

# Dr.Nadia Mohammed

## Atmospheric Chemistry Questions & Model Answers

### Q1: What is atmospheric chemistry?

Atmospheric chemistry is the study of the chemical composition of the atmosphere and the reactions and processes that control its changes over time.

### Q2: What are the primary gases in Earth's atmosphere?

Nitrogen ( $\approx 78\%$ ), Oxygen ( $\approx 21\%$ ), and Argon ( $\approx 0.93\%$ ). Trace gases include carbon dioxide, ozone, methane, and water vapor.

### Q3: What is the greenhouse effect?

The greenhouse effect is the process in which greenhouse gases absorb infrared radiation and trap heat in the atmosphere, helping regulate Earth's temperature.

### Q4: Name three major greenhouse gases.

Carbon dioxide ( $\text{CO}_2$ ), methane ( $\text{CH}_4$ ), and water vapor ( $\text{H}_2\text{O}$ ).

### Q5: What is ozone ( $\text{O}_3$ ) and where is it most abundant?

Ozone is a molecule made of three oxygen atoms. It is most abundant in the stratosphere, forming the ozone layer.

### Q6: Why is the ozone layer important?

It protects Earth from harmful ultraviolet (UV) radiation from the Sun.

### Q7: What chemicals cause ozone depletion?

Chlorofluorocarbons (CFCs) and other halogenated compounds such as HCFCs and halons.

### Q8: What is acid rain and what causes it?

Acid rain is rainfall with a low pH formed when sulfur dioxide ( $\text{SO}_2$ ) and nitrogen oxides ( $\text{NO}_x$ ) react with water vapor to produce sulfuric and nitric acids.

### Q9: What is photochemical smog?

Photochemical smog is a type of air pollution formed when sunlight reacts with nitrogen oxides and volatile organic compounds (VOCs), producing ozone at ground level.

### Q10: What is the main chemical responsible for the blue color of the sky?

Rayleigh scattering of sunlight by molecules in the atmosphere causes shorter wavelengths (blue light) to scatter more than others.

**Q11: What is the difference between tropospheric ozone and stratospheric ozone?**

Stratospheric ozone is beneficial and protects from UV radiation, while tropospheric (ground-level) ozone is a pollutant harmful to health.

**Q12: Define aerosols and give an example.**

Aerosols are tiny solid or liquid particles suspended in the air. Examples include dust, sea salt, soot, and volcanic ash.

**Q13: What is the role of hydroxyl radical (OH) in atmospheric chemistry?**

OH is known as the “atmospheric detergent” because it reacts with pollutants, helping remove them from the atmosphere.

**Q14: What is carbon sequestration?**

Carbon sequestration is the process of capturing and storing atmospheric CO<sub>2</sub>, either by natural means (plants, oceans) or artificial technologies.

**Q15: How does methane enter the atmosphere?**

Methane is released from wetlands, livestock digestion, landfills, and fossil fuel extraction.

**Q16: What is the troposphere?**

The troposphere is the lowest layer of the atmosphere where weather phenomena occur and where most atmospheric gases are concentrated.

**Q17: What is the stratosphere known for?**

It contains the ozone layer and exhibits temperature inversion due to ozone absorption of UV radiation.

**Q18: Define atmospheric pressure.**

Atmospheric pressure is the force exerted by the weight of air molecules per unit area.

**Q19: What is radiative forcing?**

Radiative forcing is the change in energy balance in Earth’s atmosphere due to factors like greenhouse gases and aerosols.

**Q20: What is the main source of nitrogen oxides (NOx)?**

Combustion processes, such as vehicle engines, industrial emissions, and lightning.

**Q21: How is ozone formed in the stratosphere?**

UV radiation splits O<sub>2</sub> molecules into single atoms that recombine with O<sub>2</sub> to form O<sub>3</sub>.

**Q22: What is the Chapman cycle?**

The chemical cycle that explains ozone formation and destruction in the stratosphere.

**Q23: What are volatile organic compounds (VOCs)?**

Organic chemicals that easily evaporate and react with NOx in sunlight to form photochemical smog.

**Q24: Give two consequences of acid rain.**

Soil nutrient loss and damage to buildings, lakes, and forests.

**Q25: What is global warming?**

The long-term increase in Earth's average temperature due to enhanced greenhouse gas concentrations.

**Q26: What is the Montreal Protocol?**

An international agreement aimed at phasing out ozone-depleting substances like CFCs.

**Q27: Define atmospheric lifetime of a gas.**

The average time a molecule remains in the atmosphere before being removed by chemical or physical processes.

**Q28: What is sulfur dioxide's role in the atmosphere?**

SO<sub>2</sub> contributes to acid rain and can form sulfate aerosols that reflect sunlight and cool the atmosphere.

**Q29: Why is water vapor important in atmospheric chemistry?**

It is a key greenhouse gas and participates in many chemical reactions, including cloud formation.

**Q30: What is the role of clouds in climate regulation?**

Clouds can reflect sunlight (cooling effect) and trap infrared radiation (warming effect).

**Q31: What is deposition in atmospheric chemistry?**

The process by which atmospheric particles or gases are transferred to Earth's surface (dry or wet deposition).

**Q32: What is a catalytic ozone destruction cycle?**

A chain of reactions where radicals like Cl• or NO• destroy multiple ozone molecules without being consumed.

**Q33: What instruments are used to measure atmospheric composition?**

Spectrometers, radiosondes, lidar, and satellite sensors.

**Q34: Give two natural sources of atmospheric pollutants.**

Volcanic eruptions and wildfires.

**Q35: What is the significance of atmospheric chemistry research?**

It helps us understand air pollution, climate change, and ways to protect air quality and life on Earth.