



FACULTY OF ENGINEERING AND THE ENVIRONMENT

DEPARTMENT OF MINING ENGINEERING

MINE VENTILATION

EMI 3204

Final Examination Paper

June 2022

This examination paper consists of 4 pages

Time Allowed: 3 hours

Total Marks: 100

Examiner's Name: Miss C.R. Mahaso

INSTRUCTIONS

1. This paper contains One section with Four questions.
2. Answer all questions.
3. Where a question contains subdivisions, the mark value of each subdivision is shown in brackets.
4. Start each question on a new page

NB: DO NOT TURN OVER THE QUESTION PAPER OR COMMENCE WRITING UNTIL INSTRUCTED TO DO SO

Additional Requirements

Non-Programmable Calculator

MARK ALLOCATION

Question 1 to 4	25Marks
Part Questions	As shown in each part question
Total Attainable	100

Page 1 of 4

Copyright: Gwanda State University

QUESTION ONE

- a) Heat can be a major problem in underground mines. Briefly describe five major sources of heat in an underground mine. [10 marks]
- b) Workers are complaining about high temperatures in their work places and your ventilation surveys have proven beyond reasonable doubt that the heat is unbearable. Describe two remedial actions that you will recommend to improve the situation. [10 marks]
- c) Describe the process of carrying out an air quantity survey. [5 marks]

QUESTION TWO

- a) The ventilation department carried out a mine ventilation survey to investigate if the air handled by the main surface fans is reaching its required destination. The following data was obtained:

Table 1: Mine ventilation survey data

Area	Airflow Quantity (m ³ /s)	Air velocity (m/s)
Working face	20	4
Workshops	30	7
Pump stations	50	10
Battery charging stations	50	12
Substations	50	10

The total airflow quantity that is handled by three main surface fans to ventilate the mine was 350 m³/s. Calculate the volumetric efficiency of this mine and comment on your answer. [4 marks]

- b) The crew measured the airflow quantity in the shaft and the value was 200 m³/s. The cross sectional diameter of this concrete lined shaft was 3.5 m. The distance from the shaft collar to the shaft bottom was 250 m. Assuming standard density for air to be 1.2 kg/m³. Using Table 2, determine the pressure loss in the shaft.

Table 2: Friction factors

Airway Type	“ k” factor
Smooth pipe	0.0028
Normal rigid ducting	0.0035
Flexible ducting	0.0065
Concrete surface	0.0040
Rock surfaced	0.0200

[4 marks]

c) To estimate airflow required in an airway or ventilation network, five factors are considered. Briefly describe any four of those factors. [12 marks]

d) Choose any two of the following and explain how they affect the design of a mine ventilation network

i. Virgin Rock temperature

ii. Degree of mechanization

iii. Rate of stoping

iv. Residence time of rock [5]

QUESTION THREE

a) Carbon monoxide (CO) gas is referred to as an ambush gas and methane (CH₄) gas as firedamp because of their properties. Describe briefly the properties of each gas and their physiological effects on human beings. [10 marks]

b) Briefly explain how you can control mine gases to prevent loss of life or occupational health problems. [10 marks]

Write short notes on the dangers and effects posed by each of the gases (listed below) on human beings

i. Hydrogen Sulphide

ii. Nitrous fumes

[5 marks]

QUESTION FOUR

a) Consider a concrete-lined shaft 91.44m deep, 5.49 m in diameter, and moderately obstructed. Calculate the Pressure loss if a quantity of 188.78 m³/s is flowing in the shaft.

Assume $K = 0.0065 \text{ kg/m}^3$ [6 marks]

b) Consider a roadway 731.52 m long with an area of 8.36 m² and a perimeter of 12.19m. A pressure loss of 373.26Pa is measured when the airflow is 25.29 m³/s. Calculate and comment on the friction factor for the roadway. [6 marks]

c) i. Given 3 airways, 1, 2, and 3 in series, $Q = 9.44 \text{ m}^3/\text{s}$ with pressure drops $P_1 = 497.68 \text{ Pa}$, $P_2 = 248.84 \text{ Pa}$ and $P_3 = 746.52 \text{ Pa}$ find Q, P and R. [6 marks]

ii. Given the three airways in the previous question with resistances $R_1 = 5.585$, $R_2 = 2.793$, and $R_3 = 8.378$ in $\text{N-s}^2/\text{m}^8$, arranged in parallel, with the total $Q = 47.195 \text{ m}^3/\text{s}$;

Find system P and R and the quantities Q_1 , Q_2 , and Q_3 . [7 marks]