AIR POLLUTION –

{ Vehicle's are much more harmful than Industry.

~~St~~

Formation of Ozone in –

(1) Stratosphere → $O_3 \rightleftharpoons O_2 + O\cdot$

(2) Troposphere → $NO_2 \xrightarrow{h\nu} NO + O\cdot$

$O_2 + O \xrightarrow{[N_2]} O_3$

Pollutants → (i) Primary → CO_2.

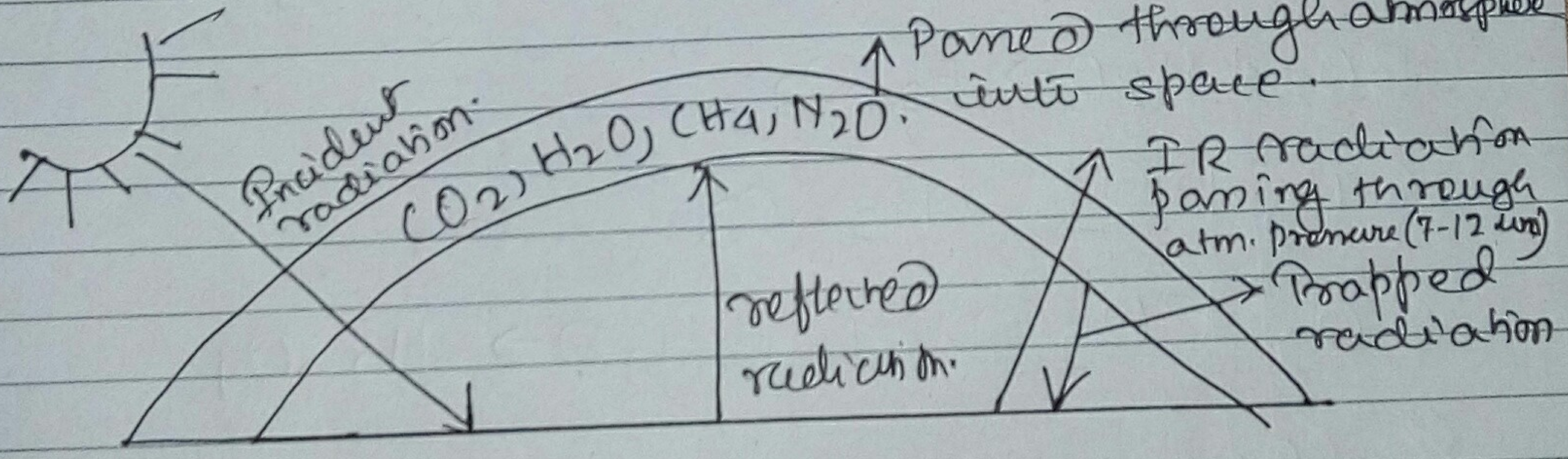
(ii) Secondary.

→ Not generally produced (Ozone)

(iii) Criteria.

↳ CO, Pb, SO_2, Particulate matter.

O_3, NO_2.



If all heat in the atmosphere leaves the earth surface then the avg. temp. of each would have been −39°C. But since it is not its temp. avg. is 15°C.

(*) Green house effect → natural warming effect.

(*) CO_2 is the major global warming causing gas.

(*) CO_2 absorbs maximum wavelength.

(*) Glass has to have thickness to stop some radiation

Acid rain

$NO_3 + H_2O \rightarrow HNO_3$.
$NO_2 + H_2O \rightarrow HNO_3$ (oxides).

water vapour + acid → aerosolic component / acid droplets.
→ comming down to earth.

Acid formed ⇒ floating with water ⇒ become larger droplet ⇒ come down as acid rain.

$NO_2 + NO_3 \rightarrow N_2O_3 + H_2O \rightarrow HNO_3$.

$SO_2 + H_2O \rightarrow H_2SO_3$.

$SO_2 + O_2 \rightarrow H_2SO_3$.

$SO_2 + O_2 \rightarrow SO_3 + H_2O \rightarrow H_2SO_4$.

Consequence

Calcium carbonate + $H_2SO_4 \rightarrow CO_2 + H_2O + CaSO_4$
($CaCO_3$)

Smog = smoke + fog : {having water droplets with pollutants}.

Types

(i) Sulphurous fog (Dangerous)
(ii) Photochemical fog / Nitrogenous Smog.

Photochemical	Sulphurous.
i) Sunlight in must.	i) evening.
ii) 20°C.	ii) 4-5°C.
iii) $O_3 / NO_2 / N_2O$.	iii) SO_2.
iv) Oxidising Smog.	iv) Reducing Smog.

Temp inversion → high altitude high temperature
↳ Reason → smog formation.

Ozone depletion → (i) Cyclic reaction.
(ii) Photochemical reaction.

CFC → Chloro Fluoro Carbon.

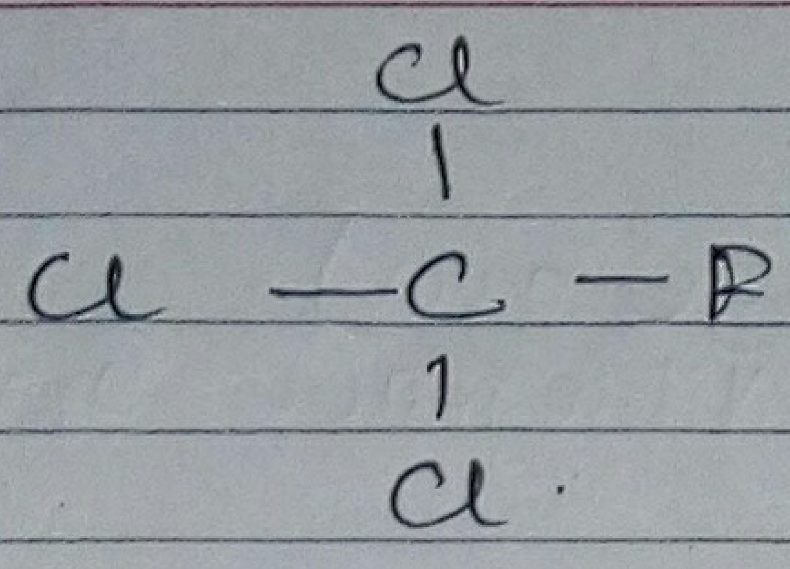
$\underbrace{CFCl_3, CFCl_2}$ → Ozone layer.

