

FMUV First Class Managers UnRestricted Metal Ventilation 23Dec2021 FN

No. of Questions: 150

Duration in Minutes: 180

1) Electrostatic precipitator removes

- A)  $\text{SO}_2$
- B)  $\text{NO}_2$
- C)  $\text{NO}_x$
- ☒ D) Particulate matter
- E) None of these

2) In deeper mines, the resistance of shafts is often ----- the combined effect of the rest of the underground layout.

- A) lesser than
- ☒ B) equal to
- C) same as
- D) greater than
- E) None of the above

3) Choose the correct statement in reference to selection of site for erecting permanent water dam in an underground metal mine.

- A) Head of water to be withstood by the dam should be as small as possible.
- B) Site should not be easily accessible
- C) Site should not be self draining.
- D) Clayey strata is most suitable for erecting dams.
- ☒ E) All of the above

4) If an accumulation test by safety lamp, spiring (or jumping) of flame gives the positive response, then that indicates an accumulation of methane gas not less than ----- % in air.

- A) 4
- B) 3.5
- ☒ C) 3
- D) 2.5
- E) 2

5) The \_\_\_\_\_ of a gas,  $\gamma$ , is the ratio of the density of the gas at standard pressure and temperature to the density of air at the same standard pressure and temperature.

- A) molecular mass
- B) atomic weight
- ☒ C) specific gravity
- D) specific weight
- E) absolute gravity

6) No auxiliary fan shall be started, stopped, removed, replaced or in any way altered or interfered with, except by or on the authority of \_\_\_\_\_, as per the statute.

- ☒ A) an official
- B) a competent person
- C) an agent
- D) an Assistant Manager
- E) a Mine Manager

7) At what percentages of Oxygen in mine air a person starts feeling dizziness, buzzing in the ears and rapid heart beat?

- A) 19
- B) 17
- ☒ C) 15
- D) 13
- E) 10

8) If an accumulation test by safety lamp gives negative response the percentage test is carried out because it may contain methane gas less than \_\_\_\_\_ % in air.

- A) 4
- B) 3.5
- ☒ C) 3
- D) 2.5
- E) 2

9) Frictional resistance offered by an airway circulating certain quantity of air through fixed area of cross-section is the least when the shape of the airway is -

- A) Square
- ☒ B) Circular
- C) Rectangular
- D) Trapezoidal
- E) Elliptical

10) Diffusion is a natural process of inter-mingling of gases due to the presence of inter molecular spaces. This is the process of ventilation of long heading or blind ends or old workings where

- A) Fan pressure is very high
- ☒ B) there is High humidity
- C) Fan pressure has little effect
- D) there is Heavy water seepage
- E) None of these

11) By Coward diagram it is clear that deficiency of Oxygen limits explosibility of Methane. What is the percentage of Oxygen below which no explosion is possible irrespective of concentration of Methane?

- A) 10%
- ☒ B) 12%
- C) 15%
- D) 17%
- E) 19%

12) Which of the following reagent is used in making Carbon Mono Oxide detector tubes?

- ☒ A) Iodine Penia Oxide
- B) Phosphorous Penia Oxide
- C) Calcium Carbonate
- D) Magnesium Hydroxide
- E) Benzene

13) What is the additional air quantity requirement for each diesel equipment per kilowatt of the maximum rated engine output specified by the manufacturer ?

- A) not less than 0.6 m<sup>3</sup>/s
- B) not less than 0.6 m<sup>3</sup>/min.
- ☒ C) not less than 0.06 m<sup>3</sup>/s
- D) not less than 0.08 m<sup>3</sup>/s
- E) not less than 0.8 m<sup>3</sup>/min.

13-08-2018  
OEM'S (S&P) / (T&U.) Circular No. 1

14) The principle of operation of constant resistance type hot-wire anemometer is based on \_\_\_\_\_.

- A) change in air temperature
- B) static pressure
- C) wheel stone bridge
- ☒ D) thermal conductivity
- E) specific heat

15) In auxiliary ventilation, exhaust system is adopted where the main problem is \_\_\_\_\_

- A) Heat
- B) Methane layering
- C) Heat and Methane layering
- D) Resirable dust
- E) None of these

16) Find the sensitivity of manometer, if the manometer is filled with a liquid of sp. Gravity equal to 0.82 and the tube is graduated in millimetres and has an inclination of 0.1 rad ?

- A) 0.802 Pa
- B) 0.908 Pa
- C) 0.009 Pa
- D) 0.007 Pa
- E) 0.675 Pa

$$0.82 \times 5 \sin 0.1 \times 9.8 = 0.802 \text{ Pa}$$

17) How splitting of air is useful in underground mine ?

- A) It increases overall quantity in the main fan
- B) Overall resistance to the air flow reduces
- C) It increases overall quantity of air, and help to provide fresh air to each district
- D) It increases overall quantity of air, reduces resistance to air flow and help to provide fresh air to each district
- E) It reduces resistance to air flow and help to provide fresh air to each district

18) The limit of explosibility of a mixture of combustible gases can be computed by which of the following equations

- A) Graham's equation
- B) Bernoulli's equation
- C) Simon's equation
- D) Solmon's equation
- E) None of these

$$L_i - \text{Charles}$$

19) If we consider a column of air density as  $\rho$ , height  $h$ , then the pressure  $P$  at its bottom is equal to its weight over unit area, is expressed as \_\_\_\_\_ (considering,  $g$  = gravitational acceleration).

- A)  $P = \rho h g$
- B)  $P = \rho h g$
- C)  $P = \rho h g$
- D)  $P = \rho h g$
- E)  $P = \rho h g$

20) The volume of a given mass of gas varies inversely as the absolute pressure if the temperature remains constant. This is explained by \_\_\_\_\_

- A) Charles' Law
- B) Kirchhoff's Law
- C) Bernoulli's Theorem
- D) Graham's Law
- E) None of these

$$\text{Boyle's law}$$

21) Total number of persons in any one rescue team using breathing apparatus in a mine including the leader shall not be \_\_\_\_\_

- A) <3 and >6
- B) <4 and >8
- C) <5 and >6
- D) <5 and >8
- E) None of these

$$\text{Rescue Rule - 32}$$

22) Anemometers are suitably used for air measurements in all the mine airways and ducts which have got diameter of at least \_\_\_\_\_ to \_\_\_\_\_ times that of the anemometer.

- A) 2, 4
- B) 6, 8
- C) 10, 12
- D) 14, 16
- E) 18, 20

$$CIS mine - Page no - 505$$

23) The coefficient of heat transfer or the thermal emissivity is a complex function of the properties of the rock surface, the \_\_\_\_\_ content, temperature and velocity of air as well as the \_\_\_\_\_ of the airway.

- A) heat, length
- B) heat, shape
- C) moisture, size
- D) humidity, shape
- E) mineral, roughness

$$CIS mine - Page no - 166$$

24) Every mechanical ventilator, other than \_\_\_\_\_ fan, shall be so designed and maintained that the current of air can be \_\_\_\_\_ when necessary.

- A) an auxiliary, reversed
- B) a booster, increased
- C) a forcing, increased
- D) an exhausting, decreased
- E) an auxiliary, doubled

$$CIS mine - Page no - 132$$

25) Auxiliary ventilation system can be of which type amongst the following -

- A) Forcing
- B) Exhausting
- C) Overlapping
- D) Reversible
- E) All the above

26) Mine inundations can be classified as -

- A) Event controlled inundations
- B) Accidental inundations
- C) Spontaneous fires
- D) Option (1) & (2)
- E) Option (1), (2) & (3)

27) Where explosives are used to win a mineral, arrangements should be made to send to the face such a quantity of air after every round of blasting as would dilute the carbon monoxide and nitrous fumes to less than \_\_\_\_ PPM, and \_\_\_\_ PPM, respectively, within a period of five minutes.

- A) 5, 50
- B) 10, 50
- C) 50, 25
- D) 50, 5
- E) 100, 10

correct 30/10/23

28) With water as manometric fluid, what should be the inclination of manometer, so that a least reading of 1mm gives sensitivity of 1 Pa ?

- A) 0.102 rad
- B) 0.212 rad
- C) 0.155 rad
- D) 0.168 rad
- E) 0.198 rad

29) Hydrogen can be ignited at a temperature as low as \_\_\_\_ degree centigrade and with an ignition energy about half of that required by \_\_\_\_.

- A) 350, carbon monoxide
- B) 400, sulphur dioxide
- C) 375, hydrogen sulphide
- D) 480, helium
- E) 580, methane

30) Which statement is INCORRECT ?

- A) Auxiliary fan shall be installed at such locations where fresh air is available in sufficient quantities.
- B) Auxiliary fan should not recirculate air
- C) Auxiliary fan shall be fitted with air duct for conducting air to the face
- D) Auxiliary fan is installed to increase the quantity of air of Main Mechanical Ventilator.
- E) No person shall enter or remain in place which is dependent for its ventilation on auxiliary fan when such fan is stopped.

