# **Environmental** Chemistry

### **TOPIC 1**

Atmospheric Pollution

**01** In stratosphere most of the ozone formation is assisted by

[2021, 27 Aug Shift-II]

(a) cosmic rays (b)γ-rays (c) ultraviolet radiations (d) visible radiations

#### Ans. (c)

In the stratosphere, the UV-light causes the splitting of  $O_2$  molecule into oxygen atoms. These atoms react with oxygen present in the air to form ozone.

 $O_{2}(q) \xrightarrow{\text{UV radiation}} O(q) + O(q)$ 

 $O_2(g) + UV \text{ radiation} \qquad O_3(g)$ 

Ozone

Therefore, the option (c) is correct.

02 The gas 'A' is having very low reactivity reaches to stratosphere. It is non-toxic and non-flammable but dissociated by UV-radiations in stratosphere. The intermediates formed initially from the gas 'A' are [2021, 27 Aug Shift-I]

#### (a)CIO + CF<sub>2</sub>CI (b)CIO + CH<sub>3</sub> (c)CH<sub>3</sub> + CF<sub>2</sub>Cl $(d)CI + CF_2CI$

#### Ans. (d)

The gas is chlorofluoro carbon. Its reaction in stratosphere is as follows :

(i)  $CCI_2 F_2 + UV \text{ light} \longrightarrow CCIF_2 + CI$ (ii)  $CCI_3 F + UV \text{ light } \longrightarrow CCI_2 F + CI$ (iii) CI +  $O_3 \longrightarrow CIO + O_2$ 

 $(iv)CIO + O \longrightarrow CI + O_2$ So, the intermediate in first step are ČI + CCIF, .

#### 03 Match List I with List II.

	List I (Compound)		<b>List II</b> (Effect/affecte d species)
Α.	Carbon monoxide	١.	Carcinogenic
Β.	Sulphur dioxide	.	Metabolised by pyrus plants
C.	Polychlorinated biphenyls	.	Haemoglobin
D.	Oxides of nitrogen	IV.	Stiffness of flower buds

#### Choose the correct answer from the options given below :

		-		-	[2021, 2	27 Ju	ly S	hift-	-11]
	А	В	С	D	А	В	С	D	
(a)		IV			(b) IV	Ι		Ш	
(c)	Ι			IV	(d) III	IV		Τ	
Δ.		()							

#### Ans. (a)

- A. If haemoglobin binds CO, it prevents the binding of  $O_2$  to haemoglobin due to the competition for same binding sites.
- B. Higher conc. SO<sub>2</sub> in air can cause stiffness of flower buds.
- C. Polychlorinated biphenyls are carcinogenic (cancer causing) in humans as well as animals.
- D. Certain plants, e.g. pinus, Juniparus, quercus, pyrus and vitis can metabolise nitrogen oxides. Hence, the correct match is  $A \rightarrow (III), B \rightarrow (IV), C \rightarrow (I), D \rightarrow (II).$

**04** Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R). Assertion(A) Photochemical smog causes cracking of rubber.

**Reason**(R) Presence of ozone, nitric oxide, acrolein, formaldehyde and peroxyacetyl nitrate in photochemical smog makes it oxidising.

#### Choose the most appropriate answer from the options given below. [2021, 26 Aug Shift-II]

(a) Both (A) and (R) are true but (R) is not the correct explanation of (A).

- (b) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (c) (A) is false but (R) is true.
- (d) (A) is true but (R) is false.

#### Ans. (b)

Both Assertion and Reason are true and Reason is the correct explanation of Assertion. Smog is a type of intense air pollution.

It is composed of nitrogen oxides, sulphur oxides, ozone, smoke and other particulates. Rubber is an organic compound and it is sensitive to number of chemical influences-oxidation, reduction etc. Excessive cracking of rubber products can be one of the indicators of the presence of atmospheric photochemical oxidants. Excessive cracking of rubber is caused by atmospheric ozone formed in the photochemical smog formation process.

**05** Given below are two statements :

**Statement I** Chlorofluoro carbons break down by radiation in the visible energy region and release chlorine gas in the atmosphere which then reacts with stratospheric ozone.

**Statement II** Atmospheric ozone reacts with nitric oxide to give nitrogen and oxygen gases, which add to the atmosphere.

For the above statements choose the correct answer from the options given below :

#### [2021, 25 July Shift-II]

- (a) Statement I is incorrect but statement II is true
- (b) Both statement I and II are false
- (c) Statement I is correct but statement II is false
- (d) Both statement I and II are correct

#### Ans. (b)

Chlorofluoro carbons are broken down by powerful UV radiation and releases chlorine free radical which reacts with ozone and start chain reaction.

 $CF_2Cl_2(g) \xrightarrow{UV} Cl(g) + CF_2Cl(g)$ 

 $C^{\bullet}(g) + O_3(g) \longrightarrow C^{\bullet}O(g) + O_2(g)$ 

 $C^{\bullet}(g) + O(g) \longrightarrow C^{\bullet}(g) + O_2(g)$ 

#### ∴Statement (I) is incorrect.

Atmosphere ozone reacts with nitric oxide to produce nitrogen dioxide and oxygen.

 $NO(g) + O_3(g) \longrightarrow NO_2(g) + O_2(g)$  $\therefore$ Statement (II) is also incorrect.

#### 06 Which one of the following gases is reported to retard photosynthesis? [2021, 20 July Shift-II]

(a)CO (b)CFCs (c)CO<sub>2</sub> (d)NO<sub>2</sub> **Ans.** (d)

From the given gases,  $NO_2$  is the gas which damage the leaves of plants and retard the photosynthesis. Higher concentration of  $NO_2$  damage the leaves of plants and retard the rate of photosynthesis.