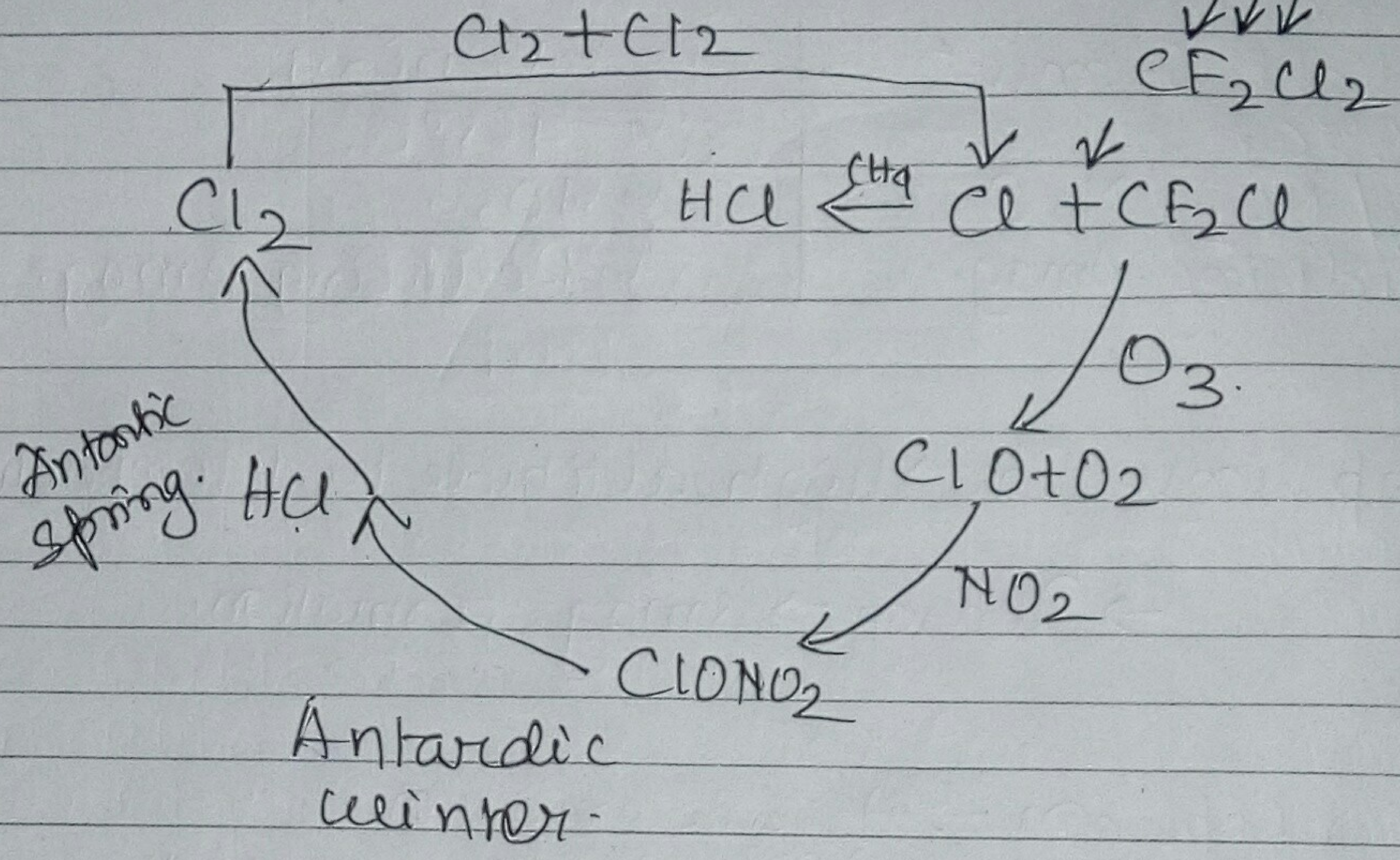
90% of ozone in stratosphere rest is in troposphere.

