



CHAPTER 10

Environmental Chemistry

Complete Exercise Solutions

MCQs • Short • Constructed • Descriptive • Investigative

9th Class Chemistry
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1. Multiple Choice Questions (Tick the correct answer)

Q1. Which gases are responsible for greenhouse effect?

(a) SO_2 , NO_2

(b) NO_2 , CO

(c) CO_2 , CH_4



(d) O_2 , N_2

Explanation: Greenhouse gases trap heat in the Earth's atmosphere. Carbon dioxide (CO_2) and methane (CH_4) are the primary greenhouse gases. SO_2 and NO_2 cause acid rain, CO is a poisonous gas, and O_2 and N_2 do not possess the molecular structure required to trap infrared radiation.

Q2. Indicate the source of sulphur which is responsible for the presence of oxides of sulphur in the atmosphere.

- (a) Decomposition of vegetation
- (b) Waste gases from digestion of animals
- (c) Photochemical smog
- (d) Combustion of fossil fuels** 

Explanation: Fossil fuels (like coal and petroleum) naturally contain sulphur impurities. When these fuels are burned, the sulphur combines with oxygen to form sulphur oxides (SO_2 and SO_3), which are released into the atmosphere.

Q3. Concentration of which gas in the atmosphere is decreased by photosynthesis in plants?

- (a) Oxygen
- (b) Nitrogen
- (c) Carbon dioxide**
- (d) Water vapours



Explanation: Photosynthesis is the process by which plants use sunlight, water, and carbon dioxide to create their own food and release oxygen. Therefore, the concentration of carbon dioxide is reduced during this process.

Q4. Which substance remains unaffected in the catalytic converter fixed in the exhaust of the automobiles?

(a) CO_2



(b) CO

(c) NO

(d) NO_2

Explanation: Catalytic converters are designed to convert harmful gases like carbon monoxide (CO), unburnt hydrocarbons, and nitrogen oxides (NO , NO_2) into less harmful substances. Carbon dioxide (CO_2) is already an oxidized product of combustion and passes through the converter largely unaffected.

Q5. People of which age groups are most affected by the air pollution?

- (a) Young adults
- (b) Middle age people
- (c) Children

(d) Both children and aged people



Explanation: Children have developing respiratory and immune systems, while the elderly often have weakened immune systems and pre-existing health conditions. Both groups are highly vulnerable to the adverse effects of air pollution.

Q6. In which area there is a greater possibility of acid rain?

- (a) Around village
- (b) Around big cities
- (c) Around industrial area**
- (d) Around water bodies



Explanation: Industrial areas burn massive amounts of fossil fuels, releasing high concentrations of sulphur dioxide (SO_2) and nitrogen oxides (NO_x). These gases react with water vapor in the atmosphere to form sulphuric and nitric acids, leading to acid rain.

Q7. Why is smog not felt in summer?

- (a) Because fog is not present in summer
- (b) Because due to heat of the Earth the smoke rises up** 
- (c) Because in summer smoke and fog cannot mix with each other
- (d) Because less fossil fuels are burnt in summer

Explanation: In summer, the Earth's surface heats up, causing warm air to rise. This convection process disperses pollutants (smoke and particulates) into the upper atmosphere, preventing them from accumulating at ground level. Furthermore, traditional smog requires cool, moist conditions (fog) which are absent in summer.

Q8. Which catalyst is used in the catalytic converter fixed in the exhaust systems of automobiles?

(a) Ni

(b) Cu

(c) Pt, Pd and Rh



(d) CaO

Explanation: Catalytic converters use precious metals, namely Platinum (Pt), Palladium (Pd), and Rhodium (Rh), as catalysts to speed up the chemical reactions that convert toxic exhaust gases into less harmful ones.

Q9. Which components are essential for the formation of photochemical smog?

