

# NCERT Solutions for Class-XI Chemistry

## Chapter-14 NCERT Chemistry Class 11

1. Define environmental chemistry.

1. Environmental chemistry is the study of chemical and biochemical processes occurring in nature. It deals with the study of origin, transport, reaction, effects, and fates of various chemical species in the environment.

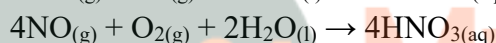
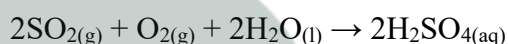
2. Explain tropospheric pollution in 100 words.

2. The presence of unwanted substances in the troposphere's lowest layer cause tropospheric pollution.

The major pollutants include oxides of nitrogen, sulphur, carbon and hydrocarbons.

- Oxides of nitrogen ( $\text{NO}_2$ ,  $\text{NO}$ ) and sulphur ( $\text{SO}_2$  and  $\text{SO}_3$ ) which are formed due to the burning of coal, automobile fuel and other fossil fuels, form nitric acid ( $\text{HNO}_3$ ) and sulphuric acid ( $\text{H}_2\text{SO}_4$ ) by reacting with water in the presence of atmospheric oxygen.

This results in 'Acid rain'.



Acid rain harms plants, agriculture and trees. It also causes respiratory problems in humans.

- Hydrocarbons are compounds that contain carbon and hydrogen in them. They burn to form oxides of carbon. They are carcinogenic in nature and are also regarded as major pollutants.

- Carbon monoxide ( $\text{CO}$ ) reacts with the haemoglobin in our blood and is poisonous in nature and can even be fatal. Even though carbon dioxide ( $\text{CO}_2$ ) is not toxic by itself, it contributes to the increase in global warming by trapping extra sun rays. This results in a heating effect upon the earth thus increasing the earth's temperature.

- Particulates like dust, smoke, fume and mist block our nasal passage and are considered harmful for our health.

- Smog is caused due to the combination of smoke and fog which reduces the visibility of traffic. Photochemical smog is formed as a result of the presence of ozone, PAN, acrolein and formaldehyde. It causes headaches, eye irritation and chest pain in humans. It cracks rubber tires and also damages the plants.

3. Carbon monoxide gas is more dangerous than carbon dioxide gas. Why?

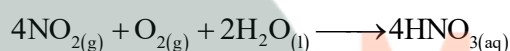
3. Carbon dioxide ( $\text{CO}_2$ ) and carbon monoxide ( $\text{CO}$ ) gases are emitted during the combustion of various fuels. Carbon monoxide is poisonous, whereas carbon-dioxide is non-toxic in nature.

Carbon monoxide is poisonous because it is capable of forming a complex with haemoglobin (carboxyhaemoglobin), which is more stable than the oxygen-haemoglobin complex. The concentration range of 3-4% of carboxyhaemoglobin

decreases the oxygen-carrying capacity of blood. This results in headaches, weak eyesight, nervousness, and cardiovascular disorders. A more increased concentration may even lead to death.

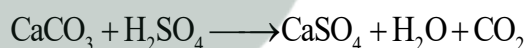
Carbon dioxide is not poisonous. It proves harmful only at very high concentrations.

4. List gases which are responsible for greenhouse effect.
4. The major gases that cause greenhouse effect are:
  - (1) Chlorofluorocarbons (CFCs)
  - (2) Methane (CH<sub>4</sub>)
  - (3) Carbon dioxide (CO<sub>2</sub>)
  - (4) Nitrous oxide (NO)
  - (5) Water (H<sub>2</sub>O)
  - (6) Ozone (O<sub>3</sub>)
5. Statues and monuments in India are affected by acid rain. How?
5. Acid rain is a byproduct of various human activities that leads to the emission of oxides of sulphur and nitrogen in the atmosphere. These oxides undergo oxidation and then react with water vapour to form acids.



Acid rain causes damage to buildings and structures made of stone and metal. In India, limestone is a major stone used in the construction of various monuments and statues, including the Taj Mahal.

Acid rain reacts with limestone as:



This results in the loss of lustre and colour of monuments, leading to their disfiguration.

