Composition of atmosphere air by volume:-

Nitrogen (N_2) → 78%.

Oxygen (O_2) → 21%.

Argon → 0.9%.

Other gases → 0.1%. (CO_2, CH_4, He, Ne etc.)

CH_4 → coal in mines and Geo-thermal produce.

→ Argon is a nobel gas which is high amount of gas present in atmosphere.

Damp :- means vapour or smoke

Damp is devided into 5 types. such as -

1) Black Damp:- Suffocating Damp (CO_2)

→ It is mainly known as CO_2 because it creates difficulties to breathing. (Choke damp)

→ It also exhisting fire.

2) Fire Damp:-

→ These are inflammable gas which catches fire with the slight rise of temperature

CH_4, C_2H_6, C_3H_8, C_4H_{10} etc.

3) White Damp:-

→ It is other known as carbon mono-xide (CO).

→ CO has the higher affinitity to the hima-globin of our blood.

4) Stink Damp:- (H_2S) → Hydrogen sulphate

→ The stink means unpleasent smell.

ex- H_2S which is like rotten egg.

5) After Damp:

→ It is the gas exist after the explosion of fire damp / coal dust.

→ There are many gas present in our mine's atmosphere. such as i) CO_2 ii) O_2 iii) CH_4 iv) H_2S v) CO

→ The physical properties of mine gases.

i) CO_2

→ Specific gravity - 1.529

→ colorless

→ odorless

→ Heavier than air

→ Acidic taste at high concentrations

ii) CO

→ Specific gravity - 0.967

→ flammable

→ colorless

→ Tasteless

→ Odorless

→ Lighter than the air

iii) H_2S :-

→ Specific gravity - 1.191

→ colorless

→ extremely flammable

→ Heavier than air

→ Highly solvable

→ Order to similare to rotten eggs at very low concetrations (0.003) ppm.

iv) O_2 :-

→ specific gravity → 1.105
→ colorless
→ Odorless
→ Tasteless
→ Non-explosive
→ supports combustion
→ Heavier than air
→ easily displaced by other gases introduced into the atmosphere.

v) CH_4 :-

→ specific gravity :- 0.5545
→ colorless
→ odorless
→ Tasteless
→ flammable
→ Lighter than air
→ Largest component of fire damp (70 to 98%)

Flame safety Lamp:-

→ To get rid of recurring problem of fire damp explosion due to open lamp considering this problem Sir. Humphry Davy in occurs. ~~1855~~ 1815 came forward with a revolutionary device known as Davy safety lamp. The flame of the lamp was covered by a wire gauge of copper having good thermal conductivity. The flame heat was ~~dissipated~~ dissipated (waste) throughout the wire gauge thus not enough of heat pass to ignite ~~to~~ explosive mixture surrounding

to the lamp. The methane entire along with inlet air was simply burnt off

Different parts of safety lamp:

1) carrying hook
2) Vent holes
3) Bonnet
4) Pillar
5) magnetic lock
6) Inner gauge ~~and~~ outer gauge
7) outer gauge
8) Borosil glass
9) Asbestos ring
10) ~~the~~ wick ~~retainer~~ holder
11) ~~wick~~
12) Regulator or wick / wick asbestos
13) Oil vessel

1) carrying hook:-

→ For holding the lamp and carrying it at knee height.

2) vent holes:-

→ The combusion gas ~~both~~ goes into lamp through this holes.

3) Bonnet:-

~~→ It is used for taking~~

→ It protects to the wire gauge from damage due to external ~~heat~~ hit.
It also guards the flame against high air velocity.

4) Pillar :-

→ The bonnet rest on Pillars over the oil vessel generally 5 Pillars are provided protect to the glass.