- **07** The statements that are true.
  - (A) Methane leads to both global warming and photochemical smog.
  - (B) Methane is generated from paddy fields.

- (C) Methane is a stronger global warming gas than CO<sub>2</sub>.
- (D) Methane is a part of reducing smog.

Choose the most appropriate answer from the options given below [2021, 18 March Shift-I] (a)(A), (B), (C) only (b)(A) and (B) only (c)(B), (C), (D) only (d)(A), (B), (D) only

#### Ans. (a)

Methane leads to both global warming and photochemical smog. Order of contribution of global warming gas

 $CO_2 > CH_4 > CFC > O_3 > N_2O > H_2O$ 

- Methane is generated in large amounts from paddy fields. CH<sub>4</sub> is 40 times stronger greenhouse gas than CO<sub>2</sub>.
- CO<sub>2</sub> can be absorbed by photosynthesis or by formation of acid rain etc., while no such activities are there for methane.
- It has more heating effects. Hence, methane is stronger global warming gas than CO<sub>2</sub>.

• Methane is not a part of reducing smog. Hence, statements (*A*), (*B*) and (*C*) are true.

## 08 Reducing smog is a mixture of [2021, 17 March Shift-I]

(a) smoke, fog and O<sub>3</sub> (b) smoke, fog and SO<sub>2</sub> (c) smoke, fog and CH<sub>2</sub> == CH---CHO (d) smoke, fog and N<sub>2</sub>O<sub>3</sub>

#### Ans. (b)

Classical smog (reducing smog) occurs in cool humid climate, it is a mixture of smoke, fog and  $SO_2$ .

It is a reducing mixture/smog.

Reducing smog = smoke + fog + SO<sub>2</sub> Note Photochemical smog occurs in warm, dry and sunny climate. The main components of the photochemical smog result from the action of sunlight on unsaturated hydrocarbons and nitrogen oxides produced by automobiles and factories. Photochemical smog has high concentration of oxidising agents and is therefore, called as oxidising smog.

**09** The greenhouse gas/es is (are)

(A) carbon dioxide(B) oxygen(C) water vapour(D) methane

#### Choose the most appropriate answer from the options given below. [2021, 16 March Shift-II] (a) Only (A) and (C) (b) Only (A) (c) (A), (C) and (D) (d) Only (A) and (B)

#### Ans. (c)

Greenhouse gases are carbon dioxide, methane, water vapours, nitrous oxide, CFCs and ozone. The greenhouse effect is a natural process that warms the Earth's surface. When the Sun's energy reaches the Earth's atmosphere, some of it is reflected back to space and the rest is absorbed and re-radiated by greenhouse gases. The absorbed energy warms the atmosphere and the surface of the Earth.

## **10** The type of pollution that gets increased during the day time and in the presence of $O_3$ is

#### [2021, 16 March Shift-I]

(a) reducing smog (b) oxidising smog (c) global warming (d) acid rain

#### Ans. (b)

Oxidising smog (photochemical smog) gets increased during the day time and in the presence of  $0_3$ .

It occurs in warm, dry and sunny climate. When fossil fuels are burnt, hydrocarbons (unburnt fuels) and nitric oxide (NO) are produced. Ozone reacts rapidly with the NO to generate NO<sub>2</sub>.

 $NO(g) + O_3(g) \longrightarrow NO_2(g) + O_2(g)$ 

Ozone is a toxic gas and both NO<sub>2</sub> and O<sub>3</sub> are strong oxidising agents and can react with the unburnt hydrocarbons in the polluted air to produce chemicals such as formaldehyde, acrolein and peroxyacetyl nitrate (PAN).

**11** Given below are two statements. **Statement I** The pH of rain water is normally ~ 5.6.

**Statement II** If the pH of rain water drops below 5.6, it is called acid rain.

In the light of the above statements, choose the correct answer from the options given below. [2021, 25 Feb Shift-II]

- (a) Both statements I and II are true.
- (b) Both statements I and II are false.
- (d) Statement I is true but statement II is false.
- (d) Statement I is false but statement II is true.

#### Ans. (a)

The pH of rain water is normally 5.6. If it pH drop below 5.6, it is called acid rain. ... Both statements are correct.

**12** Given below are two statements:

**Statement I** An allotrope of oxygen is an important intermediate in the formation of reducing smog.

**Statement II** Gases such as oxides of nitrogen and sulphur present in troposphere contribute to the formation of photochemical smog.

In the light of the above statements, choose the correct answer from the options given below. [2021, 25 Feb Shift-I]

- (a) Both statement I and statement II are true.
- (b) Both statement I and statement II are false.
- (c) Statement I is true but statement II is false.
- (d) Statement I is false but statement II is true.

#### Ans. (d)

Reducing smog is a mixture of smoke, fog and sulphur dioxide. Therefore, statement I is false.

Tropospheric pollutants such as nitrogen oxide and sulphur oxide contribute to the formation of photochemical smog. So, statement II is true.

**13** The gas released during anaerobic degradation of vegetation may lead to [2021, 24 Feb Shift-I]

(a) acid rain

(b) global warming and cancer(c) corrosion of metals(d) ozone hole

Ans. (b)

Methane ( $CH_4$ ) gas is evolved due to anaerobic degradation of vegetation which causes global warming and cancer. It is a heat trapping gas that forces the planet to warm drastically and quickly.

