NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT
DEPARTMENT OF CIVIL MINING AND PROCESS ENGINEERING

QUALIFICATION : BACHELORS OF ENGINEERING IN MINING ENGINEERING	
QUALIFICATION CODE: 08BMIN	LEVEL: 7
COURSE CODE: MVT721S	COURSE NAME: MINE VENTILATION
SESSION: NOVEMBER 2022	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

FIRST OPPORTUNITY QUESTION PAPER	
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MODERATOR:	Mr. Lawrence Madziwa

INSTRUCTIONS

1. Answer all questions.
2. Read all the questions carefully before answering.
3. Marks for each question are indicated at the end of each question.
4. Please ensure that your writing is legible, neat and presentable.

PERMISSIBLE MATERIALS

1. Examination paper.
2. One Graph Paper
3. Mathematical Instruments

THIS QUESTION PAPER CONSISTS OF 5 PAGES (Including this front page)

Instructions: Answer Question I and any 4 other questions. Excess questions will not be marked.

Question I is compulsory.

Time allowed: 3 hours

Question I

(Short Answer Questions) (20)

a) What measure is used to determine the workers' exposure to radon concentration? [1]

b) Which of the axial flow and centrifugal fan requires complex arrangement for fan reversal? [1]

c) What is Kirchhoff's second law with respect to the mine ventilation networks? [1]

d) What is the major difference between whirling hygrometer and aspirated psychometer? [2]

e) What is the source of eddy losses in centrifugal fan? [1]

f) What is the pressure inside a mine using forcing ventilation system compared to atmospheric pressure? [1]

g) What is lag on ignition with respect to methane? [1]

h) What is homotropal ventilation system and what is its advantage? [2]

i) What are the different ways to determine the resistance of a planned airway? [3]

j) Which of the axial flow and centrifugal fan delivers more airflow at lower pressure head? [1]

k) If airflow through the mine is doubled what would be the increase in the cost of ventilation? [1]

l) What is the importance of psychometry in mine ventilation? [2]

m) What is the major advantage of having main fan in the underground? [1]

n) What is the gauge pressure? [1]

o) What is stall zone? [1]

Question II

a) Briefly describe following ventilation controls (12)

   i. Air locks
   ii. Stoppings
   iii. Air crossing
   iv. Regulator

b) Briefly describe uni and bidirectional district ventilation with the help of Figures (8)

Question III

a) Ventilation survey in an inclined drift (1-2) dipping at 30° from horizontal is connected with a level airway (2-3) as shown in Figure 1 provided the following measurements. (14)

Location	Airflow m^3/s	Cross-sectional area (m^2)	Barometric pressure (kPa)
1	56	5 x 5	101
2		4 x 5	102
3		4 x 4	101.5

Determine the yearly cost of ventilating the airway if cost of electricity is N$2.25/kWh and fan efficiency is 75%.

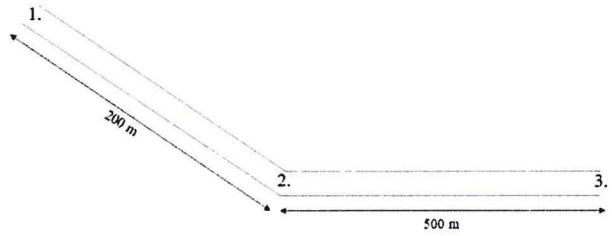


Figure 1

b) Give the arrangement of U-tube manometer for measuring static, velocity and total pressures in a straight airway (6)

Question IV

a) In the ventilation network shown in the Figure 2, the resistances of the branches are given in Ns^2/m^8. The inlet air flow rate is 15 m^3/s. Solve the given network using Hardy Cross successive approximation method until two iterations. (20)

