Chemistry 10
Possible Exam 3 Questions for Ozone and CFCs

Ozone and CFCs

1. Glossary terms for Ozone and CFCs
   a. **Troposphere** The lowest layer of the earth's atmosphere. It extends from the surface of the earth to about 10 km above the earth.
   b. **Stratosphere** The second layer of the earth's atmosphere, which extends from about 10 km to about 50 km above sea level.
   c. **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.
   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.
   e. **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.
   f. **Catalyst** A substance that speeds a chemical reaction without being permanently altered itself.
   g. **Chlorofluorocarbon** (**CFC**) A compound composed of just carbon, chlorine, and fluorine.

Complete the following statements by writing one of these words or phrases in each blank.

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	

2. 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.
3. Ozone is a very powerful _____ agent.
4. The highest concentrations of O_3 in the air we breathe are found in large industrial cities with lots of _____ and lots of _____.
5. 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.
6. 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.
7. Because the process of ozone formation is initiated by _____, the pollutant mixture is called photochemical smog.
8. The stratosphere extends from about _____ km to about _____ km above sea level.
9. _____ 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.

10. _____ 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 _____.
11. 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.
12. Oxygen molecules, O_2, and ozone molecules, O_3, 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 _____.
13. A catalyst is a substance that _____ a chemical reaction without being _____ altered itself.
14. One of the reasons why CFCs were so successful is that they are extremely _____ compounds; very few substances react with them.
15. Each chlorine atom is thought to destroy an average of _____ ozone molecules before being temporarily incorporated into a compound such as HCl or $ClONO_2$.

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 Chapter 7 of 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 we are fortunate that UV-C radiation is almost completely filtered out by the gases in the atmosphere.
18. Explain how oxygen molecules, O_2, and ozone molecules, O_3, work together to protect us from high-energy radiation.
19. Explain why CFCs eventually make their way into the stratosphere even though most chemicals released into the atmosphere do not.
20. 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.
21. Explain why the chlorine atoms liberated from CFCs are thought to be a serious threat to the ozone layer.