- 14 The statement that is not true about ozone is [2020, 2 Sep Shift-I]
  - (a) in the stratosphere, CFCs release chlorine free radicals (CI), which

reacts with  $\mathrm{O}_3$  to give chlorine dioxide radicals

- (b) in the atmosphere, it is depleted by CFCs
- (c) in the stratosphere, it forms a protective shield against UV radiation.
- (d) it is a toxic gas and its reaction with NO gives  $\ensuremath{\mathsf{NO}}_2$

#### Ans. (a)

Statement (a) is not true whereas all the given statements are true.

In the stratosphere, CFCs release chlorine free radicals (Cl<sup>•</sup>) which reacts with  $O_3$  to give chlorine monoxide (ClO<sup>•</sup>) radicals but not chlorine dioxide radicals.

**15** Thermal power plants can lead to

(a) acid rain [2020, 3 Sep Shift-I]

(b) blue baby syndrome (c) ozone layer depletion

(d) eutrophication

#### Ans. (a)

Thermal power plants emit oxides of nitrogen (NO<sub>2</sub>) and sulphur (SO<sub>2</sub>) in the atmosphere which are converted into  $HNO_3$  and  $H_2SO_4$ , respectively in the pressure of rain water ( $H_2O$ ).

$$4NO_2 + O_2 + 2H_2O \longrightarrow 4HNO_3$$
$$SO_2 + \frac{1}{2}O_2 + H_2O \longrightarrow H_2SO_4$$

Their presence in rain water becomes acidic (pH < 5.6) and it is called acid rain. 'Blue baby syndrome' is the condition due to poor oxygen transportation in the blood, resulting in blueness of the skin in babies.

Ozone layer depletion takes place due to the attack of chlorofluorocarbon(CFCs) to ozone molecules.

'Eutrophication' is associated with water pollution when huge quantities of phosphates and nitrates are released into aquatic ecosystem.

- **16** The incorrect statement(s) among (A) (D) regarding acid rain is (are) :
  - (A) It can corrode water pipes.
  - (B) It can damage structures made up of stone.
  - (C) It cannot cause respiratory ailments in animals.
  - (D) It is not harmful for trees. [2020, 3 Sep Shift-II]

(a)(C) and (D)

- (b)(A),(C) and (D)
- (c)(C)only
- (d)(A), (B) and (D)

#### Ans. (c)

Statements (A), (B) and (D) are correct whereas (C) is incorrect. Corrected statement is as follows : Acid rain can cause health problems in people. It causes respiratory aliments in human being and animals.

17 Among the gases (A)-(E), the gases that cause greenhouse effect are : [2020, 8 Jan Shift-I]

 $\begin{array}{cccc} (A)CO_2 & (B)H_2O \\ (C)CFCs & (D)O_2 \\ (E)O_3 \\ (a)(A), (B), (C) and (D) \\ (b)(A) and (D) \\ (c)(A), (B), (C) and (E) \\ (d)(A), (C), (D) and (E) \end{array}$ 

#### Ans. (c)

 $CO_2$ ,  $H_2O$ , CFCs and  $O_3$  are green house gases. These gases trap the UV-radiations coming from the sun and heat up the earth. Thus, heating up of earth is called green house effect.

**18** Assertion (A) Ozone is destroyed by CFCs in the upper stratosphere.

**Reason (R)** Ozone holes increase the amount of UV radiation reaching the earth.

[2019, 8 April Shift-I]

- (a) Assertion and Reason are incorrect.
- (b) Assertion and Reason are both correct and the Reason is the correct explanation for the Assertion.
- (c) Assertion and Reason are correct, but the Reason is not the explanation for the Assertion.
- (d) Assertion is false, but the Reason is correct.

#### Ans. (c)

Ozone is destroyed by CFCs in the upper stratosphere.

These compounds ultimately reach the stratosphere where they get broken down by powerful UV radiations and release chlorine free radical. The chlorine free radicals react with ozone and cause its depletion by converting it into chlorine monoxide radical and molecular oxygen.

$$CF_2 Cl_2(g) \xrightarrow{h\nu} Cl(g) + \overset{c}{C}F_2 Cl(g)$$
$$CFCl_3(g) \xrightarrow{h\nu} CFCl_2(g) + \overset{c}{C}l(g)$$
$$\overset{c}{C}l(g) + O_3(g) \longrightarrow Cl\overset{c}{O}(g) + O_2(g)$$

Ozone holes increase the amount of UV radiation reaching the earth. These radiations can cause skin cancer, sunburns, ageing of skin.

## **19** Excessive release of CO<sub>2</sub> into the atmosphere results in

#### [2019, 9 April Shift-I]

- (a) formation of smog
- (b) depletion of ozone
- (c) polar vortex
- (d) global warming

#### Ans. (d)

The effect of release of  $CO_2$  gas into atmosphere is global warming.

20 The layer of atmosphere between 10 km to 50 km above the sea level is called as [2019, 9 April, Shift-II]

(a) stratosphere (b) mesosphere (c) thermosphere (d) troposphere

#### Ans. (a)

The atmosphere between the heights 10 to 50 km above the sea level is stratosphere. Atmosphere is not of the same thickness at heights.

**21** The regions of the atmosphere, where clouds form and where we live, respectively, are

#### [2019, 10 April, Shift-I]

(a) stratosphere and stratosphere(b) troposphere and troposphere(c) troposphere and stratosphere(d) stratosphere and troposphere

#### Ans. (b)

The lowest region of atmosphere is troposphere which extends upto the height of 10 km (approx) from sea level. We live in the tropospheric region. It contains air, water vapour and dust which can form clouds with the help of strong air movement.

