# UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA

SECOND SEMESTER EXAMINATIONS, MAY 2018

COURSE NO : **MN 378**
COURSE NAME: **MINE VENTILATION AND SAFETY**
CLASS : **MN III** TIME: **3 HOURS**

Name: ……Index Number: ……..

**ANSWER ALL QUESTIONS IN YOUR ANSWER BOOKLET PROVIDED**

**SECTION A (30 marks)**

**ANSWER *TRUE* OR *FALSE and select A, B, C or D in your answer booklet.*** You would be instructed as to how to arrange the numbering of your answers in your answer booklets for **Sections A and B**. The question paper in **Sections A and B** must be tied loosely ***into*** the answer booklet and therefore not leaving the Exams Room.

**1.** Airway resistances may be obtained by conducting pressure surveys.

**2.** There are two (2) units for friction factor 'k', and one of them is $Nm^2/s^8$.

**3.** A high resistance mine is costly to ventilate.

**4.** Introduction of regulators in airways tends to increase the resistance of the airway.

**5.** Subsurface ventilation planning is based on both laminar flow and eddy flow concepts.

**6.** The shape factor (SF) for a circle is 3.545 and this value is greater than the SF for a rectangle.

**7.** The ventilation operating cost of an airway and the capital cost of executing the airway are both dependent on length of the airway.

**8.** For best practice booster fans are sited out-bye of the working place where extra ventilation is required.

**9.** A regulator tends to reduce the air flow and the resistance in the airway where it is installed.

**10.** The control barometer technique for pressure survey requires two (2) synchronized watches, two (2) barometers, one (1) anemometer and one (1) psychrometer and one (1) observer.

**11.** For airways in parallel the pressure drop and resistances in the branches are equal but the total air flow is the sum of the individual air flows.

**12.** The direct analysis and iterative technique of solving networks require the use of both the first and the second laws of Kirchoff.

**13.** The Hardy-Cross method for solving networks determines the correction factor for each branch, which is subsequently used to correct the assumed airflow.

**14.** Air density changes can occur due to temperature changes and this can influence the natural ventilation pressure.

**15.** The constant of proportionality λ in Chezy-D'Arcy's equation is known as friction factor and is it dimensionless.

**16.** For old working where pressure and quantity cannot be measured the use of listed design tables of resistances is recommended.

**17.** Regulations prescribe that in Ghanaian mines the speed of air must not exceed 6m/s.

**18.** Refrigeration is process of cooling and involves taking heat from a body at one temperature level and discharging it into another body at the same temperature level.

**19.** A ventilation door is essentially a stopping with an immovable partition.

**20.** Increasing the density of air handled by a fan would increase the fan pressure.

**21.** Installing two identical fans in series will deliver double the air pressure delivered by a single fan.

**22.** Air flow requirement at a work place must take in account the maximum air velocity recommended for the work place.

**23.** The Hydraulic Mean Diameter of a ducting is equal to four times the cross sectional area of the ducting, divided by the perimeter.

**24.** Shock losses occur only when the airflow changes direction within a ducting or airway.

**25.** The equivalent length of a bend in an airway is the length of airway with the same pressure drop as the bend.

**26.** Fan volume control using speed change is the most efficient method of volume control.

**27.** One advantage in using ice vest for cooling in hot mines is that one does not require a refrigeration plant.

**28.** In siting a booster fan the neutral line position defines a position where pressure in the intake airway is equal to the pressure in the return.

**29.** Fans in series increases the pressure developed as well as the volume flow.

**30.** Auxiliary fans handle only a fraction of the air flowing through a drive, while booster fans handle a fraction of the air flowing through the section of the mine where they are installed.

## SECTION B (30 marks)

**Please ANSWER A, B, C or D *in your answer booklet***

1. The following is true of shock losses:
   A) May be quantified in terms of equivalent length
   B) Enables the used of Kirchoff's laws
   C) Occur in all airways and ductings
   D) All of the above

2. The friction factor 'k' depends on:
   A) Length of airway
   B) Roughness of airway
   C) Size of airway
   D) Nature of the rubbing surface of airway

3. The reasons why incompressible flow relationships are acceptable for subsurface ventilation planning include:
   A) Fluid mechanics relationships are simpler
   B) Fluid mechanics relationships are more accurate
   C) The fluid mechanics relationships allow corrections
   D) Fluid mechanics relationships give better predictions for depths more than 500 m

4. The relationship between maximum velocity (Vmax) and average velocity (Vav) for laminar flow fluids is given by:
   A) Vmax =0.5Vav
   B) Vmax= 1.235Vav
   C) Vmax=1 2Vav
   D) None of the above

5. Pressure –quantity surveys are necessary because they help to determine:
   A) Position of main fans
   B) Position of auxiliary fans
   C) Position of booster fans
   D) None of the above

6. Air power losses occur as a result:
   A) Airway resistance
   B) Length of airways
   C) Shock losses
   D) All of the above

7. The relative shape factor for a square is:
   A) 1.12
   B) 1.13
   C) 1.14
   D) 1.15

8. Which of the following does not affect airway resistance?
   A) Shape factor of airway
   B) Air velocity in airway
   C) Length of airway
   D) None of the above

9. The air power dissipated in a drive of resistance 0.05 $Ns^2/m^8$ and airflow 30$m^3/s$ is:

A) 0.45 kW
C) 1.35 kW
B) 4.5 kW
D) 13.5 kW

10. Which one of the following instruments do you need for air pressure survey?

A) Manometer
C) Thermometer
B) Psychrometer
D) All of the above

11. Which of the following instruments is <u>not</u> required for the trailing-hose method of pressure survey?

A) Hygrometer
C) Manometer
B) Magnehelic gauge
D) Psychrometer

12. To determine the air quantity required for a gassy working face, you will require:

A) The resistance of the work place
B) The daily production
C) The quantity of air allocated to each kilogram of explosive
D) The fan capacity

13. In determining the air quantity requirement for room and pillar workings which of the following information is useful?