5) magnetic lock :-

→ To unlock the lamp the iron pin block fitted to the spring. is brought into a contact a powerful magnet so that due to contraction of the spring the pointer is groove

6) Outer and inner gauze :-

→ The main function of two gauzes is to prevent the passage of flame from interior lamp for the safety against explosion of sourrounding atmosphere even it contains explosive mixture. The gauze are made of copper wire of 28 ~~mess~~ mesh. While hot combusion gas passes through them part of the heat is absorbed by gauzes which them ~~dispet~~ disspate heat by way of radiation. Thus the temperature of combusion gas leaving the gauze as well as outer gauze temperature below the ignition of fire damp

7) ~~Asbestos~~ BORosil glass :-

→ It is blend of silica and Boron which ~~makes~~ min it reinforced / strong glass

8) Asbestos Ring :-

→ We use Two asbestos rings, one is at the buttom and top of the outer glass are put to make the joint tik proof and prevent the explosion flame gas come outside.

9) Wick Twick holder :-

→ Wick emits the active flame when set out from fire in it. The container which holds the wick is known as wick holder.

10) Wick asbestos :-

→ The pointer passes through a hollow cylinder welded in the oil vessel the flame height can be regulatored by pointer without opening the lamp.

Oil use for lamp :-

i) Kerosene for velox GL-5, non-relighting type flame safety ~~flame~~ lamp.

(ii) Esso - Solvent sprit NO. 1425 and Burman Shell BP-55 for Voler GL-60 and GL-70 relighting type safty lamp.

=oc

Exudation:-

→ Exudation gradual discharge of any gas Especially fire damp from the coal seam due to huge accumulation of gases inside the gap bet two strata or forces with the mineral material.

Factors affecting on spontaneous heating:-

i) chemical composition of coal:-

High moisture and high volatile susceptible to spontaneous heating. All bright coal which 25% or more volatile matter and 7-15% of moisture are prone to spontaneous heating

~~moisture~~

carbon:-

→ High percentage of carbon contain of a coal ~~are~~ is r not conducive (helpful) to S.H where as the coal contents less percentage of carbon are conducive to spontaneous heating

ii) ~~Bonded~~ oxygen:-

→ proness to spontaneous heating of coal decreases with decreasing oxygen content in the volatile matter of coal

ii) Banded constituents of coal:-

→ The bright band of coal i.e vitrain, clarain are more prone to spontaneous heating than the dull constituents i.e durain and fusain.

iii) Friability :-

coal which is easily crossed crushed and broken into smaller size is more prone to spontaneous heating than hard coal.

iv) Presence of Iron pyrite :-

coal containing iron pyrite is more prone to spontaneous heating

Symptoms of spontaneous heating :-

1) smell and resembles burning of timber
2) Increasing in Wet Bulb temperature and dry bulb temperature.
3) water droplets on the surface of metal and timber.
4) Uneasyness in breathing

Note :- Grahm's ratio :-

→ It is the ratio of carbon monoxide (CO) to the oxygen (O_2) in a gassy under ground mine.

→ which shows whether workable condition or not.

Incubation period :-

→ The time elapsed between when coal seam is subjected to S.H and the appearance of action of fire, due to ignition of coal seam as by the rise of temperature it reaches its critical temperature.

