss through 1,3m of straight pipe, one standard elbow head loss = loss through 6 m of straight pipe.



i) Ignore the effect of the water in the dam and determine the total head in kPa against which the pump must operate. (10)

ii) Calculate the pump shaft power and pump motor input power (the necessary assumptions must be shown). (5)

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

3.3 What is meant by “terminal velocity” of water? (2)

3.4 Mention any three methods of treating water with a scaling problem. (3)

[25]

QUESTION 4

4.1 State typical velocities for the following:

i) Intake airways

ii) Return airways

iii) Upcast shafts

iv) Downcast shafts

v) Stope (5)

4.2 Briefly describe 5 factors to consider when designing ventilation for board-and-pillar mines. (5).

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

4.4 52.5 m^3/s of air, at a density of 1.05 kg/m^3 and a pressure drop of 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)

4.5 List the advantages and disadvantages of the of the Force-Exhaust system when ventilating sinking shafts. (6)

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TOTAL MARKS: 100