Above the troposphere, stratospheric region extends upto 50 km from sea level. It contains mainly N<sub>2</sub>,  $O_2$ ,  $O_3$  and little water vapour.  $O_3$  in the stratosphere absorbs 99.5% of the sun's harmful UV raditions and thus protects the lives on the earth.

#### **22** Air pollution that occurs in sunlight

is	[2019, 10 April, Shift-II]
(a) acid rain	(b) oxidising smog
(c) fog	(d) reducing smog

#### Ans. (b)

In sunlight oxidising smog or photochemical smog or Los-Angeles smog is formed. This smog is brown in colour. It occurs in warm, dry and sunny climate. In presence of sunlight,  $NO_x$  (N-oxides),  $O_z$  and unburnt hydrocarbons of air combine to produce photochemical smog which mainly contains peroxyacetyl nitrate (PAN).



23 The correct set of species responsible for the photochemical smog is [2019, 12 April Shift-I]

(a)  $N_2$ ,  $NO_2$  and hydrocarbons (b)  $CO_2$ ,  $NO_2$ ,  $SO_2$  and hydrocarbons (c) NO,  $NO_2$ ,  $O_3$  and hydrocarbons (d)  $N_2$ ,  $O_2$ ,  $O_3$  and hydrocarbons

#### Ans. (c)

The correct set of species responsible for the photochemical smog is  $N0, N0_2$ ,  $0_3$  and hydrocarbons. Photochemical smog appears in warm, dry and sunny climate which are obtained by the action of sunlight on unsaturated hydrocarbons and nitrogen oxides. Following reactions are involved during the formation of photochemical smog.

(i)  $N_2(g) + O_2(g) \longrightarrow 2NO(g)$ (Originates from burning of fossil fuels)

(ii)  $2NO(g) + O_2(g) \xrightarrow{\text{Sunlight}} 2NO_2(g)$ 

 $NO_2(g) \xrightarrow{hv} NO(g) + [0]$ Nascent oxygen

(iii)  $O(g) + O_2(g) \rightleftharpoons O_3(g)$ Reacts rapidly with NO

 $O_3(g) + NO(g) \longrightarrow NO_2(g) + O_2(g)$ Brown gas (in high

concentration form haze)

 $3CH_4(g) + 2O_3(g) \longrightarrow 3CH_2 = O(g)$ Formaldehyde (Unburnt hydrocarbon)

> +  $CH_2 = CHCH = 0 + H_20$ Acrolein

**24** The primary pollutant that leads to photochemical smog is

#### [2019, 12 April Shift-II]

(a) acrolein (c) ozone (b) nitrogen oxides (d) sulphur dioxide

#### Ans. (b)

The primary pollutant that leads to photochemical smog is nitrogen oxides. Burning of fossil fuels such as petrol and diesel in automobiles, reaction between nitrogen and oxygen and other such reactions result in a variety of pollutants, two main of which are hydrocarbons (unburnt fuel) and nitric oxide (NO).

$$N_2(g) + O_2(g) \xrightarrow{\text{In petrol and}} 2NO(g)$$

When the concentration of these pollutants is sufficiently high, a chain reaction initiate because of the interaction of sunlight with oxides of nitrogen.

#### $2NO(q) + O_2(q) \xrightarrow{\text{Sunlight}} 2NO_2(q)$

 $\begin{array}{c} \mathrm{NO}_2(g) \xrightarrow{h\mathbf{v}} \mathrm{NO}(g) + \begin{bmatrix} 0 \end{bmatrix} \\ \underset{\text{O}_3(g)}{\overset{\text{Nocent}}{\overset{\text{NO}_2(g)}{$ 

#### **25** The pH of rain water, is approximately (a) 7.5 (b) 6.5 (c) 5.6 (d) 7.0

(c	1)7.0	
[2	2019, 9 J	an Shift-II]

#### Ans. (c)

In clean air, rain water picks up some acidic oxides like  $CO_2$  and  $SO_2$  (obtained from volcanic eruptions). These substance make the rain slightly acidic (pH = 5.6 - 6). But, when rain falls through polluted air, it consumes oxides of sulphur (SO<sub>x</sub>) and oxides of nitrogen (NO<sub>x</sub>), mists of HCl etc. They make the rain more acidic (called acid rain) of pH range 3.5 to 5.6.

26 The reaction that is not involved in the ozone layer depletion mechanism in the stratosphere is

 (a)CH<sub>4</sub> + 20<sub>3</sub> → 3CH<sub>2</sub> = 0 + 3H<sub>2</sub>0

 $(b)ClO(q) + O(q) \longrightarrow Cl(q) + O_2(q)$ 

(c)HOCl(g)  $\xrightarrow{hn}$   $\stackrel{\bullet}{O}$ H(g) +  $\stackrel{\bullet}{C}$ I(g) (d)CF<sub>2</sub>Cl<sub>2</sub>(g)  $\xrightarrow{hn}$   $\stackrel{\bullet}{C}$ I(g) +  $\stackrel{\bullet}{C}$ F<sub>2</sub>Cl(g)

#### [2019, 10 Jan Shift-II]

#### Ans. (a)

 $CH_4$  is not present in the stratosphere and also it cannot diffuse or escape into the stratosphere like freon-12 ( $CF_2CI_2$ ) from the atmosphere.