31) Fan Evasee reduces the following of the outlet air --

- A) The pressure energy
- B) the Potential energy
- C) the Fan energy
- D) the heat energy
- E) None of the above

32) If the air power in a mine is 86.27kW, calculate the motor power in kW if the efficiency of the drive is 65%.

- A) 132.72
- B) 123.72
- C) 172.32
- D) 127.37
- E) 56.075

$$\text{Motor Power} = \frac{86.27}{0.65} = 132.72$$

33) Every mechanical ventilator shall be installed in a \_\_\_\_ situated at a \_\_\_\_ distance from the opening, shaft or winze.

- A) explosionproof housing, 20m
- B) safe housing, 15m
- C) safe chamber, 1 m
- D) closed room, shorter
- E) fireproof housing, safe

34) Respective percentages of Methane and Oxygen at the nose limit of a Coward diagram is -

- A) 14.2, 0.0
- B) 14.1, 18.2
- C) 12.8, 12.1
- D) 5.0, 19.2
- E) 5.4, 14.5

Coward's diagram

35) For more than 50 m long heading/drivage, an auxiliary fan should ensure to provide at least \_\_\_\_\_ m3/min ventilation air within \_\_\_\_\_ of the face.

- A) 200 , 5.0 m  
B) 150 , 4.5 m  
C) 100 , 3.0 m  
D) 50 , 1.5 m  
E) None of these

Circulat. 30/11/17

36) The details to be shown on the Water danger plan should include -

- A) Telephone point  
B) First aid station  
C) rest station  
D) reserve station  
E) None of the above

Reg-61 mnr  
reference.

37) What shall be the 'maximum permissible respirable dust concentration' in mg/m3 at a working face of chromite mine where free respirable silica is 7.5%?

- A) 2.0 mg/m3  
B) 3.75 mg/m3  
C) 5.5 mg/m3  
D) 6 mg/m3  
E) 4.5 mg/m3

$$\frac{15}{7.5} = 2.0 \text{ mg/m}^3$$

38) Equivalent office of a mine may be calculated by the formula, where A= Eq. office in m2, Q= quantity of air flowing in m3/sec, P= Pressure absorbed in mm of water gauge, R= Resistance in kilonung

- A)  $A = 0.385Q/P$   
B)  $A = 0.0385Q/P$   
C)  $A = 0.385P/QR$   
D)  $A = 0.385P/Q$   
E)  $A = 0.0385P/QR$

$$A = \frac{0.385Q}{\sqrt{P}} \quad \text{or} \quad A = \frac{0.385}{\sqrt{R}}$$

39) A main mechanical ventilator running at 200 rpm produced 4000 cubic meter /min of air at 100 mm water gauge. What quantity of air will be produced if rotor speed is enhanced by 25%, assuming all other condition in the mine to remain unchanged.

- A) 5000 cubic meter/min  
B) 3200 cubic meter/min  
C) 6000 cubic meter/min  
D) 6250 cubic meter/min  
E) Unchanged

$$\left(\frac{250}{200}\right) \times 4000 = 5000 \text{ m}^3/\text{min}$$

$$200 \times 25\% = 250 \text{ rpm}$$

40) In a gas mask, and also in self rescuer, heat is generated as \_\_\_\_\_ is converted to \_\_\_\_\_ by the catalytic action of \_\_\_\_\_.

- A) CO<sub>2</sub>, CO, hopcalite  
B) CO, O<sub>2</sub>, catalyst  
C) CO, CO<sub>2</sub>, hopcalite  
D) CO<sub>2</sub>, O<sub>2</sub>, catalyst  
E) None of the above

41) The partitions and walls of every air-crossing shall be not less than \_\_\_\_\_ centimetres in thickness if constructed of masonry or of concrete not properly reinforced, and not less than \_\_\_\_\_ centimetres in thickness if constructed of properly reinforced concrete.

- A) 20, 10  
B) 25, 15  
C) 30, 15  
D) 38, 25  
E) 40, 20

$$\text{mnr Reg-135 (u)}$$

42) If AP=Air power in Kw, R= resistance in SI units= Quantity( m3/sec.), Then AP equals to

- A)  $RQ^3/1000$   
B)  $R/1000Q^3$   
C)  $RQ/1000$   
D)  $RQ^2/1000$   
E) None of these

$$AP = \frac{RQ^3}{1000}$$

$$AP = \frac{RQ^3 \times 10^{-3}}{1000}$$

$$AP = \frac{RQ^3 \times 10^{-3}}{1000}$$

43) Which of the following is not the cause of temperature rise in any underground mine?

- A) Conduction of heat from strata  
B) Oxidation of carbonaceous material  
C) Heat given out by men working in u/g  
D) Heat given out by machines in u/g  
E) None of the above

44) Fill in the blanks : Emergency response and evacuation plan shall cover mine evacuations and include, establishment of \_\_\_\_\_ responsibilities for administering actions identified to \_\_\_\_\_ an emergency response and establishment of emergency communication systems, procedures and \_\_\_\_\_ responsibilities for \_\_\_\_\_ emergency communications.

- A) individual, collective, carrying out, implement  
B) individual, implement, individual, carrying out  
C) collective, implement, carrying out, individual  
D) carrying out, individual, individual, implement  
E) implement, individual, collective, carrying out

45) The ventilating pressure varies as the \_\_\_\_\_ of the volume passing, so that doubling the volume means \_\_\_\_\_ the pressure.

- A) square, doubling  
~~B) square, quadrupling~~  
 C) square root, square of  
 D) square, three times  
 E) square root, same

C

46) As the air descends the downcast shaft, it gets compressed by the weight of the shaft air column approximately at the rate of 1.1 KPa per 100 m depth and its \_\_\_\_\_ energy is converted to \_\_\_\_\_ energy.

- A) kinetic, heat  
 B) pressure, kinetic  
 C) kinetic, pressure  
~~D) potential, heat~~  
 E) kinetic, geothermic

CNS miss page no - 160

47) The evaporator and condenser of a refrigeration unit have temperature of 4 and 50 degrees centigrade respectively. Determine the maximum possible coefficient of ideal coefficient of performance of this unit.

- A) 5.645  
 B) 5.875  
 C) 5.985  
~~D) 6.025~~  
 E) 6.255

$$= \frac{T_1}{T_2 - T_1}$$

$$= \frac{277.15}{303.15 - 277.15} = 6.025$$

$$T_1 = 273.15 + 4 = 277.15$$

$$T_2 = 273.15 + 50 = 323.15$$

48) A ventilation shaft of diameter 5m passes an airflow of 200 m<sup>3</sup>/s at a mean air density of 1.2 kg/m<sup>3</sup> and viscosity of air to be 17.81 x 10<sup>-4</sup>. Find the Reynold's number & type of flow.

- A) 3.03 x 10<sup>6</sup>, Turbulent  
 B) 3.13 x 10<sup>6</sup>, Turbulent  
~~C) 3.43 x 10<sup>6</sup>, Turbulent~~  
 D) 1.43 x 10<sup>6</sup>, Laminar  
 E) 1.93 x 10<sup>6</sup>, Laminar

$$Re = \frac{VD}{\mu}$$

$$= \frac{10.18 \times 5}{17.81 \times 10^{-4}} \times 1.2$$

$$Re = 3.43 \times 10^6$$

(so) Turbulent

$$V = 10.18 \text{ m/s}$$

49) Every auxiliary fan shall be installed, located and worked in such a manner that there is no risk of the air which it circulates being contaminated by any substantial quantity of inflammable or \_\_\_\_\_ gases or \_\_\_\_\_.

- ~~A) noxious, dust~~  
 B) combustible, smoke  
 C) inert, respirable dust  
 D) toxic, water vapour  
 E) explosive, particulate matter

MWR. Reg - 136 (ii)

50) Air analysis of sealed off fire area of mine is given as follows: Methane- 8 percent, Carbon monoxide- 5 percent, Hydrogen- 3 percent, Oxygen- 6 percent, Nitrogen- 68 percent. (Consider percentage of Nitrogen- 79.04 % and that of Oxygen- 20.93 % in inlet air). Calculate (i) Methane/ Total combustible ratio (ii) Excess Nitrogen %.

- A) (i) 0.50 (ii) 49.3  
 B) (i) 0.5 (ii) 50.3  
 C) (i) 0.5 (ii) 51.3  
 D) (i) 1 (ii) 52.3  
~~E) (i) 0.5 (ii) 45.3~~

51) Given two gases i.e. Gas A and Gas B, whose comparative densities are 4 and 9, respectively. What will the comparative rate of diffusion of Gas A and Gas B?

