Chemistry 10 - Possible Exam Questions for Gases, Ozone, and CFCs

**Troposphere**  The lowest layer of the earth’s atmosphere. It extends from the surface of the earth to about 10 km above the earth.

**Stratosphere**  The second layer of the earth’s atmosphere, which extends from about 10 km to about 50 km above sea level.

**UV-A**  Ultraviolet radiation in the range of about 320 to 400 nm wavelengths. This is the part of the ultraviolet spectrum that reaches the earth and provides energy for the production of vitamin D.

**UV-B**  Ultraviolet radiation in the range of about 290 to 320 nm wavelengths. Most of this radiation is filtered out by the earth’s atmosphere, but some reaches the surface of the earth. Excessive exposure can cause sunburn, premature skin aging, and skin cancer.

**UV-C**  Ultraviolet radiation in the range of about 40 to 290 nm wavelengths. Almost all UV-C is filtered out by our atmosphere. Because DNA and proteins absorb radiation in this range, UV-C could cause crop damage and general ecological disaster if it were to reach the earth’s surface in significant quantities.

**Catalyst**  A substance that speeds a chemical reaction without being permanently altered itself.

**Chlorofluorocarbon (CFC)**  A compound composed of just carbon, chlorine, and fluorine.

| 10 | permanently |
| 242 nm | premature aging |
| 240 nm to 320 nm | proteins |
| 50 | shorter |
| 1000 | skin cancer |
| DNA | speeds |
| cars | stable |
| light photons | sun |
| longer | sunburn |
| nitrogen oxides | UV-A |
| oxidizing | UV-B |
| oxygen, O₂ | UV-C |
| ozone, O₃ | |
1. Two forms of the element oxygen are found in nature: the life-sustaining diatomic ____________ and ____________, which is a pale blue gas with a strong odor.

2. Ozone is a very powerful ______________ agent.

3. The highest concentrations of O₃ in the air we breathe are found in large industrial cities with lots of ____________ and lots of ____________.

4. Any time air (which contains nitrogen and oxygen) is heated to high temperature (as occurs in the cylinders of our cars and in many industrial processes), ____________ are formed.

5. Radiant energy of wavelengths ____________ than 400 nm has enough energy to break N–O bonds in NO₂ molecules, but radiant energy with wavelengths ____________ than 400 nm does not supply enough energy to separate the atoms.

6. Because the process of ozone formation is initiated by ____________, the pollutant mixture is called photochemical smog.

7. The stratosphere extends from about ____________ km to about ____________ km above sea level.

8. ____________ radiation, which includes radiant energy of wavelengths from about 320 to 400 nm, passes through the stratosphere and reaches us on the surface of the earth. We are glad it does, because it provides energy that our bodies use to produce vitamin D.

9. ____________ radiation has wavelengths from about 290 to 320 nm. Some of it is removed by the gases in the stratosphere, but some of it reaches the surface of the earth. Radiation in this portion of the spectrum has energy great enough that excessive exposure can cause ____________, ____________, and ____________.

10. The highest-energy ultraviolet radiation is ____________, with wavelengths from about 40 to 290 nm. It is energetic enough to cause serious damage not only to us but to all life on earth. One reason it is so dangerous is that ____________, the substance that carries genetic information in living cells, absorbs UV radiation of about 260 nm. Likewise, ____________, vital structural and functional components of living systems, absorb(s) radiation with wavelengths of about 280 nm. If these wavelengths were to reach the earth in significant quantity, the changes they would cause would lead to massive crop damage and general ecological disaster.

11. Oxygen molecules, O₂, and ozone molecules, O₃, work together to absorb high-energy UV radiation. Oxygen molecules absorb UV radiation with wavelengths less than ____________, and ozone molecules absorb radiant energy with wavelengths from ____________.
12. A catalyst is a substance that ____________ a chemical reaction without being ____________ altered itself.

13. One of the reasons why CFCs were so successful is that they are extremely ____________ compounds; very few substances react with them.

14. Each chlorine atom is thought to destroy an average of ____________ ozone molecules before being temporarily incorporated into a compound such as HCl or ClONO₂.

15. What characteristic of ozone makes it useful for some purposes and a problem in other situations? What do people use it for in industry? What health problems does it cause?

16. Having aced your finals, you decide to spend your summer vacation visiting a friend in Southern California. Unfortunately, during your first day at an amusement park there, you begin to have some chest pain, slight wheezing, and shortness of breath. This reminds you of what you read about ozone in your chemistry textbook. When you tell your friend that ozone is the likely cause of your problems, she asks you to explain how the ozone you are breathing is created and why the ozone levels are higher in Los Angeles than where you live, in rural Minnesota. What do you tell her? How did you contribute to the increase in ozone as you drove your rental car from your hotel to the park?

17. Explain why UV radiation of wavelength less than 400 nm is able to break N–O bonds in NO₂ molecules, and explain why radiant energy of wavelength longer than 400 nm cannot break these bonds.

18. Explain why it is beneficial to us to have UV-A radiation reach the surface of the earth.

19. Explain why UV-B radiation can be damaging to us and our environment if it reaches the earth in higher quantities than it does now.

20. Explain why we are fortunate that UV-C radiation is almost completely filtered out by the gases in the atmosphere.

21. Explain how oxygen molecules, O₂, and ozone molecules, O₃, work together to protect us from high-energy ultraviolet radiation.

22. Explain how nitrogen monoxide, NO, is able to catalyze the conversion of ozone molecules, O₃, and oxygen atoms, O, to oxygen molecules, O₂.

23. Explain why CFCs eventually make their way into the stratosphere even though most chemicals released into the atmosphere do not.

24. Explain why the radiant energy found in the troposphere is unable to liberate chlorine atoms from CFC molecules but the radiant energy in the stratosphere is able to do this.

25. Explain why the chlorine atoms liberated from CFCs are thought to be a serious threat to the ozone layer.