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: BEMIN	**LEVEL: 7**
COURSE CODE: MVT721S	**COURSE NAME: MINE VENTILATION**
SESSION: NOVEMBER 2022	**PAPER: THEORY**
DURATION: 3 HOURS	**MARKS: 100**

SECOND OPPORTUNITY QUESTION PAPER	
EXAMINER(S)	**Mallikarjun Rao Pillalamarry**
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 05 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 (20)

(Short Answer Questions)

a) What is recoil distance and how it influences the radon emission in mines? [3]

b) What is *black damp*? [1]

c) Why a fan vibrates when it is operating at stall point? [1]

d) In a coal mine three openings with same cross-sectional area having a shape of circle, rectangle and square were made. Which of these openings have highest resistance for the airflow? [1]

e) What is the equivalent length with respect to shock losses? [1]

f) In which situation reversal of airflow in a mine may be necessary? [1]

g) Which of axial flow and centrifugal fan produces more noise when operating? [1]

h) What is psychometry? [1]

i) What happens when a person subjected to a hot environment with 100% humidity? [1]

j) In a mine wet and dry bulb thermometer on a Whirling hygrometer are recoded the same temperature. What does it mean with respect to moisture content [1]?

k) What properties of CO makes it more dangerous gas than any other gases usually found in mines? [3]

l) What is volumetric efficiency? [1]

m) What is Short Term Exposure Limit? [1]

n) Why use of booster is fan restricted in underground coal mines? [1]

o) What are the different ways to solve mine ventilation networks? [2]

Question II

a) A copper mine is ventilated with an exhaust ventilation system to ventilate two working levels as shown in Figure 1. Mine is fitted with a main exhaust fan whose characteristics are given in the table. Determine (20)

   a) Airflow through the level 1 and Level 2
   b) What options are available to increase the airflow through level 2

Total Pressure (Pa)	1240	1180	1080	920	740	540	200
Quantity (m^3/s)	5	10	15	20	25	30	35

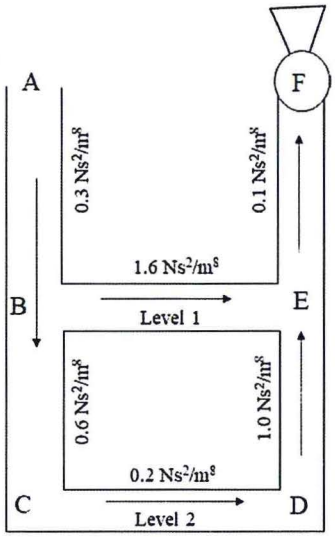


Figure 1

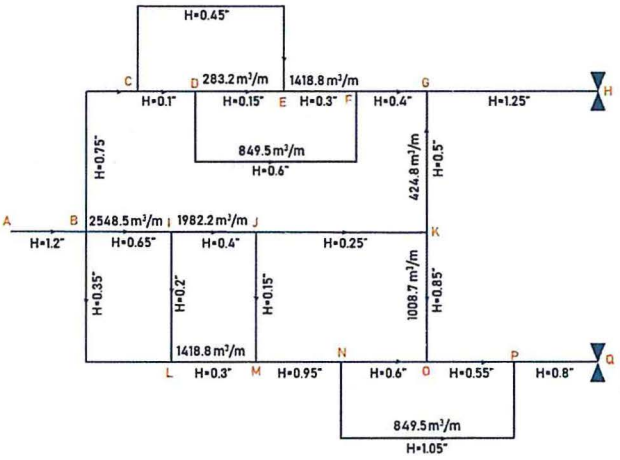
Question III

a) A mine has three splits A, B, and C each of resistance 0.1 Ns^2/m^8. The trunk roadways have a total resistance of 0.2 Ns^2/m^8. The surface fan pressure is 700 Pa. What is the flow in each split A, B and C. The quantity in splits A and B is desired to be fixed at 30 m^3/s, and 10 m^3/s respectively. What is the resultant unrestricted flow in flow in split C? What are the specifications of the flow control devices needed in splits A and B to achieve the desired flow conditions? (20)

Question IV

a) Describe how to solve complex ventilation networks using Hardy Cross method (10)

b) A segment of ventilation network of an underground mine is shown in Figure 1. Pressure drops are indicated in terms of inches of water (1 inch = 2.54 cm) and airflow in m^3/min. By using Kirchhoff's second law determine the location of regulators and the pressure drop there are causing. (10)



Question V

a) Methane is explosion took several lives in the history of coal mining. Briefly discuss about methane gas in coal mines. (10)

b) An inflow of 0.034 m^3/min of strata gas occurs whenever cutting and loading operations are conducted in a stope. The following data are provided for the stope:

Stope volume 2832 m^3

Intake-air volume 56.7 m^3/min

Concentration of the strata gas in intake air 50 ppm

Concentration of the strata gas in stope prior to start of work 75 ppm

i. The cycle times are normally distributed with a mean of 34 min and a standard deviation of 3.5 min. Calculate the probability of being gassed out during a particular cycle given that the maximum allowable concentration for the strata gas is 400 ppm.

ii. A remotely operated cutting and loading machine is being considered. Assume that no miners will be in the stope return where the concentration may be higher than the MAC, calculate the steady-state concentration in the stope. Calculate the time at which 95% of this concentration will be reached

Question VI

a) What are the methods used to measure humidity in the air and explain the significance heat - humidity of air in an underground mine? (10)

b) A rectangular tunnel of cross section 5 × 3 m^2 and 500 m in length changes of direction by means of a 90° arch of 3 m radius as shown in the figure. The tunnel is in good condition but shows significant wall irregularities, so its Atkinson friction factor is estimated to be 0.012 N s^2 m^{-4}. In addition, the shock loss factor in the arch union is assumed 0.86. If 80 m^3 s^{-1} of air whose density is 1.15 kg m^{-3}, is expected to flow through it. Calculate, omitting inlet and outlet shock losses: (10)

a. Resistance due to friction
b. Resistance of the arch union (shockloss)
c. Equivalent length of the elbow
d. Total pressure drop in the tunnel

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

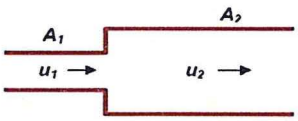
$$R_{\text{shock}} = \frac{X\rho}{2A^2} \qquad \frac{\text{N.s}^2}{m^8}$$

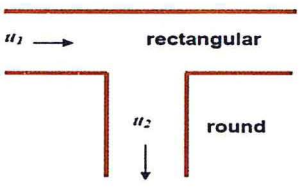
Equivalent length

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

Shockloss factor sudden expansion

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





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

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