CFC-11
CFC-113

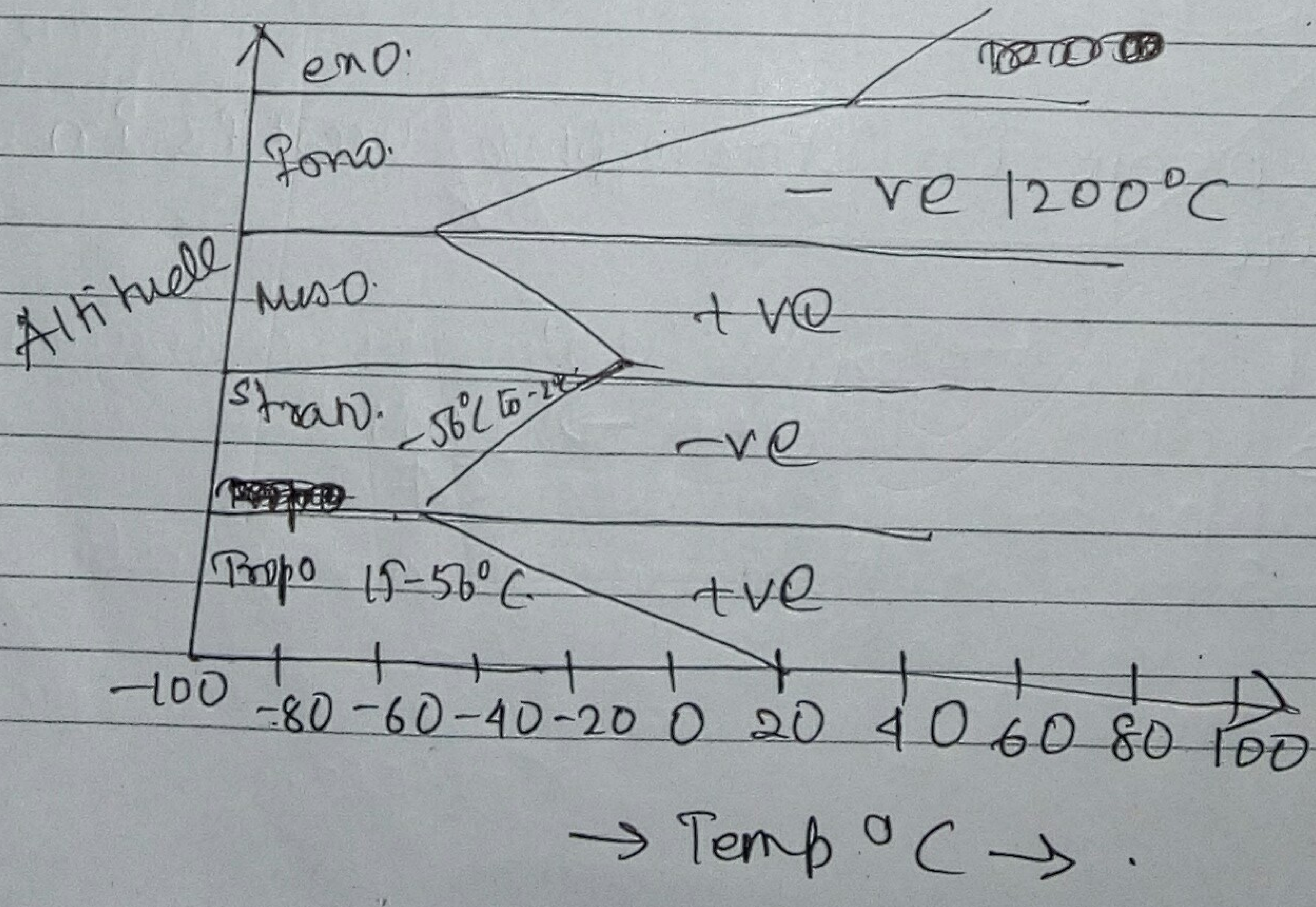
rule '90'
$90 + 11 \rightarrow \frac{101}{CF}$

Number System.





Mateoriology



@ Orunayan Bhattacharya @

ELR → Environmental Lapse Rate.
→ rate of change ~~environment~~ temperature in the environment.

Adiabatic Lapse Rate (ALR)
→ change of temperature considering air as a packet of system or air.

Packet of air is saturated the
→ Saturated / Wet Adiabatic Lapse Rat.

Lapse Rate → rate of change of temperature.

Dry Adiabatic Lapse rate
→ unsaturated air packed.

DALR > SALR.

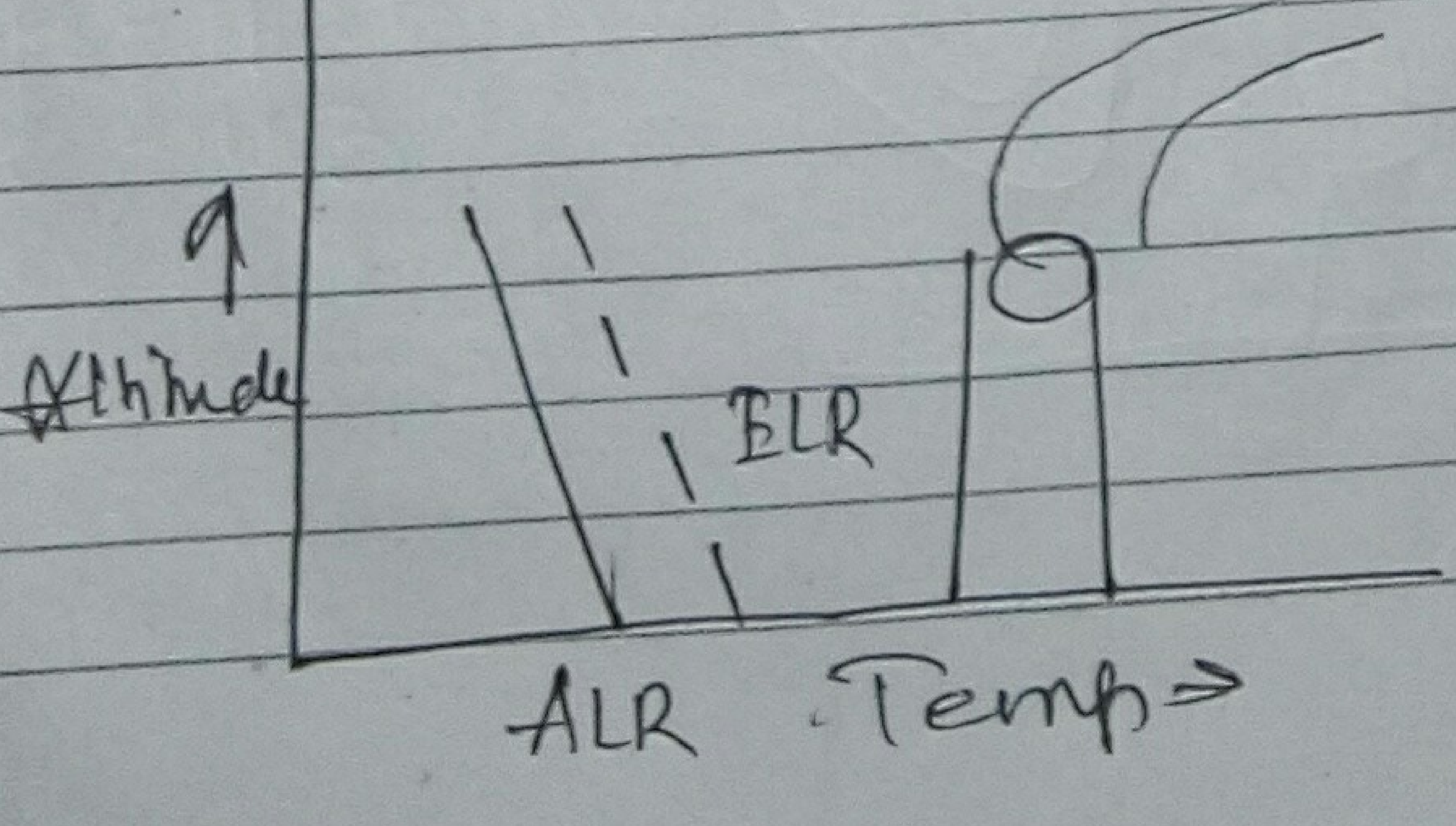
The Smoke gets dispersed when the temp. is equal to the atm.