(a) CO, NO₂, CO₂

(b) NO₂, volatile organic compounds, sunlight



(c) CO₂, NO₂, sunlight

(d) Volatile organic compounds, NO₂, CO

Explanation: Photochemical smog is a secondary pollutant formed when nitrogen oxides (NO_x, particularly NO₂) and volatile organic compounds (VOCs) react in the presence of intense sunlight.

Q10. Which gases contribute towards the formation of acid rain?

- (a) Oxides of carbon
- (b) Oxides of sulphur
- (c) Oxides of nitrogen

(d) Both the oxides of nitrogen and sulphur



Explanation: Acid rain is primarily caused by the release of sulphur dioxide (SO_2) and nitrogen oxides (NO_x). These gases undergo chemical reactions in the atmosphere to form sulphuric acid and nitric acid, which then fall to the ground with rain.

2. Questions for Short Answers

i. What is the main objective of environmental education?

The main objective of environmental education is to raise awareness among individuals about environmental issues, equip them with the knowledge and skills to address these challenges, and foster attitudes and behaviors that promote sustainable development and environmental protection.

ii. How is particulate matter released in the atmosphere?

Particulate matter is released into the atmosphere through both natural and human-made sources. Natural sources include volcanic eruptions, dust storms, and forest fires. Anthropogenic (human-made) sources include the burning of fossil fuels, industrial processes, construction activities, and agricultural practices.

iii. Which gas is more poisonous, CO or CO₂?

Carbon monoxide (CO) is significantly more poisonous than carbon dioxide (CO₂). CO binds to hemoglobin in the blood much more readily than oxygen, forming carboxyhemoglobin and preventing oxygen transport, which can quickly lead to suffocation and death. CO₂ is a natural component of the atmosphere and only becomes harmful in extremely high concentrations.

iv. How does acid rain affect forests?

Acid rain affects forests by acidifying the soil, which leaches essential nutrients (like calcium and magnesium) away from the trees. It also releases toxic metals (like aluminum) into the soil, damaging plant roots. Furthermore, acid rain directly damages the leaves and needles of trees, making them more vulnerable to diseases, cold weather, and insect infestations, ultimately leading to stunted growth and forest decline.

v. In what way sulphur present in fossil fuels becomes dangerous?

When fossil fuels containing sulphur are burned, the sulphur reacts with oxygen to form sulphur dioxide (SO_2). When released into the atmosphere, SO_2 can react with water vapor and other chemicals to form sulphuric acid, which falls as acid rain. This acid rain damages buildings, soil, water bodies, and vegetation. Additionally, inhaling high concentrations of SO_2 causes severe respiratory problems in humans.

vi. Name any three major sources responsible for the greenhouse effect.

1. Burning of fossil fuels (coal, oil, and natural gas) for electricity, heat, and transportation.
2. Deforestation (cutting down forests reduces the Earth's capacity to absorb CO_2).
3. Agricultural activities and livestock farming (producing significant amounts of methane).

vii. How is wind energy useful for us?

Wind energy is a clean, renewable, and inexhaustible source of energy. It is useful for generating electricity through wind turbines, pumping water for agricultural and domestic use, and grinding grain in windmills. It helps reduce our reliance on fossil fuels, thereby decreasing air pollution and greenhouse gas emissions.

3. Constructed Response Questions

i. How is the excessive use of insecticides and pesticides harmful for birds?

Excessive use of insecticides and pesticides leads to biomagnification. When birds consume insects or worms that have absorbed these toxic chemicals, the toxins accumulate in the birds' bodies. This can lead to acute poisoning, reproductive failure (such as the thinning of eggshells, which causes them to break during incubation), weakened immune systems, and ultimately, a decline in bird populations.

ii. Percentage of CO_2 in air is only 0.04%. Then how does it become harmful for the ecosystem?

