UNIVERSITY OF JOHANNESBURG

Program	:	*BACHELOR OF ENGINEERING TECHNOLOGY MINING ENGINEERING (B6MINQ)*
Module/Subject	:	*OCCUPATIONAL HYGIENE 2B*
Module code	:	*OCCUPB2*
Examination	:	*FINAL SUMMATIVE EXAMINATION*
Year of study	:	*SECOND*
Date	:	*14th NOVEMBER 2019*
Duration	:	*180 MINUTES*
Weight	:	*60% TOWARDS FINAL MARK*
Total marks	:	*100*

Examiner	:	*Mr. Maelani Chauke*
Moderator	:	*Mr. H. Strauss*
Number of pages	:	*10 Pages (including graph paper and formulae pages)*
Requirements	:	*Answer books*

Instructions to candidates:

1. *Answer **all** questions*
2. *All the sub-questions that appear under the heading of a question must be kept together under the heading of that specific question*
3. *Number all questions, and associated sub-questions **CLEARLY***
4. *A formulae sheet, and three pages of graph paper, are herein attached*
5. *The use of a calculator is permissible*
6. *All the relevant rules of the University of Johannesburg shall apply*
7. *Question papers **must not** be handed in. However, please ensure that all your answer books are handed in*

Question 1

1.1 What is occupational hygiene? Explain

[3]

1.2 The purpose of mine ventilation is to supply a continuous stream of fresh air to the underground mine workings. What is the role of fresh air in the underground workings of a mine.

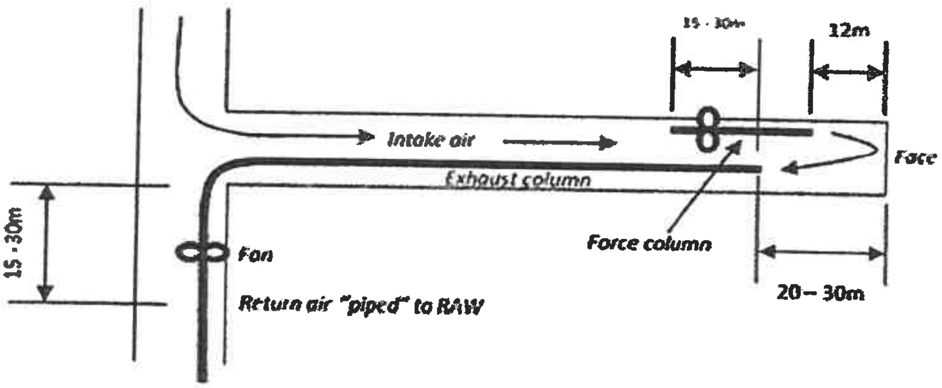
[3]

1.3 In your own words, explain the purpose of the following underground mine ventilation control structures:

- Air crossing
- Regulator
- Air stopping
- Ventilation door

[4]

1.4 The figure below depicts an auxillary ventilation system.



Discuss the salient aspects, including the advantages and disadvantages, of the auxillary ventilation system depicted above

[10]

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Question 2

2.1 Air is a mechanical mixture of different gases. Explain the meaning of 'mechanical mixture'.

[2]

2.2 **Problem [A]**

2.2.1 A volume of 350m^3 of air has a temperature of 20.5°C at a pressure of 95kPa. What would the volume be if the temperature increases to 28°C and the pressure is raised by 25kPa?

[4]

2.2.2 A quantity of 40m^3/s flows into a mining section at a temperature of 22°C and a pressure of 122kPa. At the return, it flows into an airway that is 2,8m high and 3,0m wide. The temperature here is 34°C and the pressure is 108kPa. Calculate the air velocity at this point.

[4]

2.2.3 The measurements taken at the intake and return of a mining section are tabulated below.

	Intake	**Return**
Airway dimensions	3,4 x 4,1m	3,6 x 3,6m
Air velocity	7,5m/s	8,8m/s
Temperature	21°C	34°C
Air pressure		112kPa

Calculate the air pressure drop across the section.

[10]

Question 3

Table 1 below indicates values measured during the testing of a fan laboratory in a laboratory

Table 1 Laboratory fan testing values

Volume flow rate (m^3/s)	Static Pressure (kPa)	Input Power (kW)	Air Power (kW)	Efficiency (%)
A	B	C	D	E
0	1,80	150		
10	1,60	155		
20	1,40	180		
40	1,45	190		
60	1,55	195		
80	1,60	180		
100	1,55	190		
120	1,40	214		
140	0,90	216		
160	0,40	202		

The fan speed is 10 r/s and the air density is 1,2 kg/ m^3

3.1 Calculate and then tabulate all the information necessary to generate fan, air power, electrical input power, and efficiency curves

3.2 Using the information above, plot the fan, air power, electrical input power, and the efficiency curves

3.3 The tested fan is being considered for use in an underground haulage with an airway resistance of 1,25 Ns^2/m^8. The density of the air in the haulage is 1,4 kg/ m^3. The fan will still be run at a speed of 10 r/s

3.3. 1 Calculate, and then tabulate all the information necessary to generate the new fan, systems curve, air power, electrical input power, and efficiency curves. Using the information thus generated, plot the curves