① Stack Height
② Plume Height } Effective Stack Height
↓
Actually height of the dispersion of the pollutants.

$H = h + \Delta h$.

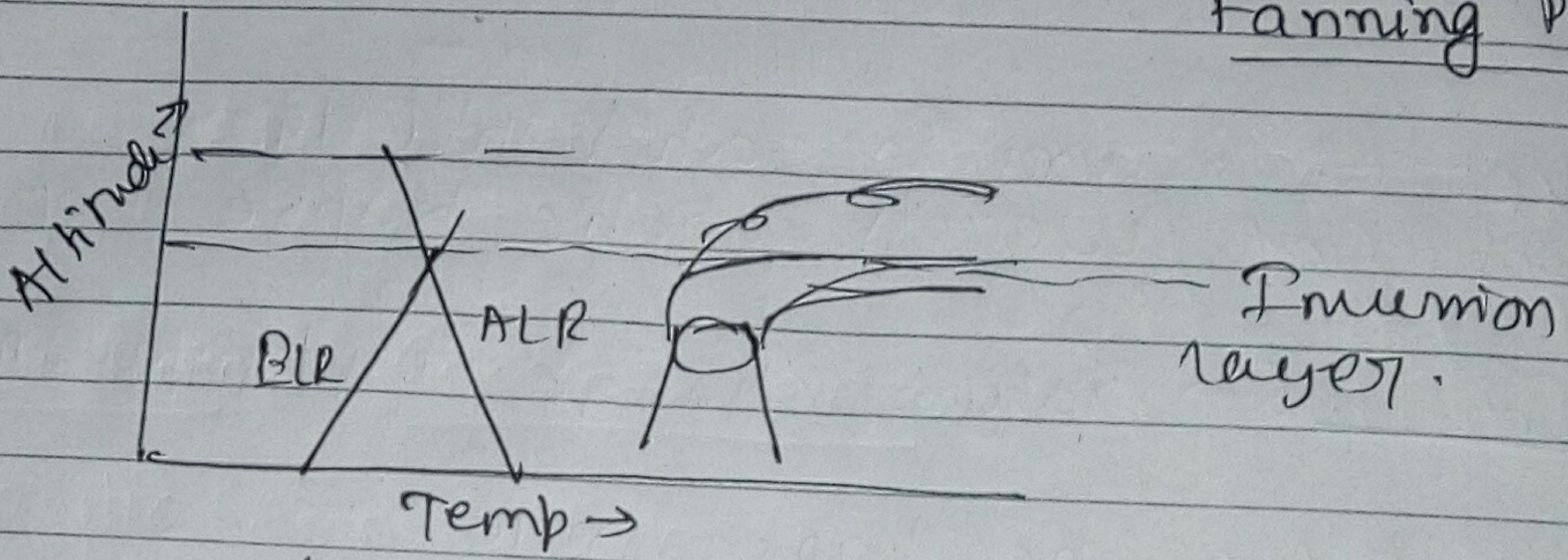
(*) What is the importance of Stack Height?

Coning Plume.