In the stratosphere, ozone layer depletion take place mainly by chlorofluorocarbons (CFCs) like  $CF_2Cl_2$  and the mechanism of ozone layer depletion can be shown as:

bu

(i) 
$$CF_2Cl_2(g) \xrightarrow{HV} Cl(g) + CF_2Cl(g)$$
  
[Option, (d)  
(ii)  $Cl(g) + O_3(g) \longrightarrow ClO^{\bullet}(g) + O_2$   
(iii)  $ClO^{\bullet}(g) + O(g) \longrightarrow Cl^{\bullet}(g) + O_2(g)$   
[Option (b)]  
(iv)  $Cl(g) + H_2O(g)$   
[Present in the

stratosphere]  $\rightarrow$  HOCl(q) + H<sup>•</sup>(q) (v) HOCI(g)  $\xrightarrow{hv} OH(g) + CI^{\bullet}(g)$ [Option(c)]

 $\Rightarrow$  One Cl<sup>•</sup> can destroy or deplete 10<sup>5</sup> O<sub>3</sub> molecules.

As (i) reaction is involved in the formation of photochemical smog, not in ozone layer depletion. So, option (a) is correct.

27 Taj Mahal is being slowly disfigured and discoloured. This is primarily due to [2019, 11 Jan Shift-II]

- (a) water pollution
- (b) soil pollution

(c) global warming

(d) acid rain

#### Ans. (d)

Acid rain (pH = 3.5 - 5.6) constitutes strong acids like HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub> and H<sub>2</sub>SO<sub>3</sub> which slowly react with marble (CaCO<sub>3</sub>) of Taj Mahal and make it disfigured and discoloured.

Here,  $CaCO_3$  (marble) gets dissolved in acids.

 $CaCO_{3}(s) \xrightarrow{2 H^{\oplus}(aq)} Ca^{2+}(aq) + H_{2}O(I) + CO_{2}(q) \uparrow$ 

**28** The molecule that has minimum/no role in the formation of photochemical smog, is

	[2019, 12 Jan Shift-I]
(a)N <sub>2</sub>	$(b)CH_2 = 0$
(c)NO	(d)0 <sub>3</sub>

#### Ans. (a)

 $N_2$  molecule has minimum role in the formation of photochemical smog. While  $CH_2 = 0, 0_3$  and NO has major role. When fossil fuels are burnt, a variety of pollutants are emitted.

Two of them are hydrocarbons (unburnt) and NO. When these pollutants build upto high levels, a chain reaction occurs from their interaction with sunlight. The reactions involved in the formation of photochemical smog are as follows:

 $NO_2(g) \xrightarrow{hv} NO(g) + O(g)$ 

$$O(g) + O_2(g) \Longrightarrow O_3(g)$$

 $NO(g) + O_3(g) \longrightarrow NO_2(g) + O_2(g)$   $O_3$  reats with unburnt hydrocarbons to produce chemicals such as formaldehyde, acrolein and PAN.

$$\begin{array}{c} 3\text{CH}_4 + 2\text{O}_3 \longrightarrow 3\text{CH}_2 = \text{O} + 3\text{H}_2\text{O} \\ + \text{CH}_2 = \text{CCH} = \text{O} + \text{CH}_3 \begin{array}{c} \text{COONO}_2 \\ \parallel \\ 0 \\ \text{(PAN)} \end{array}$$

29 The compound that is not a common component of photochemical smog is
(a) CF<sub>2</sub>Cl<sub>2</sub> (b)H<sub>3</sub>C—C—

a) CF<sub>2</sub>Cl<sub>2</sub> (b)H<sub>3</sub>C—C—OONO<sub>2</sub>

(c)  $CH_2 = CHCHO$  (d)  $O_3$ 

#### [2019, 12 Jan Shift-II]

#### Ans. (a)

Freons or CFCs or chlorofluoro carbons, i.e.  $CF_2CI_2$  is not the common component of photochemical smog. This smog is produced as the result of tropospheric pollution while freons are the components of stratospheric pollution. These are infact considered as the major cause of ozone layer depletion.

**30** The upper stratosphere consisting of the ozone layer protects us from the sun's radiation that falls in the wavelength region of

	[2019, 12 Jan Shift-II]
(a) 600-750 nm	(b) 400-550 nm
(c) 0.8-1.5 nm	(d) 200-315 nm

#### Ans. (d)

Sun emits UV-radiations, which according to following EM categorisation have the wavelength range from 1 nm to 400 nm.

Туре	Wavelength range
Radio wave	> 0.1 m
Microwave	0.1 m to 1 mm
Infrared wave	1 mm to 700 nm
Visible rays	700 nm to 400 nm
Ultraviolet rays	400 nm to 1 nm
X-rays	1 nm to 10 <sup>-3</sup> nm
Gamma rays	< 10 <sup>-3</sup> nm

Thus, option (d) with 200-315 nm range is the correct option.

**31** Assertion (A) Nitrogen and oxygen are the main components in the atmosphere but these do not react to form oxides of nitrogen.

**Reason** (R) The reaction between nitrogen and oxygen requires high

- temperature. [JEE Main 2015]
- (a) Both Assertion and Reason are correct and the reason is the correct explanation for the Assertion.
- (b) Both Assertion and Reason are correct but the reason is not the correct explanation for the Assertion.

- (c) The Assertion is incorrect but the Reason is correct.
- (d) Both the Assertion and Reason are incorrect.

#### Ans. (a)

Nitrogen is an inert gas because of the presence of strong bond. That's why although there is 78% N<sub>2</sub> in the atmosphere but nitrogen oxide in not formed under ordinary conditions. But when temperature is high enough i.e.  $\approx 2000$  K, it reacts with oxygen to form nitrogen oxide.