Q) In atmosphere contain

N_2 = 79.04%	N_2 = 78.72%
O_2 = 20.93%	O_2 = 19.95%
CO_2 = 0.03%	CO_2 = 0.39%
	CO = 0.005%

In 79.04% N_2 = 20.93% O_2

$$1\ N_2 = \frac{20.93\%}{79.04\%}$$

$$78.72\%\ N_2 = \frac{20.93\%}{79.04\%} \times 78.72\%$$

$$= 20.85\%\ O_2$$

O_2 absorb = 20.85 − 19.95

= 0.9%

CO_2 = 0.39% − 0.03%

= 0.36%

In gram ratio = $\frac{CO_2}{O_2} = \frac{0.36}{0.9} \times 100 = 40\%$

& $\frac{CO}{O_2} = \frac{0.005}{0.9} \times 100 = 0.56\%$

Q) N_2 = 77.57%

O_2 = 18.56%

CO_2 = 0.67%

CO = 0.09

N_2 = 79.04%
O_2 = 20.93%
CO_2 = 0.03%

79.04% N_2 = 20.93% O_2

$$1\ N_2 = \frac{20.93\%}{79.04}$$

$$77.57\%\ N_2 = \frac{20.93\%}{79.04} \times 77.57\%$$

= 20.54% O_2

$O_2 = 20.54 - 18.56$

$= 1.98\%$

$CO_2 = 0.67 - 0.03$

$= 0.64$

In gram ratio $= \frac{CO_2}{O_2} = \frac{0.64}{1.98} \times 100 = 32.32\%$

or $\frac{CO}{O_2} = \frac{0.09}{1.98} \times 100 = 4.54\%$

$N_2 = 79.04\%$	$N_2 = 76.65\%$
$O_2 = 20.93\%$	$O_2 = 17.54\%$
$CO_2 = 0.03\%$	$CO_2 = 0.45\%$
	$CO = 0.006\%$

79.04 N_2 20.93 O_2

$1 N_2 = \frac{20.93}{79.04}$

$76.65\% N_2 = \frac{20.93}{79.04} \times 76.65$

$= 20.29\ O_2$

O_2 absorb $= 20.29 - 17.54$

$= 2.754\ O_2$

$CO_2 = 0.45 - 0.03 = 0.42$

In gram ratio $= \frac{CO_2}{O_2} = \frac{0.42}{2.75} \times 100 = 15.27$

or $\frac{CO}{O_2} = \frac{0.006}{2.75} \times 100$

$= 0.21\%$

Mine Explosion

→ It due to Ignition of fire damp and coal dust

Explosion:-

→ It is sudden or out brust or combustion process of greed intensity which release large amount of energy and gasious product.

Limit of Flammability:

→ methane (CH_4) → lower flammability limit 5.4%.

Limit of flammability mixture:

→ For a mixture of inflammable gases the lower and upper flammability limit can be calculated by A = ghram's law

B = Daltom's law

C = Boil's law

D = Le-chatelier law

Ghram's law:-

→ It is state that of defusion of gas is inversly proportional

$$\frac{\text{rate}_1}{\text{rate}_2} = \sqrt{\frac{m_1}{m_2}}$$

Le-chatelier law:

→ It is used to find out the lower explosibility a combusible mixture of gas.

$$\frac{P_T}{P_{low}} = \frac{P_1}{L_1} + \frac{P_2}{L_2} + \frac{P_3}{L_3}$$

where P_T = Total percentage of combusible gas

P_{low} = lower explosibility of mixture

$P_1 P_2 P_3$ = concentration of indivisual gases in percentage

L_1, L_2, L_3 = lower explosibility limit of indivisual gases

Q)

Conc.	LEL.
$CH_4 = 8\%$	$CH_4 = 5$
$CO = 5\%$	$CO = 12.5$
$H_2 = 3\%$	$H_2 = 4$

$$\frac{P_T}{P_{low}} = \frac{P_1}{L_1} + \frac{P_2}{L_2} + \frac{P_3}{L_3}$$

$$\frac{16}{P_{low}} = \frac{8}{5} + \frac{5}{12.5} + \frac{3}{4}$$

$$\frac{16}{P_{low}} = 1.6 + 0.4 + 0.75$$

$$\frac{16}{P_{low}} = 2.75$$

$$P_{low} = \frac{16}{2.75}$$

$$P_{low} = 5.81$$

NOTE: 1 mole of CH_4 = C atomic mass + 4 A-m

$= 12 + 2 \times 4$

$= 12 + 8$

$= 20$

Coal-dust explosion:

→ It is a sudden combustion process of grade intensity and it has use destructive effect through pressure and heat.

→ Ignition temperature of coal is 600C° - 700C°

Factors Affecting Coal Dust Explosion:

* Particle size:

→ Size of the coal dust ~~explosion~~ 10-100 μm are very dangerous to explosion.

MINE INUNDATION

Inundation :-

→ Sudden leakge of water either from a surface. of water logged area on near by waterbody into active wattering area of a mine.

Measure against inundation :-

i) surface measure

ii) underground measure

i) surface measure :-

→ locating shaft away from water logged area

→ filling with hard material in abonded shaft or borehole.

→ marking diversion reaches.

→ concreat on the surface to chanaize the surface underground.