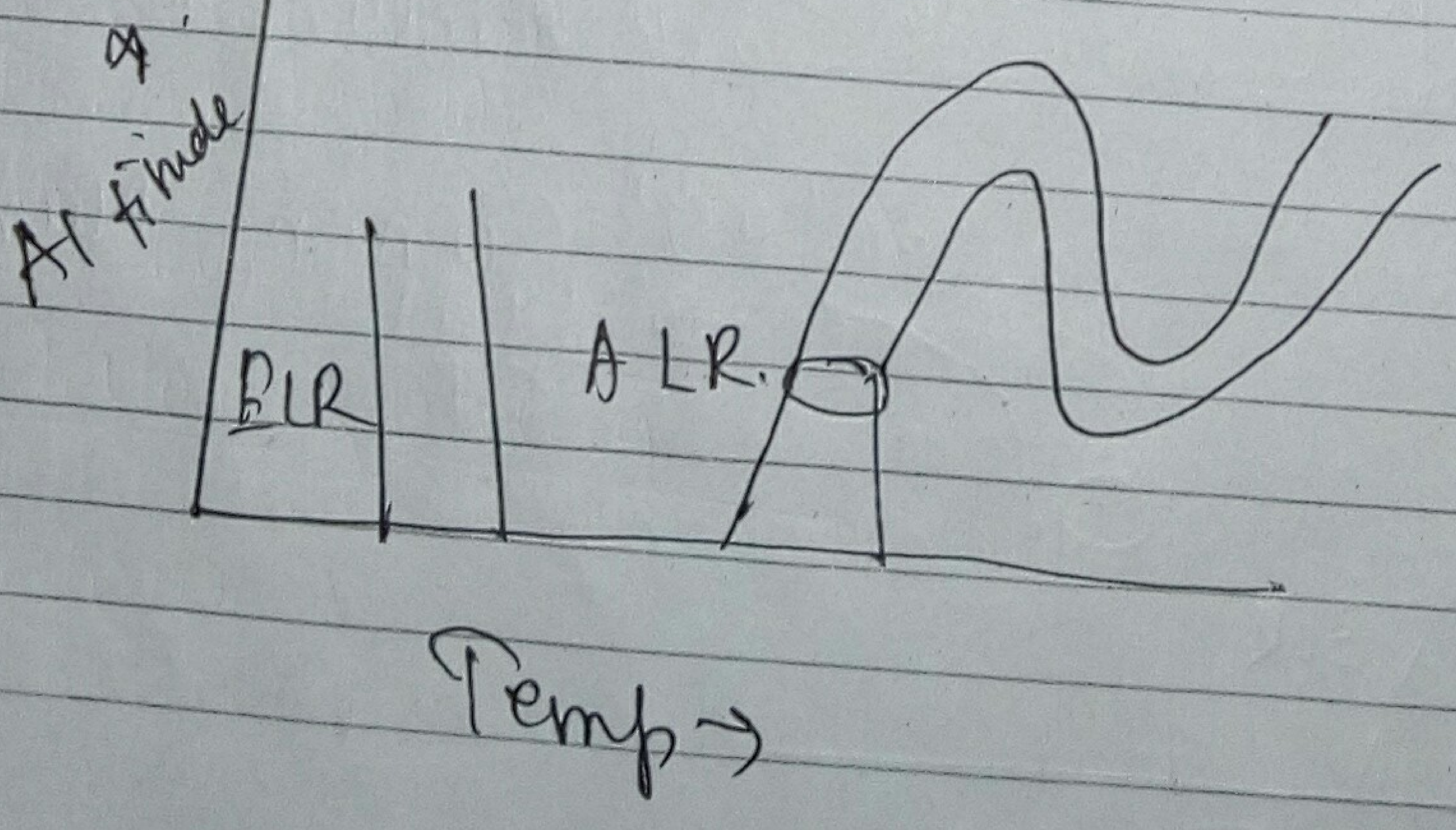
(1) ALR > ELR.
(2) Sub Adiabatic Environment.
(3) Limited vertical mixing.
(4) Stable environment, with small turbulance
(5) turbulance → air movement low.

Fanning Plume



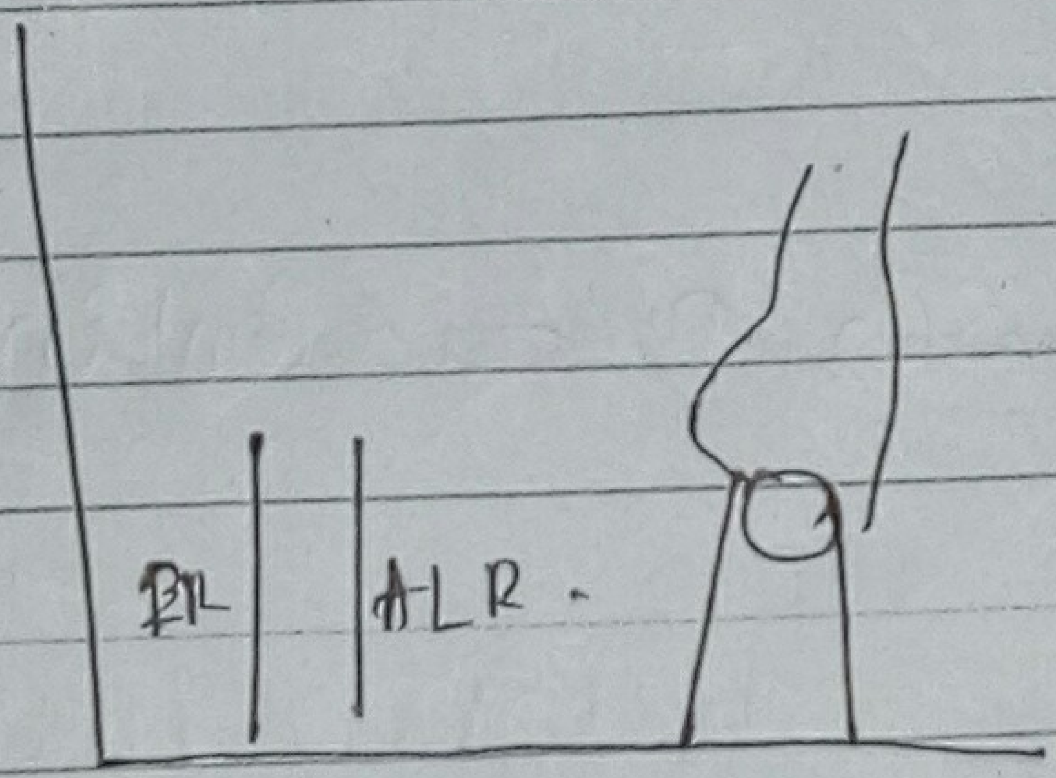
(1) Negative Lapse Rate.
(2) Stack Height is below the inversion layer.
(3) Stable environment
(4) Plume gets stuck below the inversion layer, reason for ~~fog~~ smog formation.