3.3.2 Give the salient elements of the analyses of the curves.

3.3.3 Comment on the suitability of the fan for use in the haulage airway

[30]

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Question 4

4.1 With reference to 'air pollutants' in an underground mine,_what do the terms below mean? Explain

i. Dilution
ii. Occupational exposure limit
iii. Irritants
iv. Asphyxiants
v. Anaesthetics and narcotics

[10]

4.2 Discuss two criteria used for the categorisation of mine dust. List and explain at least three categories of dust

[10]

Question 5

Underground mine fires need to be detected as quickly as possible whenever they occur; and procedures initiated to control, fight and extinguish them (i.e. fires) without delay. Mines are thus expected to implement and maintain effective fire prevention and fire detection systems, and also implement effective procedures, supported by the best possible firefighting capabilities.

Discuss the practical aspects of the above as manifest in a modern underground mine

[20]

Formula Sheet

Airflow	
Pressure drop	$p = RQ^2 = \frac{KCLQ^2}{A^3} \times \frac{\rho}{1{,}2}$
Resistance	$R = \frac{KCL}{A^3} \times \frac{\rho}{1{,}2}$
Regulator area	$A = 1{,}2Q\sqrt{\frac{\rho}{p}}$
Reynolds' Number	$R_e = \frac{\rho v D}{\mu}$
Mechanical ventilation	
Input power	$P_{Input} = VI \times pf \times \sqrt{n}$
Air power	$W_A = \frac{pQ}{1\,000}$
Efficiency	$\eta = \frac{W_A}{P_{Input}} \times 100$
<u>Fan laws</u>:	
Varying speed & constant density	$Q_2 = Q_1\frac{S_2}{S_1};\ p_2 = p_1\left(\frac{S_2}{S_1}\right)^2;\ P_2 = P_1\left(\frac{S_2}{S_1}\right)^3$
Varying density and constant speed	$Q_1 = Q_2;\ p_2 = p_1\frac{\rho_2}{\rho_1};\ P_2 = P_1\frac{\rho_2}{\rho_1}$
Networks	
Resistances in series	$R_{Total} = \sum_1^n R_n$
Resistances in parallel	$\frac{1}{\sqrt{R_{Total}}} = \sum_1^n \frac{1}{\sqrt{R_n}}$

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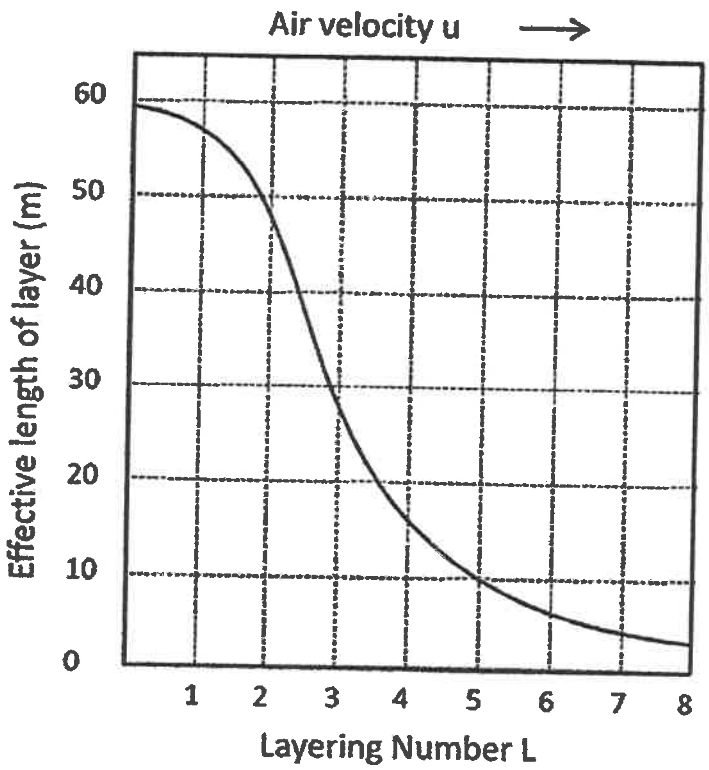
Flammable gases	
Concentration	$\eta_{Gas} = \frac{Q_{gas}}{Q_{mixture}} \times 100\%$
Layering number	$L = \frac{u}{\sqrt[3]{g\frac{1-\rho}{\rho} \times \frac{R}{D}}}$
Explosibility:	
Gas concentration	$\eta_T = \eta_{CH_4} + \eta_{CO} + \eta_{H_2}$
Upper, lower, and nose limits	$\frac{\eta_T}{L_T} = \sum \frac{\eta}{L}$
O_2 nose limit	$= 0{,}2093(100 - N_{ex} - L_{TN})$
N_{ex}	$N_{ex} = \frac{L_{TN}}{\eta_T} \sum N^+ \eta$
Flammable gas properties:	

Gas	Flammable Limits (%)		Nose Limits (%)		N^+
	Lower	Upper	Gas	Oxygen	
CH_4	5,0	14,0	5,9	12,2	6,07
CO	12,5	74,2	13,8	6,1	4,13
H_2	4,0	74,2	4,3	5,1	16,59



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