→ Back filling of surface excavation

→ const. of dump and reserve

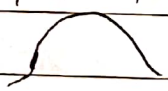
Water dump :-

→ It is a permanet artificial barrier build into the mine working to protect transmission

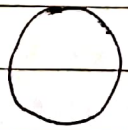
Types of dump :-

i) flat dump 

ii) s cylindercal ramp / Arch 

iii) 

iv) spherical dump



Factor considering to design a damp:-

→ size of the roadway
→ Nature of adjecent strata
→ Estimated water pressure
→ material used for construction
→ shape of damp

Thickness of damp:-

Flat damp / Rectangular damp:-

$$T = \frac{Pbh}{2(b+h)\dot{z}_s}$$

where T = thickness of damp
P = maximum water pressure
b = width of damp
h = height of damp
$\dot{z}_s$ = shear strength of material

Q) calculate the thickness of a flat damp to where as width of damp 5m, height is 8m shearing strength of material 0.15 mp.

ans:- $P = \rho g h$ ⇒ $1000 \times 9.8 \times 8$

$P = 78400$ $\quad 1 mpa = 10^6 p$

$$T = \frac{Pbh}{2(b+h)\dot{z}_s}$$

$$= \frac{78400 \times 5 \times 8}{2(5+8)0.15}$$

$$= \frac{78400 \times 5 \times 8}{26 \times 0.15} = \frac{78400 \times 5 \times 8}{26 \times 1500 \times 100}$$

$$= \frac{3136000}{3900000} = 0.804$$

Q) why Inundation occurs in mines?

→ Inaccuracy old plans.
→ The lake of old plans.
→ error of judgement of neglete or Procusion
→ on suspated presence of old shaft, bore hole or drift connecting to full of water.
→ encroaching into the working of adjecent mines by crossing the common boundary when the state of working is unknown.
→ sudden collapse of water bearing in strata due to faulty method of working.

Water management system:-

→ Revolution of water source
→ Revolution of mine water needs
→ Development of data collection plan and field investigation.
→ water distribution and conveyance
→ Site specific water balance
→ mine de-watering
→ surface water management
→ flood-plain analysis
→ water reservoir and dams.

Noise and Vibration

Noise :-

→ Noise is a any sound whose frequency is greater than Audi. Audible range (i.e 20000 Hz). Noise may damage your hearing and cause other health effects such as i) stress ii) Hyper sensitivity to noise iii) increase blood pressure iv) increase Heart rate.

→ Noise produce in mines is from operation of machines, running in vehicle, drilling, blasting, etc. most people are protected from long term damage in a working day (8 hours) by keeping exposer around 85 db but if noise exposes becomes more intentions, damage may occur in a shoter time.

→ Sudden noise level in excess of the peak exposes standard of 140 db are considered to be hazardous and capable of causing immediately hearing damage.

Identifying Noise Hazard

→ Noise assessment should only be conducted by a competent person and he does the Primilinary assesment to identify the sources of hazardous noise. Any Assesment should be done in consulation with those who understand the work process such as affacted workers there health safety representative

How to Tackle noise pollution :-

→ Sources of excess an disruptive noise which make it difficult to hear a normal voice with in 1m of noise sources.

→ workers

How to tackel noise pollution :

→ keep noise level below the exposure standard of 85db in an 8 hour day for 90 that critical situation can be still be communicate desire noise.

→ substitute noise machinery with quital machine.

→ Introduce engineering control to treat noise at it's source or in it's transmission path such as using sound silencer, noise barrier or Pactation or isolation

Accesment of noise during blasting :

→ Blasting posses various health problems due to intense noise and vibration created during explosion.

Blasting limits surface mining	Sensitive or commercial place criteria
Airblast overpressure	115 db peak for 9/10 consutative blast and not greater than 120 db peak at any time.
Ground vibration & Particle velocity	5mm/s peak particle velocity for 9/10 consutative blast and not greater than 10mm/s peak particle.

Accumulation Test

→ It is done with normal flame.

→ Accumulation test is done before percentage test to detect percentage of CH_4 above 4%.

→ In accumulation test the length of flame rises suddenly by the burning of combusible gas mixture burn inside the chamber.

→ The accuracy in accumulation test can't be achived when the percentage of CH_4 lies between 1.5% – 4%.

→ when flame sprues or jumps the percentage of gas taken nearly 3% or more.

Percentage Test

→ but it is done with testing flame.