Looping Plume



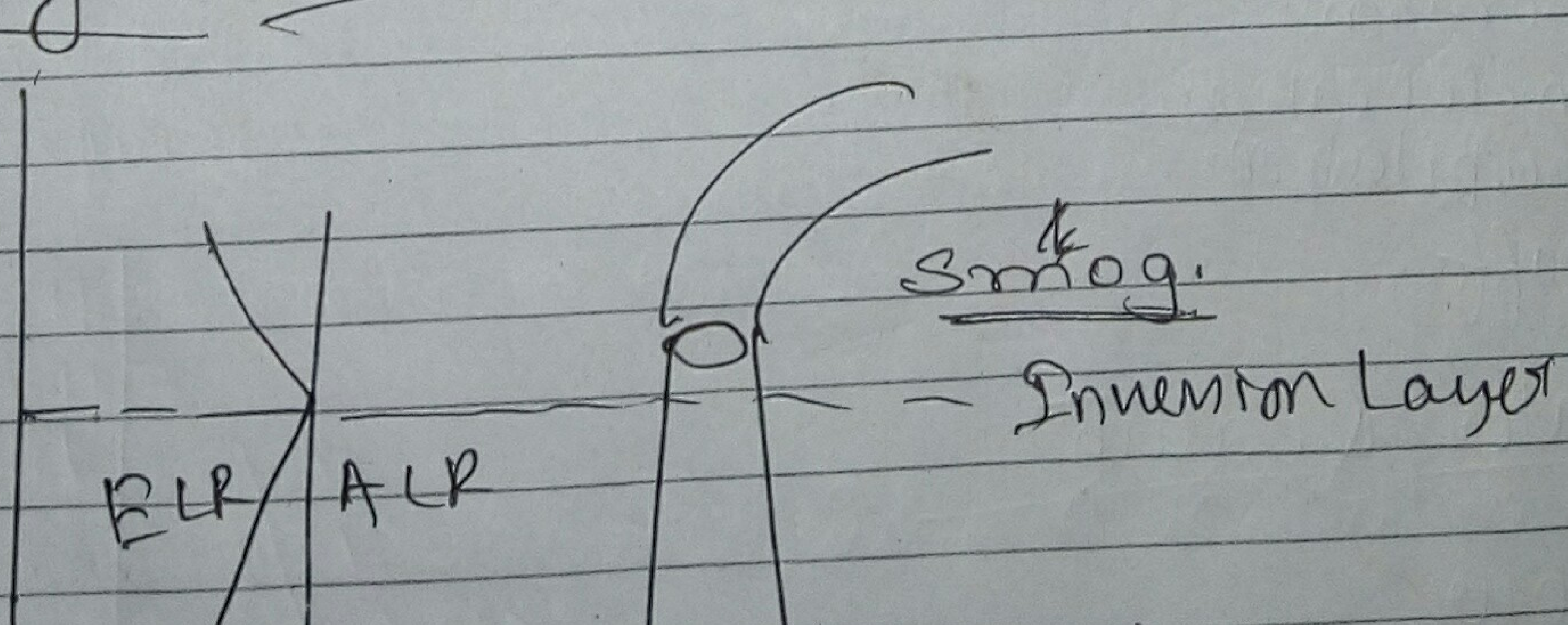
(1) ELR > ALR.
(2) Super Adiabatic.
(3) Unstable Environment / Rapid Air movement.
(4) The plume goes upward, due to environmental airmovement the plume may come down, / and might interfare in the lower troposphere. In such a case Stack height has to be heigher to ensure that the pollutant is going up / not disturbing the lower troposphere

Nutral Plume



(1) ALR = ELR.
(2) Environment is nutral.
(3) Plume does n't go high up.

Lofting Plume



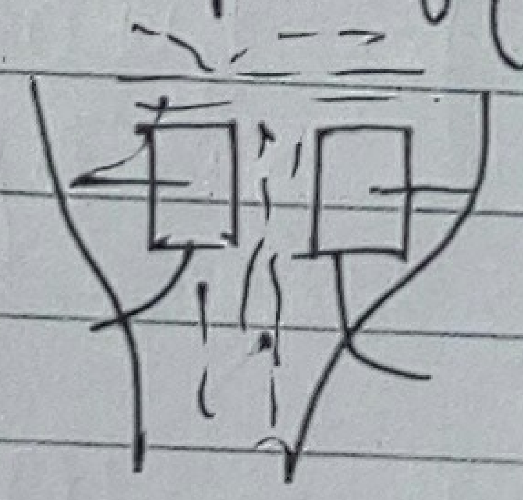
(1) Stackheight is above inversion layer.

(2) Above inversion layer it is super adiabatic. ELR > ALR.
(3) Above inversion layer environment is unstable.
(4) It is ~~good~~ better situation for dispersion of pollutants.

ELR > ALR → better for dispersion.

Air Pollution Control Devices

(1) Catalytic Convertors. (Mechanism, advantage, disadvantages)
(2) Electro Static Precipitator.
(3) Bag-House Filter.
(Problem → If moist air, SO_2, or Acid Contain).
→ They trap fly ashes.



Water Pollution

- Evaporation.
- Condensation.
- Precipitation.
- Run off.

Water Quality

- Colour
- Odour / Smell.

- Nutrient content.
- Dissolved solids.
- Dissolved oxygen.
- Sunlight Penetration.
- Organic Content. (Hydrocarbons).