Even though CO_2 makes up only 0.04% of the atmosphere, it is a potent greenhouse gas. Its molecular structure allows it to absorb and re-emit infrared radiation (heat) effectively. Even a slight increase in this percentage (due to human activities) significantly enhances the greenhouse effect, trapping excess heat in the atmosphere. This leads to global warming, which causes climate change, rising sea levels, extreme weather events, and disruption of ecosystems globally.

iii. Why only some pollutant gases present in the atmosphere cause greenhouse effect while others do not?

Greenhouse gases like carbon dioxide (CO_2), methane (CH_4), and water vapor have complex molecular structures with three or more atoms. These molecules can absorb infrared radiation (heat) emitted from the Earth's surface by vibrating and bending their chemical bonds. Gases like oxygen (O_2) and nitrogen (N_2), which make up the majority of the atmosphere, have simple two-atom structures that do not absorb infrared radiation, which is why they do not contribute to the greenhouse effect.

iv. How can you reduce the emission of CO present in the gases emitted by the burning of fuel in the automobile engines?

To reduce CO emissions from automobile engines, we can:

1. Install and properly maintain catalytic converters in vehicle exhaust systems.
2. Ensure complete combustion of fuel by maintaining engines regularly and ensuring an optimal air-to-fuel ratio.
3. Use cleaner alternative fuels such as Compressed Natural Gas (CNG), electric batteries, or hydrogen fuel cells.
4. Promote public transportation and carpooling to reduce the number of vehicles on the road.

v. Mention three different ways in which solar energy can be useful for us.

1. **Solar Panels (Photovoltaics):** Converting sunlight directly into electricity to power homes, businesses, and streetlights.
2. **Solar Water Heaters:** Using solar thermal energy to heat water for domestic or industrial use, reducing the need for electricity or natural gas.
3. **Solar Cookers:** Using concentrated sunlight to cook food without burning wood, coal, or gas, which is especially useful in rural areas to prevent deforestation and indoor air pollution.

4. Descriptive Questions

i. Describe the harmful effects of the major pollutants present in the air.

Major air pollutants have severe harmful effects:

- **Carbon Monoxide (CO):** Binds with hemoglobin, reducing oxygen transport in the blood, causing headaches, dizziness, and even death.
- **Sulphur Dioxide (SO₂) and Nitrogen Oxides (NO_x):** Cause respiratory illnesses (asthma, bronchitis), and are primary contributors to acid rain, which damages soil, water bodies, and infrastructure.
- **Particulate Matter (PM₁₀, PM_{2.5}):** Fine particles penetrate deep into the lungs and bloodstream, causing cardiovascular and respiratory diseases, and reducing visibility.
- **Volatile Organic Compounds (VOCs):** Cause eye, nose, and throat irritation, headaches, and are key components in the formation of photochemical smog. Some are carcinogenic.
- **Ground-level Ozone:** Damages crops and forests, and causes chest pain, coughing, and throat irritation in humans.

ii. Explain greenhouse effect. How is global warming dangerous for us?

Greenhouse Effect: It is a natural process where certain gases in the Earth's atmosphere (like CO_2 , methane, water vapor) trap heat radiating from the Earth's surface. Without this effect, the Earth would be too cold to support life. However, human activities have increased the concentration of these gases, trapping excess heat.

Dangers of Global Warming:

- **Rising Sea Levels:** Melting polar ice caps and glaciers cause sea levels to rise, threatening coastal cities and island nations.
- **Extreme Weather:** Increased frequency and intensity of heatwaves, droughts, floods, and hurricanes.
- **Disrupted Agriculture:** Changes in rainfall patterns and temperatures lead to crop failures and food shortages.
- **Ecosystem Damage:** Coral bleaching, loss of biodiversity, and shifting habitats for many species.

iii. What is air quality index? What information does it convey?