→ while percentage test done after accumulation test if the percentage of CH_4 is below 4%.

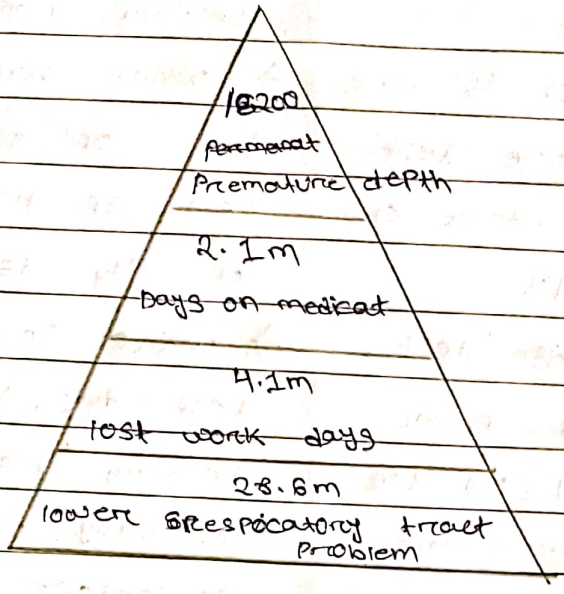
→ while in percentage test the length of testing flame rises gradually with the increase percentage of CH_4.

→ The accuracy in percentage test can be achived when the percentage of CH_4 lies between 1.5 – 4%.

→ In unnecessarly to conduct the percentage test when the flame sprues or in a safety lamp as it is decleard that the gas percentage is not less than 3%.

Occupational diseases in mines :- (IMP)

Cases with lower respiratory tract problem :-



Pneumoconiosis :-

→ The alveoli and pulmonary lymphnode at mostly affected by dust partical

Silicusis :-

→ Silicusis is often fatal lung disease caused by breathing dust containg crystelline silica particle. A basic componets sand and Gircmaite.

→ There not cure for silicusis.

Symptos :-

→ Shortness of breath

→ Fever

→ Bluelsh skin at the carr lobe and lips

As the disease progress it makes fatigue of lungs, extream shortness, loss of apptite, cheast pain and respiratory fellure.

Asbestosis :-

→ Asbestos fiber get into the organ while breathing are ↓ Esophagus ↓ Pleural membrane ↓ Diaphragm ↓ Abdomen ↓ Heart ↓ larynx

Black lung Returns :-

→ This is one of the most serious diseases facing by workers in coal industry.

→ The mining boom and new longwall mining technique have exposed more miners to more dust.

Vibration :-

→ Hole body vibration occur from operating large mobile equipment driller, hammer, pile driver, tractor, excavator etc.

Mine Illumination

Illumination

→ Remove the darkness is known as Illumination

Severity index:

→ It is a parameter to check the proness to accident in mines.

$$\boxed{S.I > 12}$$

$$S.I = \frac{(50f + s) \times 100000}{\text{man shift worked}}$$

f = fatal accident

s = serious to bodily injured

Q) Accident records of a coal mine revels that 3 fatality and 8 serious injury in 2003. with the total man shift worked during the same period way 390000.

ans :-

$$SI = \frac{(50f + s) \times 100000}{\text{man shift worked}}$$

$$= \frac{(50 \times 3 + 8) \times 100000}{390000}$$

$$= \frac{158 \times 100000}{390000}$$

$$= \frac{1580}{39}$$

$$= 40.51$$

Q) An underground coal mining employing 1200 person experienced roof faulting in union resultant 12 roof fall injury during 2005. The injury per 1000 person employing during 2005.

ans:- 1200 person 12 roof faling

1 person roof faling = 12/1200

1000 person roof faling = $\frac{12}{1200} \times 1000$

= 10

Mine Rescue:-

Accumpalation and accident data analysis:-

Accident:-

Bad event:-

=> freaveney Rate (employmest basis)

=> $\frac{\text{no. of person involve in accident}}{\text{total employe worked}} \times 1000$

=> freaveney Rate (production Rate)

$\frac{\text{no. of person involve in accident}}{\text{Total production}} \times 1 \text{ lakh}$