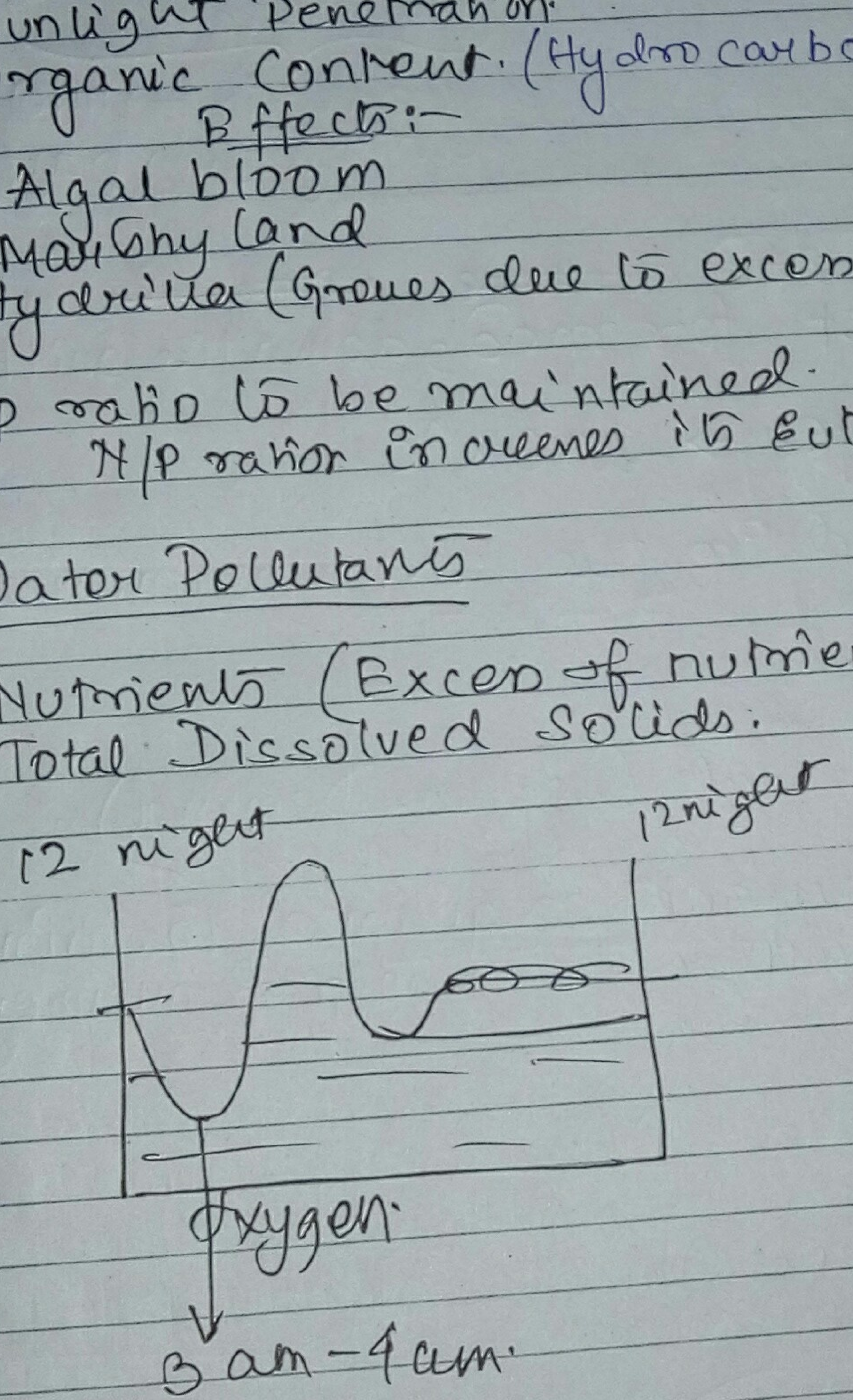
Effects:-

→ Algal bloom
→ Marshy land
→ Hydrilla (Grows due to excess Nutrients)

N/P ratio to be maintained.
If N/P ratio increases it's Eutrophication.

Water Pollutants

- Nutrients (Excess of nutrients). → Phosphorus.
- Total Dissolved Solids.



Diurnal variation of DO.

Dissolved oxygen parameter → Required for deciding → good & bad water.

Antrophogonic → Organic matter entering in a water.

~~4y~~ Organic matter + $O_2 \xrightarrow{\text{Microorganisms}} CO_2 + H_2O + SO_4$
$+ PO_3 + NO_3$
+ Some undegraded materials.

Coal is formed using this part.

Coal is formed ~~where~~ ~~coal is~~ where oxygen is not formed, down the soil layer.

Lack of oxygen → anoxic.

Coal is formed in the extreme anoxic part.

BOD (Biochemical Oxygen Demand).

→ Amount of oxygen required to disintegrate organic matter, with help of micro-organisms.

$$BOD = DO_i - DO_f$$

DO = Dissolved Oxygen.

Amount of oxygen consumed
= Amount of ~~&~~ micro-organisms.

Higher the BOD, higher is the micro-organism (i.e. dirty).

$$BOD_5 = \frac{DO_i - DO_f}{P}$$

P = dilution factor. $= \frac{V_w}{V_m} = \frac{\text{Vol. of waste}}{\text{Vol. of mixture.}}$

Precaution for BOD exp:—

① No photosynthetic organism.
② No air-space or contamination by aerial oxygen.
③ The temp. should be maintained.
④ Has to Be kept away from sunlight.

Seeded dilution Method (Type of measuring BOD)

$$BOD_m V_m = BOD_W V_W + BOD_d V_d.$$

suffix d → dilution.
" w → waster
" m → mixture.

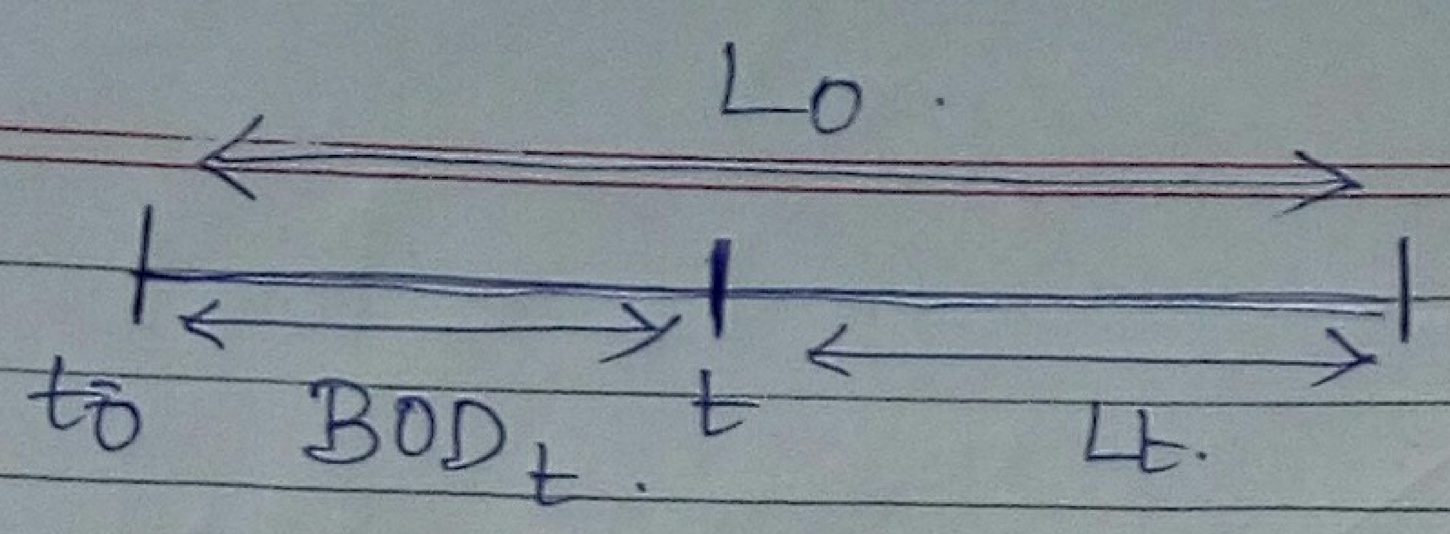
$$\text{So, } BOD_W = \frac{BOD_m V_m - BOD_d V_d}{V_W}$$

