Chamber of Mines of 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:** 09 OCTOBER 2017 **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:

FORMULA HANDOUTS ARE ALLOWED.

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THIS IS NOT AN **OPEN BOOK EXAMINATION**

INSTRUCTIONS TO CANDIDATES:

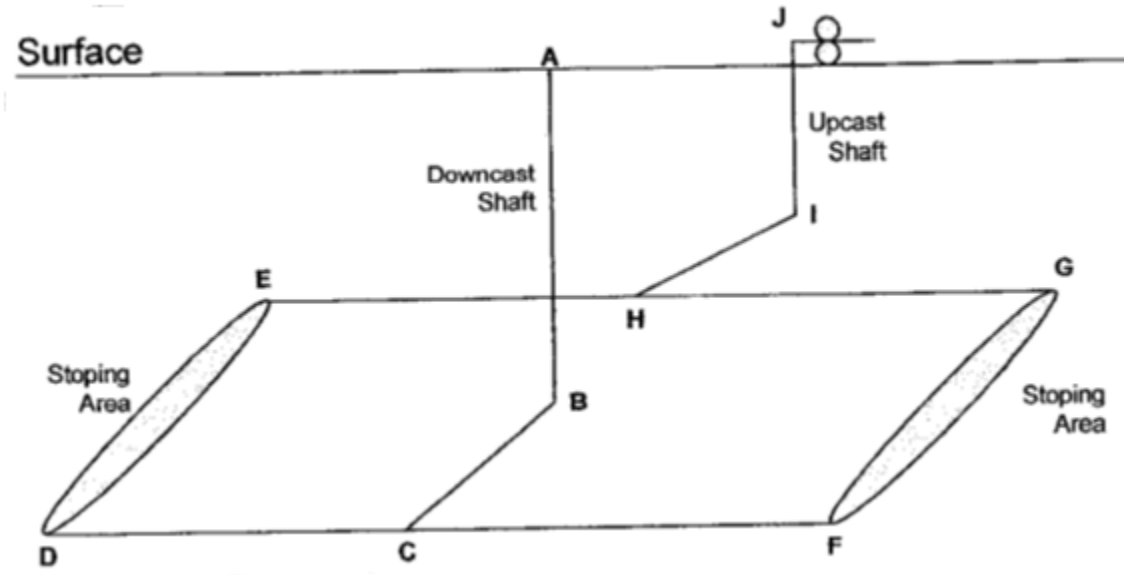
1. Answer all 4 questions **legibly** in English.
2. Write your **ID number** on the outside cover of each book used and on any graph paper or other loose sheets handed in.

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) 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



The diagram above shows the main ventilation connections in a mine. The downcast shaft (A-B) is 5.5 metres in diameter with an air velocity of 10.5 m/s. The upcast shaft (I-J) is 4.0 metres in diameter. The stoping areas (D-E & F-G) comprise numerous large parallel airways and the resistance in these branches can be assumed to be zero (0). Ignore the effects of leakage and compressed air. The air density in the fan drift is 1.01 kg/m^3. Branch resistances and mean densities are listed in the following table.

Branch	Resistance (Ns^2/m^8)	Density (kg/m^3)
A – B	0.006	1.06
B – C	0.055	1.18
C - D	0.05	1.19
C –F	0.055	1.20
D –E	0	
F –G	0	
E –H	0.038	1.10
G - H	0.04	1.09
H – I	0.006	1.09
I -J	0.0035	1.05

1.1 Calculate the air quantity at the main fans (4)

1.2 Calculate the mean velocity in the upcast shaft (3)

1.3 Calculate the main fan pressure (10)

1.4 Calculate the fan shaft power if the main fan is 74% efficient. (2)

1.5 What is the pressure loss in airway B – C? If this airway could be enlarged such that the new corrected resistance is 0.030 Ns2/m^8; what would be the effect on the fan shaft power? Assume the fan efficiency remains constant. (6)

[25]

QUESTION 2

9.6 m^3/s of air is flowing in a 760 mm diameter column at a density of 1.15 kg/m^3. An evaseé is fitted to the delivery of this column and the outlet area of this evaseé is 0.8 m2. The pressure loss due to friction and shock in the evaseé is 45Pa.

Calculate:

2.1 The theoretical static pressure regain in the evaseé. (10)

2.2 The actual or practical static pressure regain in the evaseé. (2)

2.3 The efficiency of the evaseé'. (3)

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

2.5 Define the concept "shock losses". (3)

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

[25]

QUESTION 3

Water is pumped at an average rate of 12.96 ML per day to surface from the main pump station 1 800m below surface. The amount of fissure water entering the mine is equivalent to 0.4 tons per ton of rock broken.

3.1 The total rock broken is 150 000 tons per month. Assuming a 30 day month, what is the service water usage in tons per ton broken? (3)

3.2 If the mine pumps water for 24 hours every day:

i) What size pipe would be used? (Assume standard sizes). State any assumptions made. (Hint: Make use of the chart provided). (2)

ii) Assuming the pipe size determined above, what is the pump shaft power (pump input power) required? Assume a pump efficiency of 70%. (5)

3.3 The electrical supply contract (with ESKOM) allows the mine to pump for 19 hours per day:

i) Assuming standard sizes, what size pipe would you use? Give reasons for your answer. (2)

ii) Using the pipe size as determined above, what is the pump shaft power (pump input power) required? Assume a pump efficiency of 70%. (5)

3.4 The average electricity cost is 116 cents per kWh (assume no daily variations).

i) What is the annual electricity cost for pumping 24 hours per day? (2)

ii) What is the annual electricity cost for pumping 19 hours per day? (2)

3.5 Define Terminal velocity. (2)

3.6 Briefly describe any two methods of controlling physical fouling within a water reticulation system. (2)

[25]

QUESTION 4

4.1 Mention any three methods of ventilating sinking shafts. (3)

4.2 With the aid of sketches, describe how fan total pressure, fan static pressure and fan velocity pressure can be measured, when;

i). the fan is at the inlet to the ventilation column.
ii). the fan is in the middle of the ventilation column.
iii). the fan is at the discharge of the ventilation column. (15)

4.3 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 57.4m^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)

[25]

TOTAL MARKS: [100]