 $N_2 + O_2 \xrightarrow{\approx 2000 \text{ K}} 2\text{NO}$ 

Thus, Assertion and Reason are true and Reason is the correct explanation of the Assertion.

- **32** The gas leaked from a storage tank of the Union Carbide plant in Bhopal gas tragedy was
  - (a) Methylisocyanate [JEE Main 2013]
  - (b) Methylamine
  - (c) Ammonia
  - (d) Phosgene

#### Ans. (a)

Methylisocyanate  $CH_3 \longrightarrow C \implies O(MIC gas)$  gas was leaked from the storage tank of the union carbide plant in Bhopal gas tragedy.

## **33** Identify the incorrect statement from the following [AIEEE 2011]

- (a) Oxides of nitrogen in the atmosphere can cause the depletion of ozone layer
- (b) Ozone absorbs the intense ultraviolet radiations of the sun
- (c) Depletion of ozone layer is because of its chemical reactions with chlorofluoro alkanes
- (d) Ozone absorbs infrared radiations

#### Ans. (d)

$$NO + O_3 \longrightarrow NO_2 + O_2$$
$$O_3 + hv \longrightarrow O_2 + O$$

 $NO_2 + 0 \longrightarrow NO + O_2$ 

- (a) Net reaction 20<sub>3</sub> + hv → 30<sub>2</sub> Thus, ozone layer is depleted by oxides of nitrogen. Thus, (a) is correct statement.
- (b) Ozone layer is a protective layer and absorbs harmful UV rays from the sun.

Thus, (b) is also correct statement.

(c)  $CI + O_3 \longrightarrow CIO + O_2$ 

 $0_3 + hv \longrightarrow 0^{\bullet} + 0_2$ 

 $C|0 + 0 \longrightarrow C| + 0_2$ Net reaction  $20_3 + hv \longrightarrow 30_2$ Thus, ozone layer is also depleted by reaction with freons. Thus, (c) is also correct statement.

(d) It is a incorrect statement as ozone layer is permeable for UV rays. Thus, correct answer is (d).

#### **34** Identify the wrong statements in the following [AIEEE 2008]

- (a) Chlorofluorocarbons are responsible for ozone layer depletion
- (b) Green house effect is responsible for global warming
- (c) Ozone layer does not permit infrared radiation from the sun to reach the earth
- (d) Acid rain is mostly because of oxides of nitrogen and sulphur

#### Ans. (c)

Ozone layer permits the infrared radiation to pass through but doesn't permit the higher range of ultraviolet radiation to pass through.

#### **35** The smog is essentially caused by the presence of **FAIEEE 20041**

- (a)  $O_2$  and  $O_3$
- (b)  $O_2$  and  $N_2$

(c) oxides of sulphur and nitrogen

(d)  $O_3$  and  $N_2$ 

#### Ans. (a)

Smog is formed by the action of sunlight on unsaturated hydrocarbons and nitrogen oxides.

Smog mainly contains higher concentration of Peroxyacetyl nitrate (PAN) formed by the reaction of  $NO_2$ ,  $O_3$ and unsaturated hydrocarbons.

$$NO_2 \xrightarrow{hv} NO + O$$

 $0 + 0_2 \longrightarrow 0_3$  $NO + O_3 \longrightarrow NO_2 + O_2$ 

 $NO + O_3 +$  unsaturated hydrocarbons → PAN

#### 36 When rain is accompanied by a thunderstorm, the collected rain water will have a pH value [AIEEE 2003]

#### (a) slightly lower than that of rain

- water without thunderstorm (b) slightly higher than that when the
- thunderstorm is not there

- (c) uninfluenced by occurrence of thunderstorm
- (d) which depends on the amount of dust in air

#### Ans. (a)

Т

During thunderstorm, there is formation of NO which changes to NO and ultimately to HNO<sub>3</sub> (acidrain<sup>2</sup>).

$$N_2 + O_2 \longrightarrow NO \xrightarrow{O_2} NO_2$$
  
 $4NO_2 + O_2 + 2H_2O \longrightarrow 4HNO_3$   
[pH<7]

Water and Soil Pollution

37 Water sample is called cleanest on the basis of which one of the BOD values given below

#### [2021, 1 Sep Shift-II]

(a) 11 ppm (c)3 ppm

#### Ans. (c)

BOD is the biological oxygen demand. Cleanest water sample will have BOD value equal to  $(SO_2)$  3 ppm as clean water could have BOD value of less than 5 ppm.

#### **38** BOD values (in ppm) for clean water (A) and polluted water (B) are expected respectively

(a) A > 50, B < 27(b) A > 25, B < 17(c)A < 5, B > 17(d) A > 15, B > 47

#### Ans. (c)

BOD value of clean water is less than 5 ppm. So, A < 5 BOD value of polluted water is greater than 17 ppm.

So, B > 17

Thus, correct option is (c).

#### **39** Which one of the following statements is not correct? [2021, 27 July Shift-I]

- (a) Eutrophication indicates that water body is polluted.
- (b) The dissolved oxygen concentration below 6 ppm inhibits fish growth.
- (c) Eutrophication leads to increase in the oxygen level in water.
- (d) Eutrophication leads to anaerobic conditions.

