FACULTY OF ENGINEERING AND THE ENVIRONMENT

DEPARTMENT OF MINING ENGINEERING

MINE VENTILATION

EMI 3110

Final Examination Paper

September 2023

This examination paper consists of 4 pages.

Time Allowed: 3 hours.

Total Marks: 100

Examiner's Name: Mr A Antonio

INSTRUCTIONS

1. This paper contains **ONE** section with **FIVE** questions.
2. Answer any **FOUR QUESTIONS**.
3. Each question carries 25 marks.
4. Where a question contains subdivisions, the mark value of each subdivision is shown in brackets.
5. Illustrate your answer, where appropriate, with large clearly labelled diagrams.
6. Start each question on a new page.
7. This paper comprises 4 printed pages.

Additional Requirements

Calculator

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 workplaces 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. Carbon monoxide (CO) gas is referred to as an ambush gas and methane (CH4) gas is firedamp because of their properties. Briefly describe 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]

c. 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 THREE

The head quantity characteristic of a 1.22m fan operating at 1200rpm and density of air of 1.2kg/m3 is given in the table below:

Point	1	2	3	4	5	6
H (kPa)	1.369	1.344	1.294	1.219	1.12	0.995
Q (m3/s)	21.24	23.60	25.96	28.32	30.68	33.04

a. Plot the head quantity characteristic curve for the fan. **[3 Marks]**

b. Calculate and plot the head-quantity characteristic when Speed, diameter and density are changed to 800, 1.524m and 1.12kg/m3 simultaneously. **[12 Marks]**

c. Draw and explain:

   i.   a graph showing a Mine and fan characteristic curves with natural ventilation
        (NVP) acting against the fan and the resultant curve.   **[3 Marks]**

   ii. a graph showing a Mine and fan characteristic curves with natural ventilation
        (NVP) assisting the fan and the resultant curve.   **[3 Marks]**

d. Explain the following

   i.   Auto-compression   **[1 Mark]**

   ii.   Delayed action   **[1 Mark]**

   iii. Geothermal gradient   **[1 Mark]**

   iv.   Nuisance dust   **[1 Mark]**

QUESTION FOUR

   a. Discuss the advantages and disadvantages of negative mine pressure or
      exhausting ventilation system and positive mine pressure or blowing ventilation
      system.   **[16 Marks]**

   b. Figure 1 illustrates nine airways that form part of a ventilation network. Find
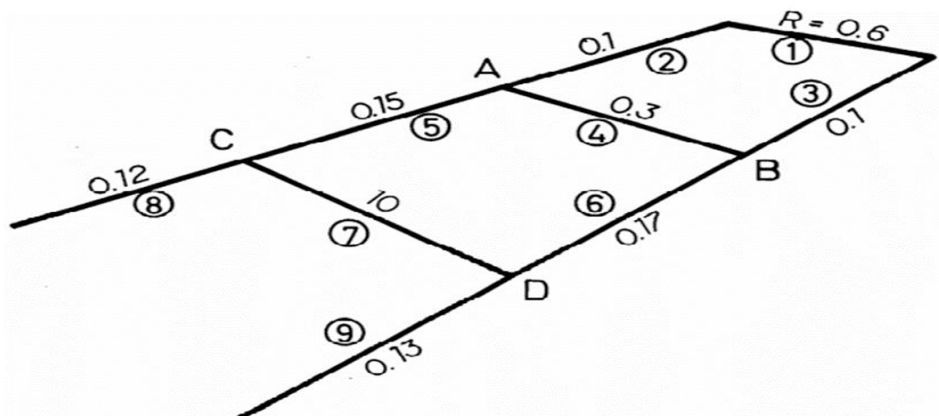   the equivalent resistance of the system.   **[9 Marks]**

Figure 1.

QUESTION FIVE

Figure 2 shows a simplified ventilation network served by a downcast and an upcast shaft, each passing 100 m3 /s. The resistance of each subsurface branch is shown. A fan boosts the airflow in the central branch to 40 m3 /s.

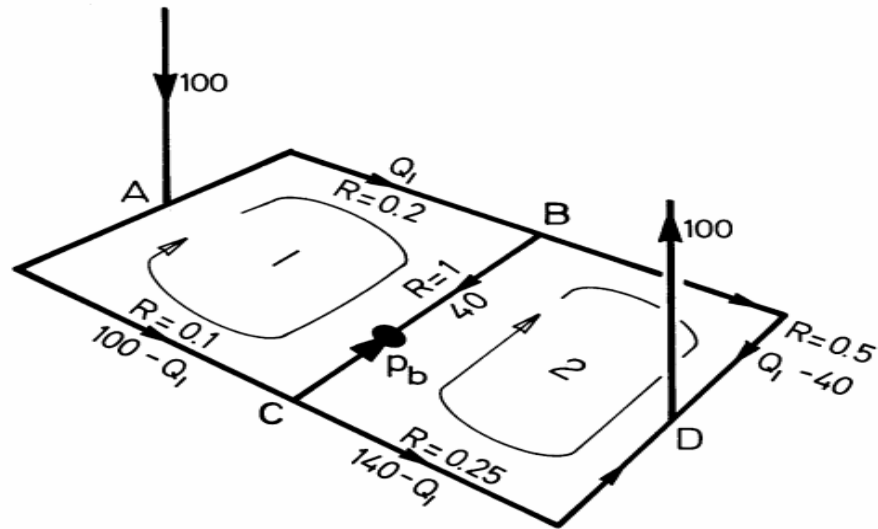Determine the distribution of airflow and the total pressure, pb developed by the booster fan. **[25 Marks]**

Figure 2.