- A) Gas A diffuses 9/4 times as fast as the Gas B.  
~~B) Gas A diffuses 1.5 times as fast as the Gas B.~~  
 C) Gas A diffuses 4/9 times as fast as the Gas B.  
 D) Gas B diffuses 1.5 times as fast as the Gas A.  
 E) Gas A diffuses 3 times as fast as the Gas B.

$$\frac{\sqrt{1}}{\sqrt{9}} = 1.5$$

CHAMBERS

52) Two fans of the same design, one having 2 m dia, running at 250 rpm, developing 111" water gauge and the other having 3 m dia, making 200 rpm, developing 112" water gauge. Compare 112" / 111", which is equal to \_\_\_\_\_

- A) 1.66  
 B) 1.55  
~~C) 1.44~~  
 D) 1.88  
 E) 2.22

$$\frac{H_1}{H_2} = \left( \frac{D_1}{D_2} \right)^2 \times \left( \frac{N_1}{N_2} \right)^2$$

$$= 1.44$$

53) A volume of 1000 m<sup>3</sup>/min of air is provided when power is 50 HP. What power will be needed to double the volume?

- A) 100 HP  
 B) 200 HP  
 C) 300 HP  
~~D) 400 HP~~  
 E) 500 HP

$$= \left( \frac{1000}{1000} \right)^3 \times 50$$

$$= 400 \text{ HP}$$

54) Fill in the blanks: A miner's personal exposure to Diesel Particulate Matter (DPM) in an underground mine shall not exceed an eight hour time weighted average (TWA) airborne concentration of \_\_\_\_\_ micrograms of Elemental Carbon per cubic meter of air. The airborne concentration of DPM shall not exceed \_\_\_\_\_ times the 8 hr-TWA value for more than \_\_\_\_\_ minutes.

- A) 100, 2, 45  
B) 100, 3, 30  
C) 100, 4, 45  
D) 100, 5, 30  
E) 75, 5, 50

$$C_{DPM} = 100 \times 10^{-3} \times 1.25 / 1.25 = 100 \times 10^{-3} \times 1.25 = 125 \times 10^{-3} \text{ mg/m}^3$$

55) A water gauge reads 100 mm in a 4metre square airway. What will be the reading when the airway is enlarged to 6 metre square airway?

- A) 50 mm  
B) 60 mm  
C) 75 mm  
D) 80 mm  
E) 120 mm

$$Q \propto A \sqrt{h}$$

56) 4000 m<sup>3</sup> min of air circulates in a mine when the pressure drop is 500 Pa. What will be the new pressure drop, if the volume of air is allowed to fall to half of the above quantity?

- A) 100 Pa  
B) 125 Pa  
C) 150 Pa  
D) 200 Pa  
E) 250 Pa

$$\left( \frac{2000}{4000} \right)^2 \times 500 = 125 \text{ Pa}$$

57) Calculate the density of air at Barometric pressure of 101.325 kPa and dry and wet bulb temperature of 300 and 296 K, respectively (Consider vapour pressure e = 2.6 kPa).

- A) 1.06 kg/m<sup>3</sup>  
B) 1.16 kg/m<sup>3</sup>  
C) 1.19 kg/m<sup>3</sup>  
D) 1.20 kg/m<sup>3</sup>  
E) 1.21 kg/m<sup>3</sup>

$$\rho = \frac{P - e}{R(T - e/P)} = \frac{101.325 - 2.6}{0.287 \times 300} = 1.16 \text{ kg/m}^3$$

58) A fan running at 100 rpm gives w.g. of 75 mm. What w.g. is it capable of giving if the speed is increased to 120 rpm?

- A) 90  
B) 94  
C) 98  
D) 108  
E) 118

$$w.g. \propto N^2 \quad \left( \frac{120}{100} \right)^2 \times 75 = 108$$

59) A water gauge of 100 mm is capable of passing 3000 m<sup>3</sup>/min of air through a certain mine. What must be the w.g. if the quantity is increased to 5000 m<sup>3</sup>/min without any other change in the conditions.

- A) 166.67 mm  
B) 277.77 mm  
C) 333.34 mm  
D) 366.47 mm  
E) 399.88 mm

$$Q \propto A \sqrt{h} \quad \left( \frac{5000}{3000} \right)^2 \times 100 = 277.77 \text{ mm}$$

60) Each 1% drop in the O<sub>2</sub> content in mine atmosphere reduces the flame of a flame safety lamp by about \_\_\_\_\_ % and the lamp gets extinguished at about \_\_\_\_\_ % O<sub>2</sub>.

- A) 40, 19  
B) 20, 13  
C) 25, 19  
D) 10, 15  
E) 30, 17

61) A ventilation shaft of diameter 5m passes an airflow of 150 m<sup>3</sup>/s at a mean air density of 1.2 kg/m<sup>3</sup> and viscosity of air to be 17.9 x 10<sup>-6</sup>. Find the Reynold's number.

- A) 2.16 x 10<sup>6</sup>  
B) 2.26 x 10<sup>6</sup>  
C) 2.36 x 10<sup>6</sup>  
D) 2.46 x 10<sup>6</sup>  
E) 2.56 x 10<sup>6</sup>

$$Re = \frac{V \cdot D}{\mu} = \frac{150 \times 5}{17.9 \times 10^{-6}} = 2.56 \times 10^6$$

62) Illumination at a surface is inversely proportional to the \_\_\_\_\_ of the distance of the surface from the source of light, and directly proportional to \_\_\_\_\_, where, 'x' is the angle between the normal to the surface and the direction of the light rays.

- A) square root, cos x  
B) cube, cot x  
C) square, cos x  
D) square, cot x  
E) square root, tan x

Set Id : 73649\_3

63) Fill in the blanks. A good rule for percentage of firedamp for any breadth of wick of flame safety lamp is - (i) Height of cap equal to breadth of wick is --- percent. (ii) height of cap equal to 1.5 times the breadth of wick is - --- percent and (iii) height of cap equal to twice the breadth of wick is --- percent.

- A) 1.5, 2.5, 3.5  
B) 2.5, 3.5, 4.5  
C) 1.5, 2, 3  
D) 1.5, 3, 4.5  
E) 2, 3, 4

$$\text{Cap height} = 1.5 \times \text{wick breadth}$$

64) A wet drilling at a drift face produces a dust concentration of 400 p.p.c.c. (particles per cubic centimetre) in the respirable size range while the dust concentration rises to 700 p.p.c.c. if the drilling is done dry. Calculate the efficiency of dust suppression by wet drilling. If the drift face is ventilated by a tube delivering 2.5 m<sup>3</sup>/sec of fresh air.

- A) 38.92%  
B) 40.24%  
C) 40.85%  
D) 42.86%  
E) 44.44%

$$\begin{aligned} \text{Wet} &= 400 \times 10^6 \times 2.5 \times 60 = 6 \times 10^6 \text{ particles} \\ \text{Dry} &= 700 \times 10^6 \times 2.5 \times 60 = 10.5 \times 10^6 \text{ particles} \\ \text{Efficiency of Dust Suppression} &= \frac{10.5 - 6}{10.5} \times 100 = 42.86\% \end{aligned}$$

65) What is the minimum number years of practical experience a person must have in belowground work in mines for being appointed as Rescue Instructor?

- A) 2  
B) 4  
C) 5  
D) 6  
E) None of the above

Rescue Rule - 8  
3 years practical experience.

66) Find out the coefficient of friction 'f' (dimensionless) if the friction factor K is equal to 0.0081 kg/m<sup>3</sup> for uniformly sized & dispersed asperities on the surface and for fully developed turbulent flow.

- A) 0.00486  
B) 0.00331  
C) 0.054  
D) 0.00291  
E) 0.0135

$$f = \frac{K}{\rho} = \frac{0.0081}{1.2} = 0.00675$$

$$f = 0.054$$

Set Id : 73649\_3

67) The following measurements were made on an underground air cooling plant. Calculate the coefficient of performance of the plant. Evaporator water flow rate = 28.5 kg/s, evaporator inlet water temperature = 297.3 K, evaporator delivery water temperature = 282.5 K, compressor motor output power = 550 kW, sp. heat of water = 4.187 kJ/kg K.

- A) 3.21  
B) 3.33  
C) 3.45  
D) 3.55  
E) 3.76

$$\begin{aligned} \text{COP} &= \frac{\text{Cooling Effect}}{\text{Work Input}} = \frac{28.5 \times 4.187 \times (297.3 - 282.5)}{550} \\ &= \frac{1766 \text{ kW}}{550} = 3.21 \end{aligned}$$

68) The quantity of air going down a D.C. shaft is 600 m<sup>3</sup>/min. The surface main ventilator develops w.g. of 60mm. When the ventilator is stopped the air going down the shaft is 180 m<sup>3</sup>/min. What is the N.V.P. assisting the fan?