#### Ans. (c)

Statement (c) is not correct as eutrophication leads to decrease in oxygen level. Eutrophication means well nourished. It occur in following four simple steps:

- Lakes in many parts of the Earth have been severly eutrophied by sewage, agricultural industrial wastes.
- The contaminents are rich in nitrate and phosphate, spark the over growth of algae in water bodies.
- When algae forms, it blocks sunlight from entering water and user up oxygen. Eventually, water becomes oxygen depleted.
- Finally, this oxygen depleted water becomes a dead zone and can no longer support life.
- **40** Given below are two statements Statement | Non-biodegradable wastes are generated by the thermal power plants.

Statement II Bio-degradable detergents leads to eutrophication.

In the light of the above statements, choose the most appropriate answer from the option given below.

#### [2021, 18 March Shift-II]

- (a) Both statements I and II are false.
- (b) Statement I is true but statement ll is false.
- (c) Statement I is false but statement ll is true.
- (d) Both statements I and II are true.

#### Ans. (d)

Non-biodegradable wastes are generated by the thermal power plants which produces fly ash. Detergents which are biodegradable causes problem called eutrophication, which kills aquatic life by deprieving it of oxygen. Hence, both statements are true.

**41** Which of the following statement(s) is (are) incorrect reason for eutrophication?

- A. Excess usage of fertilisers.
- B. Excess usage of detergents.
- C. Dense plant population in water bodies.
- D. Lack of nutrients in water bodies that prevent plant growth.

(b) 15 ppm

(d)21ppm

[2021, 31 Aug Shift-I]

#### Choose the most appropriate answer from the options given below. [2021, 17 March Shift-II]

(a) Only A (c) B and D

(b) Only C (d) Only D

#### Ans. (d)

Statement (D) is incorrect.

As eutrophication is the gradual increase in the concentration of phosphorus, nitrogen, and other plant nutrients in an aging aquatic ecosystem such as a lake. The productivity or fertility of such an ecosystem naturally increases as the amount of organic material that can be broken down into nutrients increases.

42 Given below are two statements. Statement I The value of the parameter "Biochemical Oxygen

Demand (BOD)" is important for survival of aquatic life.

**Statement II** The optimum value of BOD is 6.5 ppm.

In the light of the above statements, choose the most appropriate answer from the options given below.

#### [2021, 24 Feb Shift-II]

- (a) Statement I is false but statement II is true.
- (b) Both statements are true.
- (c) Statement I is true but statement II is false.
- (d) Both statements are false.

#### Ans. (c)

Statement I is true but statement II is false.

Clean water would have BOD value of less than

5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

Hence, the value of parameter 'BOD' is important for survival of aquatic life but optimum value of BOD is 17 ppm or more. So, statement II is incorrect.

#### 43 The condition that indicates a polluted environment is [2020, 5 Jan Shift-I]

(a) pH of rain water to be 5.6

- (b) eutrophication
- (c) BOD value of 5 ppm

(d) 0.03% of  $\rm CO_2$  in the atmosphere

#### Ans. (b)

In this process large quantities of phosphates and nitrates are released

into water. It enables rapid growth of bacteria and algae in water and then microorganism use so much oxygen, enough oxygen in not left for other animals living in the water.

In eutrophication nutrient enriched water bodies support a dense plant population, which kills animal life by depriving it of oxygen and results in subsequent loss of biodiversity. It indicates polluted environment.

44 Biochemical oxygen demand (BOD) is the amount of oxygen required (in ppm) [2020 Jan Shift-II]

- (a) for the photochemical breakdown of waste present in 1m<sup>3</sup> volume of a water body.
- (b) for sustaining life in a water body.
- (c) by anaerobic bacteria to breakdown inorganic waste present in a water body.
- (d) by bacteria to breakdown organic waste in a certain volume of a water sample.

#### Ans. (d)

B.O.D is defined as the amount of oxygen (ppm) required by bacteria to breakdown organic waste in certain volume of a water sample.

**45** Which is wrong with respect to our responsibility as a human being to protect our environment?

#### [2019, 8 April Shift-I]

(a) Restricting the use of vehicles

- (b) Avoiding the use of floodlighted facilities
- (c) Setting up compost tin in gardens
- (d) Using plastic bags

#### Ans. (d)

Using plastic bags is wrong with respect to responsibility as a human being to protect our environment. Plastic bags are non-biodegradable in nature. It remains in the environment as such and does not degraded by bacteria. If it is not disposed properly then it may lead serious threat to the environment. The activities that can be used to protect our environment are as follows:

- Restricting the use of vehicles.
- Avoiding the use of flood lighted facilities.
- Setting up compost tin in gardens.

#### 46 The maximum prescribed

concentration	of copper in drinking
water is	[2019, 8 April Shift-II]
(a) 5 ppm	(b) 0.5 ppm
(c) 0.05 ppm	(d) 3 ppm

#### Ans. (d)

According to W.H.O. and US environmental protection agency guidelines, maximum allowable concentration of metals in drinking water are as follows :

Metal	<b>Maximum concentration</b> (ppm or mgdm <sup>-3</sup> )
Cd	0.005
Mn	0.05(option-c)
Al	0.2
Fe	0.2
Cu	3.0 (option-d)
Zn	5.0 (option-a)

# **47** The concentration of dissolved oxygen (DO) in cold water can go upto

	[2019, 11 Jan Shift-I]
c)8ppm	(d) 16 ppm
a) 14 ppm	(b) 10 ppm

#### Ans. (b)

Dissolved oxygen (DO) is the oxygen dissolved in water either from atmosphere or by photosynthesis. The lower the concentration of DO in a water sample, the more polluted is the water sample.