Q) what is the freaveney rate of accident of a mine where employing of 5000 person and there was a 8 total injury, 3 Reportable injury and 3 miner injury.

ans:- $\frac{\text{no. of accident}}{\text{total employee worked}} \times 1000$

= $\frac{8}{5000} \times 1000 = \frac{8}{5} = 1.8$

Q) 500 coal miners were randomly selected from an under ground coal mine. It was found that 50 workers experienced injury in the year 2014. The contribution of a injury based on younger age group (age ≤ 40 years) and old age group (age > 40 group)

Age	injured	non-injured	Total
Young	120 (A)	130 (B)	150
old	30 (C)	320 (D)	350
	50	450	500

The add injury for younger age group as compared to older age group.

ans :- Odds Ratio = $\frac{AXD}{BXC} = \frac{20 \times 320}{30 \times 130} = \frac{64}{39} = 1.64$

Relative Risk = $\frac{\frac{a}{a+b}}{\frac{c}{c+d}} = \frac{\frac{20}{150}}{\frac{30}{350}} = \frac{20}{150} \times \frac{350}{30} = \frac{70}{45}$

$= 1.55$

Attributed risk = $\frac{a}{a+b} - \frac{c}{c+d} = \frac{20}{150} - \frac{30}{350}$

$= \frac{2}{15} - \frac{3}{35}$

$= \frac{14-9}{105}$

$= \frac{5}{105}$

$= \frac{1}{21}$

Illumination

→ Illumination is the providely of light to the darkness area to enable worker to visualize equipments and sites where there worker.

→ It is a illuminuess flux (ϕ) per unit area.

$$E = \frac{\phi}{A}$$

Unit of limuness flux = lemen

Unit of illumination = lux

$$1 \text{ lux} = \frac{1 \text{lemen}}{1 m^2}$$

lumination intensity :-

$$I = \frac{\phi}{\omega} \text{ (solid angle)}$$

→ Unit of lumination intensity is candel

$$\text{solid angle } (\omega) = \frac{\text{area}}{(\text{radious})^2}$$

→ Unit of solid angle is sterridiam

Mean spherical candla power :-

→ It is the avarage candela power of a lamp in all direction.

$$\text{MSCP} = \frac{\text{flux}}{\text{solid angle}} = \frac{\text{lumen}}{\omega}$$

$$\text{MSCP(I)} = \frac{\text{lumen}}{4\pi} \quad (\because \text{spherical or solid angle } 4\pi)$$

$$\text{lumen} = \text{MSCP} \times 4\pi$$

→ measurment of solid angle is Goniometer.

Laws of Illumination :- (V.V.I)

Laws-1

→ According to this law illumination of a surface is inversely proportional to the square of distance between the source and surface.

1st law is

$$E = \frac{I}{d^2}$$

Laws-2

→ Illumination is directly proportional to the cosine between the normal to the surface and direction of incident light.

$$E = \frac{I}{d^2} * \cos\theta$$

Mine Rescue and Re-covery

Proto mark IV apparatus :-

→ It consist of

a) A light alloy hollow cylinder of 2 liter capacity containing 300 liter of oxygen compressed to 150 kg/cm². It is fitted with mainvalve the pressure gauge valve, A bypass valve A reducing valve The main valve is the cylinder closing and opening valve which is kept open by locking device when the apprratus is in use. The reducing valve the reduces of the pressure oxygen supplied to the wearer and ensure 2 liter oxygen per minute. The Bypass valve in manually operated by the wearer if the reducing valve fail or when the wearer needs more oxygen then the supplied by the reducing valve. The pressure gauge valve admids high pressure oxygen to the pressure gauge.

b) Breathing bag is made of bulcanised rubber and devided into 2 compactmest by a partition. The bag contents 2 kg of CO_2 absorbent known as protosorb. It is the mixture of calcium hydroside and caustic soda, it keeps the percentage of CO_2 in the breathing circuit below 2%.

c) A cooling chambert of cupper containing sodium phosphate which is an crystal form an ordinary temperature.

d) Inhalation and exhalation valve and relief valve. The relief valve allows the escape of any oxygen in excess of wearer reavirement.

e) Nosecliip, mouthpicee inhalation and exhalation tube.