A) Volume of stope
C) Explosive charge for a round
B) Ventilation re-entry period
D) All of the above

14. A ventilation network is defined by some three elements. Which of the following is NOT one of them?

A) Regulator
C) Circuit
B) Crossing
D) All of the above

15. The magnitude of natural ventilation at a mine depends on:

A) The difference in temperature inside and outside the mine
C) The difference in air densities in the shafts
A) The difference in elevation of the shafts
D) All of the above

16. Natural Ventilation pressure in a mine can be measured directly by

A) Determining the pressure drop across a stopping within a main ventilation Shaft with the fan switch off
B) Determining the pressure drop across a stopping mounted in a main horizontal airway with fan switch off
C) Determining the pressure drop across a stopping mounted in a main horizontal airway with the fan running
D) Determining the pressure drop across a stopping within a main ventilation shaft with the fan running

17. One of the three (3) fan characteristic curves is:
    A) Air flow rate vrs efficiency of fan motor
    B) Air flow rate vrs ventilation efficiency
    C) Air flow rate vrs efficiency of the impeller
    D) None of the above

18. The Fan Pressure law states that:
    A) $P \propto N \propto D \propto \rho$
    B) $P \propto N \propto D^2 \propto \rho$
    C) $P \propto N^2 \propto D \propto \rho$
    D) $P \propto N^2 \propto D^2 \propto \rho$

19. Volume control for a centrifugal fan cannot be achieved by:
    A) Inlet Guide Vanes angle change
    B) System Resistance change
    C) Use of Variable Speed Motor
    D) Blade Angle change

20. Indicate which one of the following is a ventilation control device
    A) Ventilation Door
    B) Ventilation Air lock
    C) Ventilation Regulator
    D) All of the above

21. The total Pressure drop around a circuit is 1000 Pa when the airflow is 10 $m^3/s$. What duty of Booster fan would be required to double the pressure drop around the circuit and double the airflow as well?
    A) Pressure: 1000 Pa and Quantity: 20 $m^3/s$
    B) Pressure: 2000 Pa and Quantity: 10 $m^3/s$
    C) Pressure: 2000 Pa and Quantity: 20 $m^3/s$
    D) Pressure: 1000 Pa and Quantity: 10 $m^3/s$

22. Which of the following can be used when ventilating a development end?
    A) An axial flow fan
    B) A ventilation ducting
    C) A mixed flow fan
    D) All of the above

23. The pressure drop measured across a ventilation ducting with resistance of 0.2 $Ns^2/m^8$ was 5kPa. The air quantity flowing should be:
    A) $5m^3/s$
    B) $25m^3/s$
    C) $158m^3/s$
    D) $25{,}000m^3/s$

24. Two identical fans staged up in series tend to
    A) Double the pressure developed
    B) Double the air quantity flowing
    C) Double the air pressure and double the air quantity
    D) None of the above

25. Airways in parallel are characterized by the following:
    A) Total resistance is the sum of the square root of the individual airway resistances
    B) Total pressure drop is the sum of airway pressure drops
    C) Total Air quantity is equal to the individual airway air quantities
    D) None of the above

26. Ventilation air locks are installed
    A) To enable passage of personnel and equipment
    B) To prevent the passage of air, personnel and equipment
    C) To enable short circuiting of air during passage of personnel and equipment
    D) To prevent short circuiting of air during passage of personnel and equipment

27. Which of the following is <u>not</u> true of refrigerants used underground?
    A) Must not be toxic
    B) Must not be corrosive
    C) Must not be such that condensing temperature of refrigerant will not allow mine water to be used for cooling
    D) Must not have a high latent heat of evaporation

28. One fact with refrigeration systems is that when the refrigerant evaporates
    A) It turns to water vapour
    B) It absorbs heat
    C) The vapour condenses
    D) It gives off heat

29. Which of the following is a direct system of distributing cooling effect?
    A) Bulk cooling using spray chambers
    B) Use of chilled service water
    C) Bulk cooling using cooling coils
    D) None of the above

30. Re-circulation at booster fan sites leads to
    A) Stalling of the fan
    B) Reduction in air quantity handled by fan
    C) Multiple point operation of the fan
    D) Reduction in fan pressure developed

## Section C (40 marks)

**Please answer eight (8) questions only**

1) Derive the relationship for Shape Factor (SF).

2) Show that Air Power is expressed as P × Q, where P = Pressure and Q = Air flow

3) Mention five (5) factors that affect ventilation operating cost.

4) Give five (5) reasons why Pressure-Quantity surveys are necessary.

5) Define the terms:

   a) Volumetric Efficiency; and

   b) Heat removal capacity (HRC).

6) What is a ventilation network? Mention and define the three (3) elements that characterize a ventilation network.

7) State the laws of air distribution and pressure distribution.

8) When are airways said to be in parallel? Write out the equations for determining total pressure drop, total resistance and total airflows in a parallel connected ventilation network.

9) Use a diagram to illustrate the stable zone, stall zone, economic zone and rational zone of fans in operation.

10) Mention the four (4) options available fan volume control and use a diagram to illustrate any one of them.

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