- A) 4.66 mm  
B) 5.44 mm  
C) 5.67 mm  
D) 5.93 mm  
E) 6.25 mm

$$\begin{aligned} \text{NVP} &= \frac{(60)^2 - (180)^2}{(60)^2} \times 60 \\ &= \frac{3600 - 32400}{3600} \times 60 = -5.93 \text{ mm} \end{aligned}$$

69) The total quantity of air i.e. 1000 cubic metre per minute is to be divided in two splits i.e. Split A and Split B. If the resistance of split A is R1 and resistance of split B is 4R1, then find out the quantity that will flow in Split B? (consider, pressure P is same for both splits.)

- A) 333.33 m<sup>3</sup>/min  
B) 200.00 m<sup>3</sup>/min  
C) 666.67 m<sup>3</sup>/min  
D) 500.00 m<sup>3</sup>/min  
E) 250.00 m<sup>3</sup>/min

$$\begin{aligned} \frac{Q_A}{R_1} &= \frac{Q_B}{4R_1} \\ \text{Split A} &= 1000 \times \frac{R_1}{1.5R_1} = 666.67 \text{ m}^3/\text{min} \\ \text{Split B} &= 1000 \times \frac{0.5R_1}{1.5R_1} = 333.33 \text{ m}^3/\text{min} \end{aligned}$$

70) Express by a chemical equation the products of the combustion of sulphuretted hydrogen in air.

- A) 2H<sub>2</sub>S + 3O<sub>2</sub> = 2SO<sub>2</sub> + 2H<sub>2</sub>O  
B) 2H<sub>2</sub>S + 4O<sub>2</sub> = 2SO<sub>2</sub> + 4H<sub>2</sub>O  
C) 4H<sub>2</sub>S + 3O<sub>2</sub> = 4SO<sub>2</sub> + 2H<sub>2</sub>O  
D) 2H<sub>2</sub>S + 2O<sub>2</sub> = 2SO<sub>2</sub> + 2H<sub>2</sub>O  
E) H<sub>2</sub>S + 3O<sub>2</sub> = 2SO<sub>2</sub> + 2H<sub>2</sub>O

71) Two identical fans, each capable exhausting a mine 2000 m<sup>3</sup>/min of air, are combined in series. What will be the quantity produced, when the power is the same as the sum of the single powers? (assume that the internal fan resistance and natural ventilation are negligible.)

- A) 2519.84 m<sup>3</sup>/min  
B) 2828.42 m<sup>3</sup>/min  
C) 2500.00 m<sup>3</sup>/min  
D) 2789.44 m<sup>3</sup>/min  
E) 3464.10 m<sup>3</sup>/min

$$352 \times 2000 = 2519.78 \text{ m}^3/\text{min}$$

72) A 2000 m long conveyor transports 500 t/hour through a vertical lift of 200m. If the conveyor motor consumes 1000 kW at combined motor/transmission efficiency of 90%. Calculate the heat generated along the length of conveyor.

- A) 627.5 kW  
B) 600.00 kW  
C) 588.5 kW  
D) 567.5 kW  
E) 550.5 kW

$$1000 \times 500 \times 700$$

73) Resistance of mine roadway A is 0.4354 NS<sup>2</sup>/m<sup>4</sup>. Resistance of roadway B is 10 NS<sup>2</sup>/m<sup>4</sup>. Find the equivalent resistance, if the roadways A & B are in parallel.

- A) 0.198 NS<sup>2</sup>/m<sup>4</sup>  
B) 0.228 NS<sup>2</sup>/m<sup>4</sup>  
C) 0.298 NS<sup>2</sup>/m<sup>4</sup>  
D) 0.312 NS<sup>2</sup>/m<sup>4</sup>  
E) 0.306 NS<sup>2</sup>/m<sup>4</sup>

$$\frac{1}{R_{eq}} = \frac{1}{0.4354} + \frac{1}{10} = 1.83 = \frac{1.83}{100}$$

$$R_{eq} = \left(\frac{100}{1.83}\right)^2 = 0.298$$

74) An airway of 3m x 4m and 200 m long is being remade to 4m x 5 m. If the power expended in ventilating it was 14 HP, what will it be when completed, if the velocity is kept the same?

- A) 8.4 HP  
B) 24 HP  
C) 18 HP  
D) 20 HP  
E) 23.33 HP

75) Assuming an air-water mix in the foam of 1000:1, a thousand litres of air expands to 1300 litres while 1 litre of water evaporates to become 1700 litres of water vapour giving 3000 litres of mixture. If the air originally had an oxygen content of 21 per cent then the evaporation of water will reduce that to \_\_\_\_\_%, which will extinguish flaming combustion.

- A) 8.1  
B) 9.1  
C) 10.2  
D) 11.1  
E) 12

$$= 21 \times \frac{1300}{3000}$$

$$= 9.1\%$$

76) Toxic metal dusts, such as \_\_\_\_\_, beryllium and manganese - may cause systemic intoxications, affecting blood, kidneys or the central nervous system.

- A) lead, cadmium,  
B) asbestos, silica  
C) cobalt, tungsten  
D) coal, cement  
E) iron, limestone

77) Density of air at 20 degree centigrade and 760 mm of Hg is equal to -

- A) 1.20 kg/m<sup>3</sup>  
B) 1.16 kg/m<sup>3</sup>  
C) 1.29 kg/m<sup>3</sup>  
D) 1.1 kg/m<sup>3</sup>  
E) 1.3 kg/m<sup>3</sup>

$$\frac{0.4645 \times 10^3}{273 + 20} = \frac{0.4645 \times 760}{273 + 20} = 1.20 \text{ kg/m}^3$$

78) Calculate the Air power required to circulate 3000 m<sup>3</sup>/min of air through a 2500 m long tunnel of 3.5 x 3.5 m cross section with k = 0.0098 NS<sup>2</sup>/m<sup>4</sup>.

- A) 22.23 kW  
B) 23.325 kW  
C) 24.45 kW  
D) 24.86 kW  
E) 25.25 kW

$$P = k \cdot Q^2$$

$$P = 0.0098 \times (3000)^2 = 89.46 \text{ kW}$$

$$P = 23.325 \text{ kW}$$

79) A circular shaft of 15m diameter admits 6000 m<sup>3</sup>/min of air into a mine. What quantity would a 21m dia shaft pass under same conditions?

- A) 13425.65 m<sup>3</sup>/min  
B) 13667.89 m<sup>3</sup>/min  
C) 13213.23 m<sup>3</sup>/min  
D) 13765.34 m<sup>3</sup>/min  
E) 13814.6 m<sup>3</sup>/min

$$Q_2 = \sqrt{\frac{P_2}{P_1}} \times Q_1$$

$$= \sqrt{\frac{89.46}{13914.6}} \times 6000$$

$$= 13914.6 \text{ m}^3/\text{min}$$

80) Take typical fuel consumption to be 0.3 litres per rated kW hour for the diesel engine. At a calorific value of 34000 kJ/litre, the heat produced or emitted for each kilowatt of mechanical output will be \_\_\_\_\_.

- A) 2.83 kJ/sec  
B) 2.63 kJ/sec  
C) 2.53 kJ/sec  
D) 2.43 kJ/sec  
E) 2.23 kJ/sec

$$\frac{0.3 \times 34000}{3600} \times = 2.83 \text{ kJ/sec}$$

81) When the water gauge is 50 mm, the power is 50 HP. What will the water gauge read, if the power is increased to 100 HP, without affecting the circulation.

- A) 56.77 mm  
B) 67.86 mm  
C) 75.66 mm  
D) 79.37 mm  
E) 86.55 mm

$$\left(\frac{100}{50}\right)^2 \times 50 = 79.37 \text{ mm}$$

82) The readings of anemometer before and after measuring the velocity were 1567 and 3142 when the instrument was held for five minutes in the air current. Find the quantity passing if the road is 4m wide and 3m high on top side and 2m high on the lower side of the road.

- A) 2560 m<sup>3</sup>/min  
B) 2675 m<sup>3</sup>/min  
C) 2865 m<sup>3</sup>/min  
D) 3010 m<sup>3</sup>/min  
E) 3150 m<sup>3</sup>/min

$$V = \frac{3142 - 1567}{5 \text{ min}} = 315 \text{ m/min}$$

$$Q = A \times V$$

$$= (4 \times 2.5) \times 315$$

$$Q = 3150 \text{ m}^3/\text{min}$$

83) 4000 m<sup>3</sup>/min of air pass through 3 m wide x 2m high roadway. If cross sectional dimensions of the roadway be altered to 2.5 m x 2 m, what will then be the quantity passing?