6. What is smog? How is classical smog different from photochemical smog?
6. Smog is a combination of smoke and fog which causes air pollution. There are two types of smog:
  - (a) Photochemical smog
  - (b) Classical smog

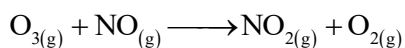
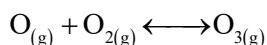
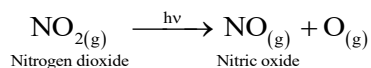
They can be differentiated as follows:

	<b>Photochemical smog</b>	<b>Classical smog</b>
<b>Components</b>	formaldehyde, nitric oxide, ozone, PAN, acrolein	Smoke, fog and sulphurdioxide.
<b>Occurrence</b>	dry, sunny climate	cool, humid climate
<b>Nature</b>	Oxidizing in nature	Reducing in nature

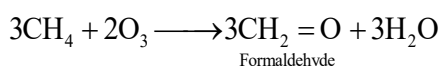
7. Write down the reactions involved during the formation of photochemical smog.
7. Photochemical smog is formed as a result of the reaction of sunlight with hydrocarbons and nitrogen oxides. Ozone, nitric oxide, acrolein, formaldehyde, and peroxyacetyl

nitrate (PAN) are common components of photochemical smog. The formation of photochemical smog can be summarized as follows:

Burning of fossil fuels leads to the emission of hydrocarbons and nitrogen dioxide in the atmosphere. High concentrations of these pollutants in air results in their interaction with sunlight as follows:



While ozone is toxic in nature, both  $\text{NO}_2$  and  $\text{O}_3$  are oxidizing agents. They react with the unburnt hydrocarbons in air to produce formaldehyde, PAN, and acrolein.



8. What are the harmful effects of photochemical smog and how can they be controlled?
8. • Photochemical smog is oxidizing in nature since it is composed of  $\text{NO}_2$  and  $\text{O}_3$ , which are responsible for corrosion of rubber, stones, metals and painted surfaces.

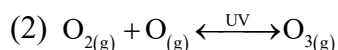
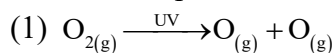
Photochemical smog also contains formaldehyde, PAN and acrolein. Both ozone and PAN and cause eye irritation while nitric oxide (derived from  $\text{NO}_2$ ) is responsible for throat and nose irritation. At higher levels, this type of smog can also cause headaches, throat dryness, chest pain and other respiratory ailments.

#### CONTROL MEASURES:

Use of catalytic converters can be used to prevent the release of  $\text{NO}_2$  into the atmosphere.

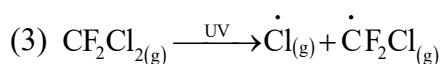
Plants such as *Pyrus*, *Pinus*, *Quercus*, *Juniperur*, and *Vitis* can be planted as these have the capability to metabolize  $\text{NO}_2$ .

9. What are the reactions involved for ozone layer depletion in the stratosphere?
9. In the stratosphere, ozone is a product of the action of UV radiations on dioxygen as:

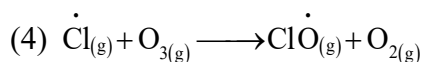


Reaction (ii) indicates the dynamic equilibrium existing between the production and decomposition of ozone molecules. Any factor that disturbs the equilibrium may cause depletion of ozone layer by its decomposition. One such factor is the release of chlorofluorocarbon compounds (CFCs). These are non-reactive, non-flammable molecules that are used in refrigerators, air conditioners, plastics, and electronic industries.

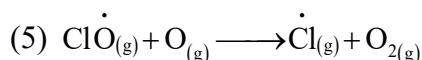
Once released CFCs mix with atmospheric gases and reach the stratosphere, where they are decomposed by UV radiations.



The chlorine free radical produced in reaction (iii) reacts with ozone as:



The  $\dot{\text{Cl}}_{(g)}$  radicals further react with atomic oxygen to produce more chlorine radicals as:



The regeneration of  $\dot{\text{Cl}}_{(g)}$  causes a continuous breakdown of ozone present in the stratosphere, damaging the ozone layer.

10. What do you mean by ozone hole? What are its consequences?
10. Stratospheric clouds present in Polar Regions provide a surface for the reaction of hypochlorous acid and chlorine nitrate which on further reaction, gives molecular chlorine. HOCl and Molecular chlorine get photolysed to provide chlorine-free radicals. The radicals, on reaction with atomic oxygen, resulting in the production of more chlorine radicals. This regeneration of chlorine-free radicals results in a continuous breakdown of ozone in the stratosphere, thus almost permanently damaging the ozone layer. This phenomenon is known as the 'ozone hole'.
11. What are the major causes of water pollution? Explain.
11. Water pollution arises as a result of several human activities, which leads to the presence of several undesirable substances in water. Major water pollutants with their sources have been tabulated as follows:

Pollutant	Source
Micro-organisms	Domestic sewage
Organic wastes	Domestic sewage, decaying animals and plants, animal excreta and waste, discharge from food processing industries
Plant nutrients	Chemical fertilizers
Toxic heavy metals	Chemical factories and industries
Sediments	Strip mining and soil erosion
Pesticides	Chemicals used for killing fungi, weed, insects
Radioactive substances	Mining of uranium-containing minerals
Heat	Water used for cooling in industries

Roles played by major pollutants are:

- (1) **Pathogens:** These water pollutants include bacteria and other organisms. They enter water from animal excreta and domestic sewage. Bacteria present in human excreta (for example, Escherichia coli and Streptococcus faecalis) cause gastrointestinal diseases.
- (2) **Organic wastes:** These are biodegradable wastes that pollute water as a result of run off. The presence of excess organic wastes in water decreases the amount of oxygen held by water. This decrease in the amount of dissolved oxygen inhibits aquatic life.
- (3) **Chemical pollutants:** These are water soluble chemicals like heavy metals such as cadmium, mercury, nickel, etc. The presence of these chemicals (above the tolerance limit) can damage the kidneys, central nervous system, and liver.