$$= BOD_m \frac{V_m}{V_W} - BOD_d \frac{V_d}{V_m}$$

$$= BOD_m \frac{V_m}{V_W} - BOD_d \frac{V_d}{V_m} \times \frac{V_m}{V_W}.$$

$$= BOD_m \frac{1}{P} - BOD_d \frac{1}{P}(1-P).$$

$$= \frac{1}{P}\left[BOD_m - BOD_d(1-P)\right].$$



$$BOD_t = L_0 - L_t = L_0 - L_0 e^{-kt}$$
$$= L_0 (1 - e^{-kt})$$

$$\frac{dL_t}{dt} \propto -L_t$$

$$\int_0^t \frac{dL_t}{L_t} = -k \int_0^t dt$$

$$\ln L_t - \ln L_0 = -kt$$

$$\ln \frac{L_t}{L_0} = -kt$$

$$\therefore L_t = L_0 \cdot e^{-kt}$$

(*) A BOD test is done using 50 ml of mixed water, using 100 ml of pure water. The initial dissolved oxygen of the mixture is 6 mg per litre & after 5 days it becomes 2 mg/L. After a long time the DO remained fixed at 1 mg/l.

(i) What is the BOD_5 of waster water?
(ii) Remaining BOD after 5 days.
(iii) What is the ultimate BOD.
(iv) What will the reaction when contant, when measured at 35°C temp ($K_{20} = 0.322$)

~~Soln~~ Hint:—

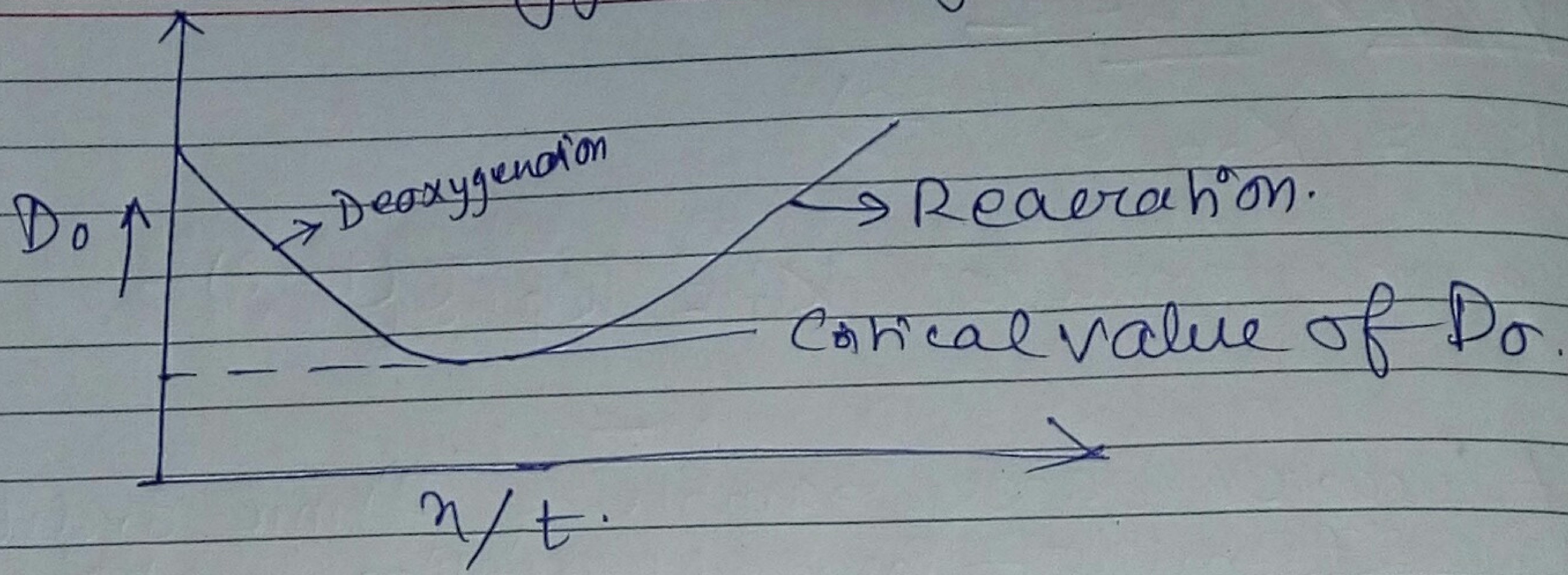
$$K_T = K_{20}\,\theta^{(T-20)}$$

General formulae, $K_T = K_i\,\theta^{(T-i)}$

(*) A waster water sample of 25ml is diluted by 275 ml of seeded dilution water. The initial dissolved oxygen is 5 milligram/L. & after 5 days it is 3 milligram/L. If the seeded dilution of water is $D_i = 10$ mg/L. & ~~final~~ $D_f = 8$ mg/L, find the BOD_5 of the waster water.

Soln:—

Oxygen Dag Curve.



Rate of Deoxygenation $\propto$ Amout of waste matter present at that point of time (dt)
(D).

→ rate of reaeration is dependen on deficiency of oxygen.