- A) 2000 m<sup>3</sup>/min  
B) 2400 m<sup>3</sup>/min  
C) 3000 m<sup>3</sup>/min  
D) 3200 m<sup>3</sup>/min  
E) 3375 m<sup>3</sup>/min

$$Q_1 = \sqrt{\frac{P_1}{Q_1}} \times \sqrt{\frac{P_2}{Q_2}} \times Q_1$$

$$= \sqrt{\frac{15}{6}} \times \sqrt{\frac{10}{4}} \times 4000$$

$$Q_2 = 3201 \text{ m}^3/\text{min}$$

84) The Schaefer's method, the Sylvester's method are the processes related with \_\_\_\_\_.

- A) manual artificial respiration  
B) re-opening of sealed off area  
C) assessment of relative humidity  
D) cooling power of the mine air  
E) None of the above

85) The percentage of carbon dioxide in a certain ventilation district is found to be 1.25%. The quantity of air circulating is 1500 cubic metre per minute. Calculate the additional amount of air required to reduce the percentage to 0.5 percent.

- A) 2500 m<sup>3</sup>/min  
B) 2250 m<sup>3</sup>/min  
C) 2000 m<sup>3</sup>/min  
D) 1750 m<sup>3</sup>/min  
E) 600 m<sup>3</sup>/min

9.

86) Calculate the pressure required to circulate 3000 m<sup>3</sup>/min of air through a 2500 m long tunnel of 3.5 x 3.5 m cross section with  $K = 0.0098 \text{ N s/m}^2$ .

- A) 435.6 Pa  
B) 445.6 Pa  
C) 453.5 Pa  
D) 464.5 Pa  
E) 466.5 Pa

$$P = \frac{K S Q^2}{A^3}$$

$$P = \frac{0.0098 \times 4.5 \times 3000^2}{(3.5 \times 3.5)^3}$$

$$\frac{3000}{60} = 50 \text{ m/s}$$

$$P = 466.5 \text{ Pa}$$

87) Dust suppression water is supplied to a workplace at a rate of 100 litres per tonne of rock mined. If the water is supplied to the machine at 12 degree centigrade and leaves the district at 26 degree centigrade, determine the cooling provided by the service water at a mining rate of 5 tonnes/minute. (Given: Sp. Heat of water = 4187 J/Kg °C)

- A) 444.88 Kw  
B) 468.65 Kw  
C) 474.5 Kw  
D) 488.5 Kw  
E) 496.5 Kw

$$5 \times 100 = \frac{500}{60} = 8.33 \text{ lit/sec}$$

$$= 8.33 \times 4.187 (26 - 12)$$

$$= 488.5 \text{ Kw}$$

88) In a mine having equivalent orifice of 4m<sup>2</sup>, the w.g. is 36 mm. What is the new equivalent orifice, if the w.g. is increased to 100 mm.

- A) 2 m<sup>2</sup>  
B) 24 m<sup>2</sup>  
C) 3 m<sup>2</sup>  
D) 4.8 m<sup>2</sup>  
E) 6.6 m<sup>2</sup>

$$A_2 = \sqrt{\frac{P_1}{P_2}} \times A_1$$

$$= \sqrt{\frac{36}{100}} \times 4$$

$$= 2.4 \text{ m}^2$$

88) A fan is running at 850 rpm and passing an airflow of 150 m<sup>3</sup>/s. Assuming that the efficiency remains unchanged, calculate the corresponding new volume flow, if the fan is run at 1275 rpm.

- A) 175 m<sup>3</sup>/s  
B) 200 m<sup>3</sup>/s  
C) 225 m<sup>3</sup>/s  
D) 250 m<sup>3</sup>/s  
E) 275 m<sup>3</sup>/s

$$\frac{1275}{850} \times 150 = 225 \text{ m}^3/\text{s}$$

(B) < N

90) Three airways have resistances 4, 6.25 and 9 units respectively and are connected in parallel. Calculate their equivalent resistance.

- A) 0.85 units  
B) 0.765 units  
C) 0.667 units  
D) 0.564 units  
E) 0.685 units

$$\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{32}{37}$$

$$R_e = \left(\frac{37}{32}\right)^2 = 0.657 \text{ units}$$

91) A mine produces 4 million litres of water per day, emitted at an average temperature of 42 degree centigrade. When the water is delivered into the shaft sump for pumping to the surface the water temperature is 32 degree centigrade. Determine the heat load from the water on the mine ventilation system. (Sp. heat of water = 4.187 J/kg °C)

- A) 1567.8kW  
B) 1765.6 kW  
C) 1876.5 kW  
D) 1938.4 kW  
E) 2006.6 kW

$$\text{Heat load} = \left(\frac{4 \times 10^6}{24 \times 60 \times 60}\right) \times 4.187 (42 - 32)$$

$$\text{Heat load} = 1938.4 \text{ kW}$$

92) The total quantity of air i.e. 1000 cubic metre per minute is to be divided in two splits i.e. Split A and Split B. If the resistance of split A is R1 and resistance of split B is 4R1, then find out the quantity that will flow in Split A? (consider, pressure P is same for both splits.)

- A) 200.00 m<sup>3</sup>/min  
B) 333.33 m<sup>3</sup>/min  
C) 666.67 m<sup>3</sup>/min  
D) 749.99 m<sup>3</sup>/min  
E) 799.99 m<sup>3</sup>/min

$$Q_{\text{split A}} = 200.67$$

$$A = 1000 \times \frac{1}{1+4} = 200.67$$

$$B = 1000 \times \frac{4}{1+4} = 800.33$$

93) The sample of the return air from the district or section of the mine liable to heating gave the following results. Oxygen- 20.20%, Nitrogen- 78.74%, Carbon dioxide- 0.31 percent, Carbon monoxide- 0.003%, Methane- 0.75%. Calculate Carbon monoxide produced/ Oxygen absorbed Ratio. (Assume the intake air contains 79.04 percent Nitrogen and 20.93 percent oxygen by volume.)

$$\frac{20.93}{79.04} \times 78.74 = 20.85$$

$$\frac{0.003}{20.85} \times 100 = 0.014$$

$$\frac{0.003}{0.014} \times 100 = 46\%$$

94) Given two gases i.e. Gas A and Gas B, whose comparative densities are 4 and 16, respectively. What will the comparative rate of diffusion of Gas A and Gas B?

- A) Gas A diffuses at twice the rate of Gas B.  
B) Gas B diffuses at twice the rate of Gas A.  
C) Gas B diffuses at four times the rate of Gas A.  
D) Gas B diffuses at eight times the rate of Gas A.  
E) Gas A diffuses at four times the rate of Gas B.

$$A \propto \frac{1}{\sqrt{d_1}}$$

$$\frac{A}{B} = \frac{1}{\sqrt{d_1}} \times \frac{\sqrt{d_2}}{1} = \frac{\sqrt{16}}{\sqrt{4}} = 2$$

95) A shaft is increased in diameter from 4 m to 6 m. Find the reduction/increase in pressure to send the same quantity of air down the shaft. If the initial pressure is P1.

$$P_1 \propto \frac{1}{D^5}$$

$$P_2 = \left(\frac{D_1}{D_2}\right)^5 \times P_1$$

$$= \left(\frac{4}{6}\right)^5 \times P_1$$

$$P_2 = 0.13 P_1$$

96) As per the statute, Where in any mine it is intended to construct a reservoir, dam or other structure to withstand a pressure of water or other material which will flow when wet, or to control an influx of water (other than a reservoir, dam or structure for storing small quantities of water) the owner, agent or manager shall give in writing not less than \_\_\_\_\_ days notice of such intention to the \_\_\_\_\_.

- A) 7, Chief Inspector  
B) 14, Chief Inspector  
C) 14, Regional Inspector  
D) 30, Chief Inspector  
E) 30, Regional Inspector

$$14 \text{ MR} \cdot \text{Reg} - 130$$

97) A mine requires 5 MW of air cooling. Calculate the mass flow rate of water involved if the water is supplied at 5 degree centigrade and returns at 20 degree centigrade. (Sp. Heat of water = 4187 J/Kg °C)

- A) 69.61 kg/s  
B) 75.56 kg/s  
C) 79.61 kg/s  
D) 84.31 kg/s  
E) 86.54 kg/s

$$5 \times 10^6 = 4187 (20-5) \times m.f$$

$$m.f = \frac{5 \times 10^6}{62805}$$

$$m.f = 79.61 \text{ kg/s}$$

98) The details to be shown on ventilation plan, and section of the mine shall include --

- A) every pumping, telephone and ambulance station and every haulage & travelling roadway  
B) every water-dam with dimensions and other particulars of construction;  
C) every fire-stopping and its serial number and position of fire fighting equipments  
D) every room used for storing inflammable material  
E) All the above

99) An air sample analysis produces the following results.  $CH_4 = 8\%$ ,  $CO = 5\%$ ,  $H_2 = 3\%$  percent. Determine the Upper Explosibility limit of mixture of all the combustible gases. (Assume Upper Explosibility limit of  $CH_4 = 14\%$ ,  $CO = 74.2\%$  &  $H_2 = 74.2\%$ ).