12. Have you ever observed any water pollution in your area? What measures would you suggest to control it?
12. Human activities like storm-water drainage, run-off from agricultural fields, discharges from wastewater treatment plants etc, result in water pollution. Toxic metals like Fe, Al and Mn are released into water bodies by industries and factories. So, it should be made sure that the water released from these industries are free of this type of toxicity. Their discharges should be frequently checked for traces of these metals and then released into water bodies. Instead of using fertilizers, manure and compost can be used effectively, so that these fertilizers don't get into water bodies and pollute them.
13. What do you mean by Biochemical Oxygen Demand (BOD)?
13. Biochemical oxygen demand is the amount of oxygen required by bacteria to decompose organic matter in a certain volume of sample of water. Clean water would have a BOD value of less than 5 ppm, whereas highly polluted water has a BOD value of 17 ppm or more.
14. Do you observe any soil pollution in your neighbourhood? What efforts will you make for controlling the soil pollution?
14. Pesticides and fertilizers are the major pollutants that cause soil pollution. When insecticides like DDT are used, they get stuck in the soil for a longer time since they are not soluble in water and thus contaminating the crops and soil. Moreover, pesticides and insecticides are not biodegradable in nature and when they enter the food chain, they go till the highest trophic levels and thus affect the whole biodiversity of an area. Thus, soil pollution can be controlled by controlling the addition of pesticides and fertilizers and instead use manures and compost.
15. What are pesticides and herbicides? Explain giving examples.
15. Pesticides are a mixture of two or more substances. They are used for killing pests. Pests include insects, plant pathogens, weeds, mollusks, etc., that destroy the plant crop and spread diseases. Aldrin and dieldrin are the names of some common pesticides. Herbicides are pesticides specially meant for killing weeds. For example, sodium chlorate ( $\text{NaClO}_3$ ), sodium arsenite ( $\text{Na}_3\text{AsO}_3$ ), etc.
16. What do you mean by green chemistry? How will it help decrease environmental pollution?
16. The production process which uses the existing knowledge that we have on the principles of chemistry to create, develop and implement chemical compounds and products to decrease the amount of hazardous substances in the environment. Green chemistry aims to make sure that the end products yield is 100% so that there are no harmful substances released into the environment. For example, we now use  $\text{H}_2\text{O}_2$  instead of tetrachloroethane and chlorine gas in the process of bleaching and drying of paper.

17. What would have happened if the greenhouse gases were totally missing in the earth's atmosphere? Discuss.
17. Earth's most abundant greenhouse gases are CO<sub>2</sub>, CH<sub>4</sub>, O<sub>3</sub>, CFCs, and water vapour. These gases are present near the Earth's surface. They absorb solar energy that is radiated back from the surface of the Earth. The absorption of radiation results in the heating up of the atmosphere. Hence, greenhouse gases are essential for maintaining the temperature of the Earth for the sustenance of life. In the absence of greenhouse gases, the average temperature of the Earth will decrease drastically, making it uninhabitable. As a result, life on Earth would be impossible.
18. A large number of fish are suddenly found floating dead on a lake. There is no evidence of toxic dumping but you find an abundance of phytoplankton. Suggest a reason for the fish kill.
18. Phytoplankton is consumed by bacteria which require dissolved oxygen for this process. Thus, the higher the amount of Phytoplankton, the larger is the use of dissolved oxygen by bacteria to consume Phytoplankton. Thus, all the oxygen in the lake is used up and BOD drops below 6 ppm, suffocating the fish.
19. How can domestic waste be used as manure?
19. Depending upon the nature of the waste, domestic waste can be segregated into two categories i.e., biodegradable and non-biodegradable. Biodegradable waste such as leaves, rotten food, etc. should be deposited in land fills, where they get decomposed aerobically and anaerobically into manure. Non-biodegradable waste (which cannot be degraded) such as plastic, glass, metal scraps etc. should be sent for recycling.
20. For your agricultural field or garden you have developed a compost producing pit. Discuss the process in the light of bad odour, flies and recycling of wastes for a good produce.
20. • The compost pit should be covered to prevent bad odour and flies.  
• Non-biodegradable wastes should not be dropped into the compost pit so as not interfere in the decomposition of the wastes. Instead, they should be sent for recycling.