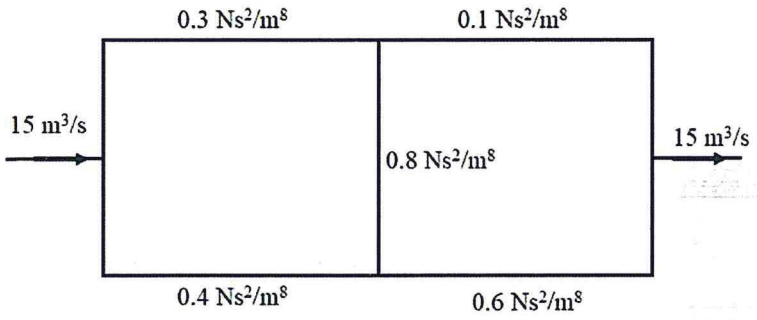


Figure 2

Question V

a) The combined characteristics of two identical fans working in a series is given below (10)

Pressure (Pa)	1030	950	840	690	490	100
Quantity (m^3/s)	20	30	40	50	60	70

The air quantity flowing through the mine under these conditions is 55 m^3/s. However, due to mechanical reason one of the fans had to be shut-off. What is the pressure and quantity in this situation?

b) Briefly discuss losses in cetrifugal and axial flow fans. (10)

Question VI

a) The diagram (Figure 3) shows a development end with a force fan and column. The volume flowing through the fan is 5 m^3/s. The only leakage from the column takes place at point z which is 3.34 m^3/s. In the development end two fissures giving of methane at X and Y. Fissure X giving off 0.01 m^3/s which mixes completely with the air at the point of issue. Fissure Y giving off 0.03 m^3/s which mixes completely with the air at the point of issue. (10)

i. Calculate percentage of methane at A

ii. Calculate percentage of methane at B

iii. What will be the methane percentage at A if the leakage is stopped and the fan quantity is reduced to 4 m^3/s.

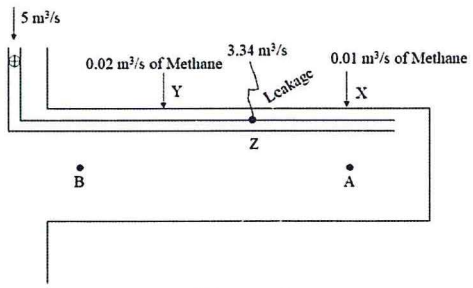


Figure 3

b) Briefly discuss about the installation of auxiliary fan in mines (10)

ADDITIONAL INFORMATION

The quantity of dilution air required for a steady-state situation is calculated as follows

$$Q = E_g \frac{100}{(\text{MAC-B})} \qquad \frac{\text{m}^3}{\text{s}}$$

The time required to dilute the concentration of contaminants to a specific level

$$\tau = \frac{y}{Q + E_g} \ln \left[\frac{Q \times B + E_g - (Q + E_g)\, x_0}{Q \times B + E_g - (Q + E_g)\, x_\tau} \right]$$

Modified Bernoulli's equation for mine ventilation

$$\frac{u_1^2}{2} + Z_1 g + \frac{P_1}{\rho} = \frac{u_2^2}{2} + Z_2 g + \frac{P_2}{\rho} + F_{12} \qquad \frac{J}{kg}$$

Resistance

$$R = \frac{klo}{A^3}$$

Coefficient of Friction

$$f = \frac{2k}{\rho}$$

Resistance of shockloss

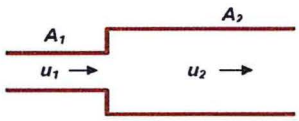
$$R_{\text{shock}} = \frac{X\rho}{2A^2} \qquad \frac{\text{N.s}^2}{m^8}$$

Equivalent length

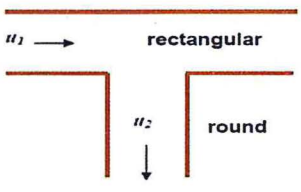
$$l_{eq} = \frac{X\rho}{8k} d \ \text{m}$$

Shockloss factor sudden expansion

$$X_2 = \left[\frac{A_2}{A_1} - 1 \right]^2 \qquad X_1 = \left[1 - \frac{A_1}{A_2} \right]^2$$



$$X_2 = 0.5 \left[1 + 2.5 \frac{u_2}{u_1} \right]$$



$$\Delta Q_m = \frac{\sum RQ^2 - \sum RQ_a^2}{\sum 2R|Q_a|}$$