- A) 21.22%  
B) 20.56%  
C) 20.23%  
D) 23.56%  
E) 25.56%

$$\frac{8}{14} + \frac{5}{74.2} + \frac{3}{74.2} = 23.56\%$$

100) When rpm of the fan is increased by 1.5 times, the pressure developed by fan will change & it will --

- A) increase by 1.5 times  
B) decrease by 1.5 times  
C) increase by 2.25 times  
D) decrease by 2.25 times  
E) None of these

$$P \propto N^2$$

$$= (1.5)^2$$

$$\text{eq: } 2.25 \text{ times increase}$$

101) With installation of evasee, the following readings were obtained. Evasee inlet velocity: 16m/s, Evasee outlet velocity: 4m/s. Calculate the pressure gain in evasee in Pa, if density of air is 1.2 kg/m<sup>3</sup>.

- A) 134  
B) 144  
C) 154  
D) 164  
E) 174

$$P = \frac{V_1^2 - V_2^2}{2g}$$

$$= \frac{16^2 - 4^2}{2 \times 9.8} \times 1.2$$

$$= 14.693 \text{ mm} \times 7.8$$

$$= 144 \text{ Pa}$$

102) The sample of the return air from the district or section of the mine liable to heating gave the following results. Oxygen- 20.20%, Nitrogen- 78.74%, Carbon dioxide- 0.31 percent, Carbon monoxide- 0.003%, Methane- 0.75%. Calculate Carbon dioxide produced/ Oxygen absorbed Ratio. (Assume the intake air contains 79.04 percent Nitrogen, 20.93 percent oxygen and 0.03 percent carbon dioxide by volume.)

- A) 47%  
B) 45%  
C) 43%  
D) 41%  
E) 39%

$$\frac{20.93}{79.04} \times 78.74 = 20.85$$

$$CO_2 = 20.85 - 20.20 = 0.65$$

$$CO = 0.31 - 0.03 = 0.28$$

$$\frac{CO_2}{CO} = \frac{0.28}{0.65} \times 100 = 43\%$$

103) No workings shall be made in any mine vertically below any spot lying within a horizontal distance of -- metres from either bank of a river or canal or from the boundary of a lake, tank or other surface reservoir, according to the provision of Indian Metalliferous Mines Regulations in force.

- A) 10  
B) 12  
C) 30  
D) 60  
E) None of these

$$12m$$

$$15m$$

$$mmR - Reg (12-24)$$

104) The method commonly used for cleaning air of its dust load is --

- A) gravitational cleaning  
B) inertial cleaning  
C) Scrubbing  
D) Filtration  
E) All the above

105) A fan is running at 850 rpm and passing air of inlet density of 1.2 kg/m<sup>3</sup>. The pressure developed by the fan is 2 kPa. Assuming that the efficiency remains unchanged, calculate the corresponding new pressure if the fan is run at 1275 rpm in air of density 1.1 kg/m<sup>3</sup>.

- A) 3.37 kPa  
B) 3.57 kPa  
C) 3.87 kPa  
D) 3.97 kPa  
E) 4.12 kPa

$$P \propto \left(\frac{N}{850}\right)^2 \times \frac{1.1}{1.2} \times 2 \text{ kPa}$$

$$= 4.12 \text{ kPa}$$

106) A district of a mine is ventilated by 15 m<sup>3</sup>/s quantity of air and w.g. across the district is 25mm. If the quantity has to be reduced to 10 m<sup>3</sup>/s by installing regulator in the return of the district, calculate the size of regulator.

$$Q_1 = \frac{P}{R_1} \quad R_1 = \frac{245}{15^3} = 1.08$$

$$Q_2 = \frac{P}{R_2} \quad R_2 = \frac{245}{10^3} = 2.45$$

$$\text{Resistance in Regulator } R_R = R_2 R_1 = 2.45 \times 1.08 = 2.645$$

$$R_R = \frac{12}{Q^3} \Rightarrow Q = \sqrt[3]{\frac{12}{2.645}} = 1.03 \text{ m}^3/\text{s}$$

107) The velocity in a brick arched airway was determined by the smoke test. The distance measured off was 20 m and the smoke took 10 seconds to travel this distance. The airway was 4m wide and 4 m from the floor to the crown of the arch, the latter being a semicircle starting 2 m from the floor. Calculate the quantity of air passing.

$$\text{Total area} = 4 \times 2 + \frac{1}{2} \pi \times 2^2 = 14.28 \text{ m}^2$$

$$V = \frac{Q}{A} \Rightarrow Q = V \times A = 2 \text{ m/s} \times 14.28 \text{ m}^2 = 28.56 \text{ m}^3/\text{s}$$

$$Q = A \times V = 14.28 \times 2 = 28.56 \text{ m}^3/\text{s}$$

108) Calculate the Air power required to circulate 3000 m<sup>3</sup>/min of air through a 2500 m long tunnel of 3 x 3 m cross section with  $k = 0.0098 \text{ N s}^2/\text{m}^4$ .

$$P = \frac{K Q^3}{A^3} = \frac{0.0098 \times 3000^3}{(3 \times 3)^3} = 0.44 \times 50^3 \times 10^3$$

$$= 50.41 \text{ kW}$$

109) Which amongst the following is not an apparatus to record or measure atmospheric pressure?

- A) Fortin barometer
- B) Hypsometer
- C) aneroid barometer
- D) Barographs
- E) None of these

110) When the water gauge is 50 mm, the power is 125 HP. What will the water gauge read, if the power is increased to 150 HP, without affecting the circulation.

$$\left(\frac{150}{125}\right)^{\frac{2}{3}} \times 50 = 56.45 \text{ mm}$$

111) A fan driven by 3 phase induction motor having efficiency of the motor 88 %, voltage 550 V, current 120 A and the power factor of 0.85. What would be the HP in air, assuming the fan to have the efficiency 80.7 %?

$$\text{Fan efficiency} = \frac{\text{Air Power}}{\text{Motor Power}} = \frac{P_{\text{air}}}{P_{\text{motor}}} = \frac{P_{\text{air}}}{\sqrt{3} \times 550 \times 120 \times 0.85 \times 0.88} = \frac{P_{\text{air}}}{85500.88} = 80.7\%$$

$$P_{\text{air}} = \frac{85500.88 \times 80.7}{100} = 68900.88 \text{ W} = 91.8 \text{ HP}$$

112) With w.g. of 50mm, 5000 cubic metre per minute of air circulates in a mine. What will be the quantity if the pressure is increased 50 %?

$$Q \propto \sqrt{P} \Rightarrow Q_2 = \sqrt{\frac{P_2}{P_1}} \times Q_1 = \sqrt{\frac{75}{50}} \times 5000 = 6123.7 \text{ m}^3/\text{min}$$

113) Dry bulb temperature of mine air is 35.2 degree centigrade and the wet bulb temperature is 34 degree centigrade. Estimate the Relative Humidity of mine air.

$$35.2 - 34 = 1.2 \quad \therefore 1.2 \times 7 = 8.4 \quad 100 - 8.4 = 91.6\%$$

114) Identify the CORRECT statement or statements with respect to the benefits of ice as a medium of heat transfer in mines:

- Statement (1): It greatly reduce water flow in shaft pipe lines.
  - Statement (2): Coolth is stored in ice bunkers & silos to satisfy short term variations in demand.
  - Statement (3): The system is more capable of being upgraded for future increases in cooling load.
- A) Statement (1) only  
B) Statement (2) only  
C) Statement (1) & (2) only  
D) Statement (2) & (3) only  
E) All the statements

Set Id : 73649\_3

115) The diffusers are fitted to ----- fans and the exhausters are attached to ----- fans.

- ☒ A) forcing exhaust  
☐ B) exhaust, forcing  
☐ C) exhaust, reversible  
☐ D) exhaust, overlapping  
☐ E) None of the above

CAB P11359 Paq120-433

116) Each kg of Oxygen consumed, oxidises 1232 kg of carbon. Taking calorific value of carbon as 33800 kJ/kg, it gives a corresponding heat production of ----- kJ heat per kg of oxygen used.

- A) 90133.33  
 B) 45634  
 C) 12675  
 D) 54324  
 E) 15432

$$= \frac{12}{32} \times 33800 = 12675$$

117) A fan is driven by D.C motor having efficiency of motor 88 %, the voltage being 550 and the current 120 amperes. Calculate the mechanical efficiency of the fan, if HP in air is 47.3 HP?