The concentration range of dissolved oxygen (DO) in cold water reaches upto 10 ppm, but that in normal water (at room temperature) is within 5 ppm.

#### **48** A water sample has ppm level concentration of the following metals: Fe = 0.2; Mn = 5.0; Cu = 3.0; Zn = 5.0. The metal that makes the water sample unsuitable for drinking

is	[2019, 9 Jan Shift-I]
(a) Cu	(b) Fe
(c) Mn	(d) Zn

#### Ans. (c)

For drinking water, the maximum recommended levels of some metals, set by European Environment Commission (EEC) is

Metal	Max. concentration in ppm
Zn	5
Mn	0.05
Fe	0.2
Cu	3

As the concentration of Mn in the given water sample is more than the recommended concentration. Thus, it makes water unsuitable for drinking.

#### 49 The condition for

methemoalobinemia by drinking water is [2019, 9 Jan Shift-II]

(a) > 50 ppm nitrate (b) > 50 ppm chloride

(c) > 50 ppm lead

(d) > 100 ppm sulphate

#### Ans. (a)

According to EEC (European Environment Commission), excess of NO<sub>3</sub><sup>-</sup> (> 50 ppm) in drinking water may lead to methemoglobinemia ('Blue baby syndrome'). It also may cause stomach-cancer.

**50** Water filled in two glasses A and B have BOD values of 10 and 20, respectively. The correct statement regarding them, is [2019, 10 Jan Shift-I]

- (a) A is more polluted than B
- (b) A is suitable for drinking, wherease B is not
- (c) Both A and B are suitable for drinkina

(d) B is more polluted than A

#### Ans. (d)

BOD is defined as the amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water. Clean water or drinking water has a BOD value < 5 nnm.

So, water filled with A, BOD = 10 ppm is polluted and water filled with B, BOD = 20 ppm, is also polluted. But, *B* is more polluted than *A*.

#### **51** Peroxyacetyl nitrate (PAN), an eye irritant is produced by

[2019, 11 Jan Shift-I]

- (a) organic waste
- (b) acid rain
- (c) classical smog
- (d) photochemical smog

#### Ans. (d)

Molecular formula of peroxyacetyl

nitrate (PAN) is CH<sub>3</sub>--0-0-NO<sub>2</sub>. It is a secondary pollutant. It is present in photochemical smog (oxidising or Los Angeles smog). PAN is a powerful lachrymator or tear producer and it also causes breathing troubles.

#### 52 Water samples with BOD values of 4 ppm and 18 ppm, respectively, [2019, 12 Jan Shift-I] are

(a) clean and clean (b) highly polluted and clean (c) highly polluted and highly polluted

(d) clean and highly polluted

#### Ans. (d)

The amount of oxygen required by bacteria to break down the organic matter present in a certain value of a sample of water is called biochemical oxygen demand (BOD). The amount of BOD in the water is a measure of the amount of organic material in the water, in terms of how much oxygen will be required to break it down biologically. Clean water would have BOD value of less than 5ppm whereas highly polluted water would have BOD value of 17 ppm or more.

BOD value of clean water = 4 ppmBOD value of highly polluted water = 18 ppm.

**53** A water sample has ppm level concentration of following anions : [JEE Main 2017]

$$F^{-} = 10$$
  
 $SO_{4}^{2-} = 100$ 

 $NO_{3}^{-} = 50$ 

The anion/anions that make/makes the water sample unsuitable for drinking is/are (a) Only NO<sub>3</sub> (b) Both  $SO_4^2$  and  $NO_3^-$ (c)Only F<sup>-</sup>

(d) Only  $SO_4^2$ 

#### Ans. (c)

**NO**<sub>-</sub> The maximum limit of nitrate (NO<sub>-</sub>) in drinking water is 50 ppm and its source is fertilisers. If the maximum limit is increased in water it will cause

methemoglobinemia (blue baby syndrome.)

**SO<sup>2-</sup>** The maximum limit of sulphate

(SO<sub>4</sub><sup>2-</sup>) according to WHO is 500 pm and its sources are acid rain, industries. Excess  $SO_4^2$  has laxative effect.

**F**<sup>-</sup> The maximum limit of fluoride (F<sup>-</sup>) is about 1.5 ppm. Its higher concentration converts enamel to more harder fluorapatite. Concentration (>2ppm) causes brown mottling of teeth and high concentration (>10 ppm) are harmful for bones and teeth.

 $\therefore$  SO<sub>4</sub><sup>2-</sup> (100 ppm) and NO<sub>3</sub><sup>-</sup> (50 ppm) in water is suitable for drinking but the concentration of F<sup>-</sup> (10 ppm) makes water unsuitable for drinking.

**54** The concentration of fluoride, lead, nitrate and iron in a water sample from an underground lake was found to be 1000 ppb, 40 ppb, 100 ppm and 0.2 ppm, respectively. This water is unsuitable for drinking due to high concentration of [JEE Main 2016]

	-
(a) lead	(b) nitrate
(c)iron	(d)fluoride

#### Ans. (b)

This water is unsuitable for drinking due to high concentration of nitrate. In drinking water, maximum permissible concentration of

> Lead ≈ 50 ppb Nitrate ≈ 50 ppb Iron ≈ 0.2 ppm Fluoride ≃ 1 ppm

55 What is DDT among the following?

(a) Green house gas [AIEEE 2012] (b) A fertilizer

- (c) Biodegradable pollutant
- (d) Non-biodegradable pollutant

#### Ans. (d)

DDT is a non-biodegradable pollutant. It is the first chlorinated organic insecticide.