UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE AND ENGINEERING

FINAL EXAMINATION, DECEMBER 2001

FOURTH YEAR PROGRAM – LASSONDE MINERAL ENGINEERING

MIN470HIF VENTILATION AND OCCUPATIONAL HEALTH

Exam Type: B

Examiner: H.D. Goodfellow

1. Assume that you are a mine ventilation engineer at a large complex underground mine in Northern Ontario. This mine uses numerous diesel powered equipment for the underground mining operations. A new mine regulation has been passed which will reduce the allowable levels for diesel fume by a factor of ten. Senior management at the mine has asked you to prepare a detailed technical report to assess current level of compliance with diesel exhaust fume and a feasibility study to assess the different control strategies to comply with the new regulations. Economics will play a key role in the final decision.

   Develop the detailed work plan for the mine ventilation survey and identify key parameters to assess future changes to ensure compliance. Describe the different control options for diesel fume and the procedures to evaluate different control strategies.

   Mark = 20

2. a) Determine the friction loss in a mine airway having the following characteristics: unlined airway in coal, curved, moderately obstructed.

   Mark = 20

Cross Section	1.22 X 3.66 m
L	914 m
Q	22.6 m^3/s
w	1.201 kg/m^3
K	0.0137 kg/m^3

b) Calculate the air power in kW required for the given flow in the above airway.

c) Describe the procedures you would follow to select a fan for a mine ventilation application. Identify the type of fan to be selected for a mine ventilation application with a flow of 50 m^3/s at a static pressure of 400 mm wg.

Mark = 20

3. a) Given five airways in series with the following resistances in units of $N.s^2/m^8$

$$R_1 = 22.36$$
$$R_2 = 33.54$$
$$R_3 = 11.18$$
$$R_4 = 22.36$$
$$R_5 = 11.18$$

Find the equivalent resistance and total head loss of the airways if 4.719 m^3/s flows through them.

b) Four airways are arranged in parallel with a total quantity of 47.19 m^3/s flowing through them. Resistances of the airways are given below. Find the head loss for the parallel airways and the quantity of air flowing through each:

Airway	R ($N.s^2/m^8$)
1	2.627
2	0.151
3	0.349
4	0.397

c) Give an example of a complex mine ventilation network and the steps required to analyze these networks.

Mark = 20

4. a) A total of 50 m^3/s of air enters the downcast shaft of a mine at a pressure of 600 mm Hg and a temperature of 15°C. At the bottom of the air shaft, the pressure is 650 mm Hg and the temperature is 22°C.

Does the air volume at the bottom of the shaft increase or decrease and by what percentage?

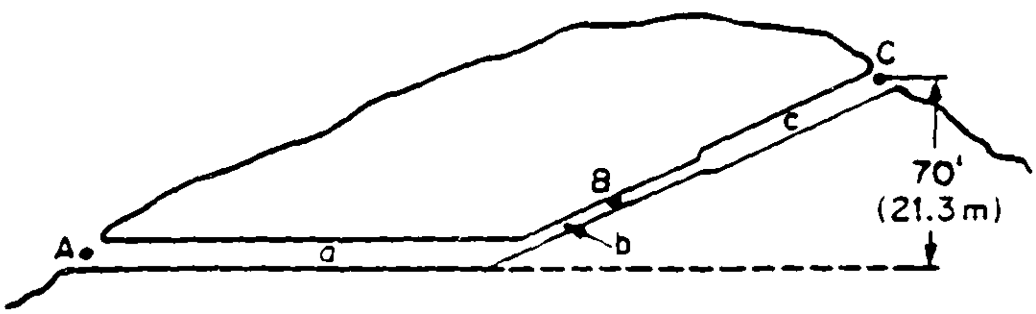
b) Describe the application of tracer gas techniques to investigate transportation of diesel fumes.

c) Describe the key steps in the development of a *mine* ventilation system for present day mining operations.

5. a) Plot and label the head gradients *in mm* H_2O for the system shown in the Figure below with the energy source located

   i) as a blower (at A)
   ii) as an exhauster (at C)
   iii) as a booster (at B)

Mark = 20



b) Label and calculate the mine static, velocity and total heads for each of the syterns in part (a) above.

<u>DATA</u> (Heads and Head losses)

Friction

Duct a	12.7 mm H_20
Duct b	50.8 mm H_20
Duct c	25.4 mm H_20

Velocity

Duct a	12.7 mm H_20
Duct b	38.1 mm H_20
Duct c	25.4 mm H_20

Shock

Inlet	12.7 mm H_20
Contraction	25.4 mm H_20
Bend	12.7 mm H_20
Expansion	12.7 mm H_20
Discharge	25.4 mm H_20

MIN470HIF VENTILATION AND OCCUPATIONAL HEALTH
Examination Aids

1. $TP = VP + SP$

2. $Q = VA$

3. $V = 4.043\sqrt{VP}$

4. $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

5. $P_b = P_a + P_y$

6. $\frac{W_2}{W_1} = \left(\frac{288 - 0.00198z}{288}\right)^{4.256}$

7. $R(287.045 J / KgK)$

8. $Q = Q_g\left(\frac{1 - MAC}{MAC - B}\right)$

9. $\tau = \frac{Y}{Q + Q_g} \ln\left[\frac{QB + Q_g - (Q + Q_g)\tau_g}{QB + Q_g - (Q + Q_g)\tau_g}\right]$

10. $V_t = \frac{\rho_p D_p^2 g}{18\mu}$

11. $FTP = TP_{outlet} - TP_{inlet}$

12. $FSP = FTP - VP_{out}$

13. $P_i = \frac{Q \ x \ FTP}{\eta_T}$

14. $\frac{P_1}{W} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{W} + \frac{V_2^2}{2g} + Z_2 + H_l$

15. $H_l = H_f + H_x$

16. $MINEH_t = MINEH_s = MINEH_y$

17. $H_f = \frac{KOLQ^2}{A^3}$

18. $H_1 = H_f + H_x$
$= \frac{K_o(L+L_e)Q^2}{A^3}$

19. $P_a = \frac{HQ}{1000} KW$

20. $H \propto Q^2$

21. $H_1 = RQ^2$

22. $\sum Q = 0$

23. $\sum H_L = 0$

24. $R_{eg} = R_1 + R_2 + R_3 + ..$

25. $\frac{1}{\sqrt{R_{eg}}} = \frac{1}{\sqrt{R_1}} + \frac{1}{\sqrt{R_2}} + \frac{1}{\sqrt{R_3}} + ...$

26. $R_{eg}Q^2 = R_1Q_1^2 = R_2Q_2^2 = ...$