- A) 60.70%  
 B) 66.67%  
 C) 70.67%  
 D) 76.67%  
 E) 79.67%

$$\text{Efficiency} = \frac{\text{HP in air}}{\text{HP in motor}} \times 100 = \frac{47.3}{58.1} \times 100 = 81.41\%$$

118) The equivalent orifice of a mine showing 100 mm w.g. is 2 m<sup>2</sup>. What would the pressure be, if the orifice be considered 4 m<sup>2</sup>?

- A) 50 mm  
 B) 60 mm  
 C) 75 mm  
 D) 80 mm  
 E) 25mm

$$P_2 = \left(\frac{P_1}{A_1}\right)^2 \times P_1 = \left(\frac{100}{2}\right)^2 \times 100 = 25 \text{ mm}$$

119) Twenty cubic metre of gas at 15.5 degree centigrade are heated to 26.6 degree centigrade, what is the new volume if the pressure is kept constant?

- A) 22.77 cubic meter  
 B) 25.77 cubic meter  
 C) 23.77 cubic meter  
 D) 21.77 cubic meter  
 E) 20.77 cubic meter

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow V_2 = \frac{20 \times 299.6}{288.5} = 20.77 \text{ m}^3$$

Set Id : 73649\_3

120) Two identical fans, each capable exhausting a mine 3153 m<sup>3</sup>/min of air, are combined in series. What will be the quantity produced, when the water gauge is kept same as when working singly?

- A) 4000 m<sup>3</sup>/min  
 B) 4123 m<sup>3</sup>/min  
 C) 4333 m<sup>3</sup>/min  
 D) 5461 m<sup>3</sup>/min  
 E) 4459 m<sup>3</sup>/min

$$52 \times 3153 = 4459 \text{ m}^3/\text{min}$$

121) Fan circulates 4 m<sup>3</sup>/s of air. The Area of inlet of exhauster is 1 m<sup>2</sup> and that of outlet is 2 m<sup>2</sup>. Calculate the gain in pressure in exhauster, if density of air is 1.2 kg/m<sup>3</sup>.

- A) 5.2 Pa  
 B) 6.2 Pa  
 C) 6.8 Pa  
 D) 7.2 Pa  
 E) 8.2 Pa

$$P = \frac{\rho}{2} (V_1^2 - V_2^2) = \frac{1.2}{2} (4^2 - 2^2) = 7.2 \text{ Pa}$$

122) Hopcalite is a mixture of copper and ----- oxides used as catalyst to convert ----- into carbon dioxide when exposed to the oxygen in air.

- A) Lead, carbon monoxide  
 B) Permanganese, carbon monoxide  
 C) Sodium, sulphur dioxide  
 D) Potassium, carbon monoxide  
 E) aluminium, hydrogen sulphide

123) If the length of an airway is increased from 100 m to 180 m, how much must the water gauge be increased or decreased to maintain the same velocity. Take the original water gauge to be 60 mm.

$$P_{dL} = \frac{\rho L V^2}{4} \Rightarrow P_2 = \frac{108}{100} \times 60 = 64.8 \text{ mm}$$

124) Respirable dust approximates to that fraction which penetrates to the gas exchange region of the -----

- A) Nose  
 B) Chest  
 C) Throat  
 D) Mouth  
 E) None of the above

LUYRS

Set id : 73649\_3

125) Fill in the blanks : In case of use of diesel equipment's in belowground mines, at least once in every \_\_\_\_\_ during the diesel equipment's are in normal operation, the atmosphere of the roadway, in which the equipment's are operated, shall be tested for the presence of the noxious and inflammable gases. The tests for noxious gases shall be carried out in the roadway's approximately at \_\_\_\_\_ m above the floor level and \_\_\_\_\_ m from the diesel equipment exhaust on the return side.

- A) hour, 1, 2  
B) four hours, 1, 1.5  
C) shift, 1.5, 1  
D) day, 1.5, 2  
E) week, 1.5, 2.5

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126) If actual vapour density is 10 g/m<sup>3</sup> at 20 degree centigrade compared to the saturation vapour density at that temperature of 18 g/m<sup>3</sup>, then the Relative humidity is \_\_\_\_.

- A) 50%  
B) 55.55%  
C) 61.15%  
D) 72.25%  
E) 66.66%

$$RH = \frac{10}{18} \times 100 = 55.55\%$$

127) If the quantity of air produced by mine fan has to be increased from 1000 m<sup>3</sup>/min with power requirement in HP as H<sub>1</sub> to 2000 m<sup>3</sup>/min with power requirement in HP as H<sub>2</sub>, then H<sub>2</sub>/H<sub>1</sub> is equal to \_\_\_\_.

- A) 4  
B) 5  
C) 6  
D) 7  
E) 8

$$\left(\frac{2000}{1000}\right)^3 = \frac{H_2}{H_1}$$

$$H_2 = 8 H_1$$

128) Calculate the w.g. produced by 3 m dia fan running at 250 rpm and delivering 6000 m<sup>3</sup>/min of air, if the blades are radial. Air density = 1.2 kg/m<sup>3</sup>.

- A) 172 mm  
B) 175 mm  
C) 180 mm  
D) 189 mm  
E) 198 mm

$$\text{Blade HP required} = \frac{\pi D^3 n}{60} \times \frac{\pi \times 3 \times 250}{60} = 39.26 \text{ m/s}$$

$$\text{radial } H = \frac{v^2}{2g}$$

$$= \frac{(39.26)^2}{2 \times 9.8}$$

$$= 157.36 \text{ m}$$

$$= 189 \text{ mm}$$

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129) Determine the useful cooling effect or evaporator duty, if water mass flow rate = 50 kg/s, sp. Heat of water = 4.187 J/Kg °C & temperature drop of water = 10 degree centigrade.

- A) 2093.5 Kw  
B) 3124.5 Kw  
C) 3212.21 Kw  
D) 3244.54 Kw  
E) 3286.95 Kw

$$\text{cooling} = m \cdot F \cdot \text{sp. Heat} \cdot \Delta T$$

$$= 50 \times 4.187 \times 10 = 2093.5 \text{ Kw}$$

130) The \_\_\_\_\_ and \_\_\_\_\_ are the most important deposition mechanisms in relation to inhaled airborne dust, and these processes are governed by particle aerodynamic diameter.

- A) interception, electrostatic deposition.  
B) diffusion, impingement  
C) sedimentation, impaction  
D) interception, diffusion  
E) impingement, electrostatic deposition

2.

131) Calculate the w.g., a fan has to develop for ventilating a roadway under the following conditions, (i) cross section = 2.4 mx 3 m, (ii) Length = 100m (iii) Quantity of air passing = 6m<sup>3</sup>/s (iv) coefficient of resistance = 0.00161 mm of wg per m<sup>2</sup> of rubbing surface per 1m/s velocity of air.

- A) 0.677 mm  
B) 0.477 mm  
C) 0.377 mm  
D) 0.277 mm  
E) 0.167 mm

$$P = \frac{W \cdot L}{A^3} = \frac{0.00161 \times 4 \times 100 \times 2 \times (2.4 \times 3) \times 6 \times 6}{(2.4 \times 3)^3}$$

$$= 0.167 \text{ mm}$$

132) At what percentages of Oxygen in mine air a person becomes unconscious within half an hour ?

- A) 19  
B) 17  
C) 15  
D) 13  
E) None of the above

10% O<sub>2</sub> deficiency

133) A fan is running at 850 rpm and passing air of inlet density of 1.2 kg/m<sup>3</sup> with the shaft power of 440 kW. Assuming that the efficiency remains unchanged, calculate the corresponding new power, if the fan is run at 1275 rpm in air of density 1.1 kg/m<sup>3</sup>.

- A) 1312.2 Kw  
B) 1321.2 Kw  
C) 1342.3 Kw  
D) 1361.2 Kw  
E) 1375.2 Kw

$$= \left(\frac{1275}{850}\right)^3 \times \frac{1.1}{1.2} \times 440 \text{ Kw}$$

$$= 1361.2 \text{ Kw}$$

134) A mine requires 10 MW of cooling. Calculate the mass flow rate of water involved, if the water is supplied at 3 degree centigrade and returns at 20 degree centigrade. (Sp. Heat of water = 4187 J/kg °C)

- A) 132.5 kgs  
B) 140.5 kgs  
C) 144.5 kgs  
D) 148 kgs  
E) 152.2 kgs

$$10 \times 10^6 = 4187 (20-3) \times m \cdot f$$

$$m \cdot f = \frac{10 \times 10^6}{71179} = 140.5 \text{ kgs/s}$$

135) Find the percentage of Blackdamp in a mine air sample having the following analysis (percent by volume).  $O_2 = 19$ ,  $N_2 = 79.04$ ,  $CO = 0.25$ ,  $CO_2 = 0.02$ ,  $CH_4 = 1.89$  (Atmospheric air entering the mine has  $O_2 = 20.93$ ,  $N_2 = 79.04$ ,  $CO_2 = 0.03$ ).