The Air Quality Index (AQI) is a standardized scale used by governments to communicate how polluted the air currently is or how polluted it is forecast to become. It typically ranges from 0 to 500, where higher values indicate greater air pollution and higher health risks. It conveys information about the concentration of specific pollutants (like PM_{2.5}, PM₁₀, O₃, NO₂, SO₂, CO) and categorizes air quality into levels such as Good, Moderate, Unhealthy, Very Unhealthy, and Hazardous, along with corresponding health advisories.

iv. Who are high risk groups and why is pollution more dangerous for them?

High-risk groups include children, the elderly, pregnant women, and individuals with pre-existing health conditions such as asthma, heart disease, or diabetes. Pollution is more dangerous for them because:

- **Children:** Their lungs and immune systems are still developing, and they breathe faster, inhaling more pollutants per unit of body weight.
- **Elderly:** They often have weakened immune systems and age-related decline in lung and heart function.
- **Pregnant Women:** Exposure to pollutants can affect fetal development and lead to premature births or low birth weight.
- **Individuals with pre-existing conditions:** Even small amounts of pollutants can trigger severe asthma attacks or cardiovascular events.

v. Describe three strategies to address environmental issues.

1. **Transition to Renewable Energy:** Shifting away from fossil fuels towards solar, wind, and hydroelectric power reduces greenhouse gas emissions and air pollution.
2. **Afforestation and Conservation:** Planting trees and protecting existing forests helps absorb CO₂, preserve biodiversity, and prevent soil erosion.
3. **Policy and Public Awareness:** Implementing strict environmental regulations (e.g., emission limits, plastic bans) and promoting the 3Rs (Reduce, Reuse, Recycle) through public education campaigns to encourage sustainable lifestyles.

5. Investigative Questions

i. Major Pakistani cities experience a very high AQI in winter which renders them the most polluted cities in the world. Point out some of the major causes of high AQI in these cities.

The major causes of high AQI in Pakistani cities during winter include:

1. **Temperature Inversion:** In winter, the air near the ground is cooler than the air above it. This creates a "lid" that traps pollutants (smoke, dust, vehicle exhaust) near the ground, preventing them from dispersing.
2. **Increased Fossil Fuel Burning:** The demand for heating increases in winter, leading to more burning of wood, coal, and natural gas.
3. **Crop Residue Burning:** Farmers in the region often burn agricultural stubble after the harvest season, contributing massive amounts of smoke and particulate matter.
4. **Vehicular and Industrial Emissions:** Poorly maintained vehicles and industries lacking proper emission control technologies continuously pump pollutants into the air, which are then trapped by the inversion layer.

ii. Why does AQI not rise in Pakistan in hot days of summer?

AQI does not rise as drastically in summer because high surface temperatures cause the air near the ground to heat up and rise. This convection process mixes the pollutants vertically, dispersing them into the higher atmosphere and preventing them from accumulating at ground level. Furthermore, the demand for heating and the practice of crop residue burning are significantly lower in summer. However, summer can still have high AQI due to dust storms and photochemical smog.

iii. How has climate change affected Pakistan during the last five years?

In the last five years, Pakistan has experienced severe impacts of climate change:

1. **Extreme Flooding:** The catastrophic floods of 2022 submerged a third of the country, displacing millions, causing loss of lives, livestock, and crops, and resulting in billions of dollars in economic damage.
2. **Severe Heatwaves:** Record-breaking temperatures in cities like Karachi and Jacobabad have caused heatstroke emergencies and loss of life.
3. **Glacial Lake Outburst Floods (GLOFs):** Increased melting of Himalayan and Karakoram glaciers has led to sudden and destructive floods in northern regions.
4. **Erratic Monsoon Patterns:** Shifting rainfall patterns have caused prolonged droughts in some areas and sudden, intense cloudbursts in others, severely impacting agriculture and water security.
5. **Severe Smog Episodes:** Prolonged winter smog in Punjab has become an annual crisis, causing respiratory illnesses and shutting down schools and businesses.

Thank You!

You have completed

Chapter 10: Environmental Chemistry

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