- A) 7.13%  
B) 7.23%  
C) 7.31%  
D) 7.51%  
E) 7.79%

$$N_2 = \frac{19}{20.93} \times 79.04 = 71.75\%$$

$$CO_2 = \frac{0.02}{0.03} \times 0.03 = 0.02$$

$$CH_4 = 1.89$$

$$Blackdamp \% = 100 - 71.75 - 1.89 - 0.02 = 26.34\%$$

136) In a belowground mine, the temperature increases on an average one degree centigrade for every 70m in depth. If the temperature at a depth of 50m below earth's surface is 25 degree centigrade, then the probable temperature at a depth of 2000 m, will be -.

- A) 78.57 deg centigrade  
B) 62.85 deg centigrade  
C) 52.85 deg centigrade  
D) 48.75 deg. Centigrade  
E) 45.57 deg. Centigrade

137) Consider an airway before it is affected by a fire. Air flows along it at a mass flowrate of  $M$  (kgs) and doing work against friction at a rate of  $F$  (J/kg). The airpower dissipated against friction,  $Pow$ , is equal to — (Watts).

- A)  $F \cdot M$   
B)  $F/M$   
C)  $F/M^2$   
D)  $F/M^3$   
E)  $2F/M$

138) A cloud of dust of a ————— material behaves similarly to a flammable gas mixed with air in its ability to propagate a flame if in sufficient concentration; in a confined space it can produce an ———.

- A) combustible, explosion  
B) incombustible material, explosion  
C) toxic, ignition  
D) flammable, oxidation  
E) None of the above

139) Calculate the quantity of air flowing down the mine shaft of circular section and 7 m diameter, if the velocity is 600 min/m.

- A) 100 m³/sec  
B) 200 m³/sec  
C) 350 m³/sec  
D) 385 m³/sec  
E) 415 m³/sec

$$Q = A \times V$$

$$= \pi (4.25)^2 \times 10 \times \frac{600}{60} = 385 \text{ m}^3/\text{sec}$$

140) The dry bulb temperature and wet bulb temperature recorded in a mine D.C. shaft pit bottom is 33 degree centigrade and 30 degree centigrade respectively. Calculate water content of intake air, if the water content of saturated air at normal atmosphere pressure is 35 gm³ at 33 degree centigrade.

- A) 30.5 gm³  
B) 27.65 gm³  
C) 33.75 gm³  
D) 26.60 gm³  
E) 25.55 gm³

$$33 - 30 = 3^\circ \quad P-H = 347 - 100 = 247$$

$$\text{water content of intake air} = 35 \times 0.79 = 27.65 \text{ gm}^3$$

141) If the equivalent resistance of three identical parallel roadways is  $R$ . By adding one additional identical roadway in parallel i.e. total four parallel roadways, the resistance becomes —.

- A) 1.77R  
B) 0.177R  
C) 0.0562R  
D) 0.5652R  
E) None of the above

$$R_1 = \frac{R}{3} = \frac{R}{3}$$

$$R_2 = \frac{R}{4} = \frac{R}{4}$$

$$\frac{R_1}{R_2} = \frac{\frac{R}{3}}{\frac{R}{4}} = \frac{4}{3} = 1.33$$

$$\frac{R_1}{R_2} = \frac{1.33}{1} = 1.33$$

142) Every auxiliary fan shall be installed, located and worked in such a manner that an air-duct for conducting the air to or from the face or blind end, and such air-duct shall be so maintained as to minimise any leakage of air and to ensure an adequate supply of air to within \_\_\_\_\_ metres of the \_\_\_\_\_ or blind end.

- A) 5, face  
B) 4.5, face  
C) 5, rest station  
D) 5, refuge chamber  
E) None of these

$$C_{\text{refuge}} = 1075$$

143) An air sample taken from a return airway yields the following analysis  $N_2 = 79.22\%$ ,  $O_2 = 20.05\%$ ,  $CO = 18$  ppm. Find out Graham's Ratio. (Assumption - Air is supplied with 20.93%  $O_2$  & 79.04%  $N_2$ .)

- A) 0.31%  
B) 0.29%  
C) 0.25%  
D) 0.23%  
E) 0.19%

$$C_{\text{return}} \text{ Ratio} = \frac{0.0018}{\left(\frac{20.93}{79.04}\right) \times 179.22 - 20.95} \times 100 = 0.191$$

144) Dusts are solid particles, ranging in size from below \_\_\_\_\_  $\mu\text{m}$  up to at least \_\_\_\_\_  $\mu\text{m}$ , which may be or become airborne, depending on their origin, physical characteristics and ambient conditions.

- A) 0.1, 10  
B) 1, 100  
C) 2, 100  
D) 5, 100  
E) 10, 100

145) A circular shaft which absorbs 150 mm of w.g. is being widened from 4 m to 6 m. What pressure will it take when completed, if the coefficient of friction is constant?

- A) 15 mm  
B) 17.5 mm  
C) 19.75 mm  
D) 21.50 mm  
E) 100 mm

$$P_2 \frac{1}{D_2^5} = P_1 \left(\frac{D_1}{D_2}\right)^5 \times D_1^5$$

$$= \left(\frac{4}{6}\right)^5 \times 150$$

$$= 19.75 \text{ mm}$$

146) The evaporator and condenser of a refrigeration unit have temperature of 5 and 45 degrees centigrade respectively. Determine the Carnot or ideal coefficient of performance of this unit.

- A) 5.678  
B) 5.875  
C) 6.954  
D) 7.225  
E) 8.224

$$5^\circ = 278.15 \text{ K}$$

$$45^\circ = 318.15 \text{ K}$$

$$\text{ideal coefficient of performance} = \frac{T_1}{T_2 - T_1}$$

$$= \frac{278.15}{318.15 - 278.15} = 6.954$$

147) Resistance of mine roadway A is 0.8  $\text{Ns}^2/\text{m}^8$ . Resistance of roadway B is 0.3  $\text{Ns}^2/\text{m}^8$ . Find the equivalent resistance, if the roadways A & B are in parallel.

- A) 1.1  $\text{Ns}^2/\text{m}^8$   
B) 0.55  $\text{Ns}^2/\text{m}^8$   
C) 0.1854  $\text{Ns}^2/\text{m}^8$   
D) 0.1154  $\text{Ns}^2/\text{m}^8$   
E) 0.2154  $\text{Ns}^2/\text{m}^8$

$$\frac{1}{R_{\text{eq}}} = \frac{1}{R_A} + \frac{1}{R_B} = \frac{1}{0.8} + \frac{1}{0.3} = \frac{2914}{100}$$

$$R_{\text{eq}} = \left(\frac{100}{2914}\right)^2 = 0.1154 \text{ m}^8/\text{Ns}^2$$

148) The amount of water carried by ventilating air is 7.62  $\text{g}/\text{m}^3$ . If the quantity of air circulating in a mine is 6000  $\text{m}^3/\text{min}$ , calculate the amount of water carried by ventilating air per day.

- A) 60.6875 tonnes  
B) 62.6754 tonnes  
C) 70.7658 tonnes  
D) 68.8876 tonnes  
E) 65.8368 tonnes

$$= \frac{7.62 \times 6000 \times 60 \times 24}{1000} = 65.8368 \text{ tonnes}$$

149) A 500m long airway passes 10  $\text{m}^3$  of air per second. A new airway of the same cross section and similar surface but 250 m long is added in parallel to it. Calculate the total quantity of air passing after addition of new airway? (Consider that the pressure across the airway remain unchanged after addition of the new airway).

- A) 24.14  $\text{m}^3/\text{s}$   
B) 28.34  $\text{m}^3/\text{min}$   
C) 30.12  $\text{m}^3/\text{min}$   
D) 32.42  $\text{m}^3/\text{min}$   
E) 34.2  $\text{m}^3/\text{min}$

$$R_1 Q_1^2 = R_2 Q_2^2$$

$$500 \times (10)^2 = 250 \times Q_2^2$$

$$Q_2 = 14.14$$

$$Q = Q_1 + Q_2 = 10 + 14.14 = 24.14 \text{ m}^3/\text{s}$$

150) The density of hydrogen is 1, and of oxygen 16. Thus the relative rates of diffusion of hydrogen and oxygen are that the-

- A) oxygen will diffuse into hydrogen at 4 times the rate that hydrogen will diffuse into oxygen.  
B) oxygen will diffuse into hydrogen at 8 times the rate that hydrogen will diffuse into oxygen.  
C) Hydrogen will diffuse into oxygen at 8 times the rate that oxygen will diffuse into hydrogen.  
D) Hydrogen will diffuse into oxygen at 4 times the rate that oxygen will diffuse into hydrogen.  
E) Hydrogen will diffuse into oxygen at 2 times the rate that oxygen will diffuse into hydrogen.