

Chapter 2: Protecting the Ozone Layer



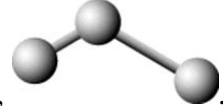
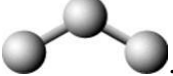
Student: _____

- O₂ and O₃ molecules are
 - allotropes.
 - structural isomers.
 - isotopes.
 - geometrical isomers.
- How many protons, neutrons, and electrons are there in a neutral atom of $^{19}_{9}\text{F}$?

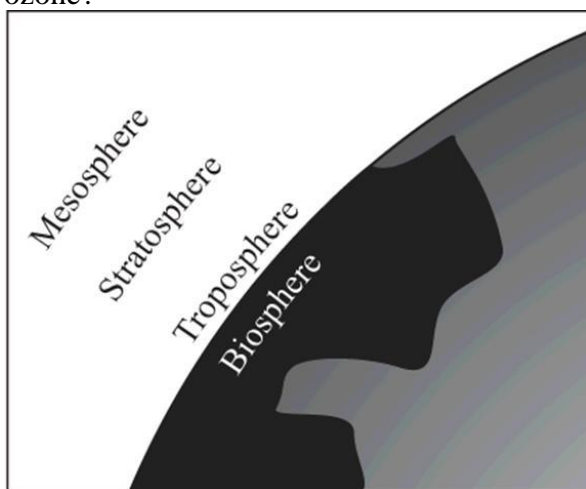
	# protons	# neutrons	# electrons
A.	10	9	10
B.	9	9	9
C.	10	9	9
D.	9	10	9

- A
 - B
 - C
 - D
- Which color in the rainbow has the shortest wavelength?
 - orange
 - red
 - yellow
 - blue
 - The wavelength of light in the visible range is
 - about the size of an atom of carbon.
 - intermediate between the size of an animal cell and a virus.
 - about the diameter of a CD.
 - intermediate between the size of an animal cell and the diameter of a CD.
 - Which is correct?
 - Ozone forms by combining an oxygen atom with an oxygen molecule.
 - There is a dynamic steady state of ozone in the stratosphere.
 - UV radiation will dissociate ozone into an oxygen atom and an oxygen molecule.
 - All of these choices are correct.

6. Which statement is correct?
 - A. UV-A is the most energetic of the three forms of UV light.
 - B. UV-B is the most energetic of the three forms of UV light.
 - C. UV-C is the most energetic of the three forms of UV light.
 - D. UV-A, UV-B, and UV-C are equally energetic.
7. During the Antarctic spring, ozone is destroyed at a greater rate than it is formed
 - A. on the surface of atmospheric ice crystals.
 - B. in a process that is catalytic.
 - C. in polar stratospheric clouds.
 - D. All of these choices are correct.
8. The goal of the Montreal Protocol in 1987 was to
 - A. reduce the amount of new production of chlorofluorocarbons in developed countries.
 - B. recycle existing chlorofluorocarbons rather than release them into the air.
 - C. encourage research into substitutes for chlorofluorocarbons.
 - D. All of these choices are correct.
9. HFCs may be used to replace CFCs. Which compound is a HFC?
 - A. $\text{CH}_2\text{Cl}-\text{CCl}_2\text{F}$
 - B. CH_2FCl
 - C. $\text{CF}_3\text{CH}_2\text{F}$
 - D. CHClF_2
10. The speed of light in air
 - A. depends only on the frequency of the light.
 - B. depends only on the wavelength of light.
 - C. is independent of the wavelength and frequency of light.
 - D. depends on both the wavelength and the frequency of light.
11. DNA, the genetic material of living organisms, is damaged by light in the
 - A. visible region of the spectrum.
 - B. ultraviolet region, especially below a wavelength of 320 nm.
 - C. ultraviolet region, especially above a wavelength of 340 nm.
 - D. infrared region of the spectrum.
12. The ozone hole is most prominent on the Earth over
 - A. North America.
 - B. Europe.
 - C. Africa.
 - D. Antarctica.
13. Which contributes to the ozone hole?
 - A. automobile exhaust
 - B. chlorofluorocarbons (CFCs)
 - C. loss of Northern forests
 - D. All of these choices are correct.

14. Ozone in our atmosphere is important because it
- absorbs some UV radiation.
 - helps trees grow.
 - reacts with excess CO_2 .
 - reflects IR radiation.
15. Wavelength is the
- number of waves passing a fixed point in one second.
 - height of the wave.
 - distance between successive peaks in a wave.
 - distance between a peak of one wave and the next trough.
16. The structure of ozone most closely resembles a
- linear molecule with different lengths of chemical bonds, for example,
 
 - linear molecule with the same length of chemical bonds, for example,
 
 - bent molecule with different lengths of chemical bonds, for example,
 
 - bent molecule with the same length of chemical bonds, for example,
 
17. The correct Lewis dot structure for HCl is:
- $\text{H}:\ddot{\text{Cl}}:$
 - $\text{H}:\text{Cl}$
 - $\text{H}::\ddot{\text{Cl}}:$
 - $\text{H}:\ddot{\text{Cl}}:$
18. As the ozone hole gets more pronounced, with time, one expects the incidence of skin cancer to
- decrease worldwide.
 - increase worldwide.
 - increase in the northern hemisphere and decrease in the southern hemisphere.
 - decrease in the northern hemisphere and decrease in the northern hemisphere.
19. The Montreal protocol is a
- treaty to protect against global warming.
 - treaty to reduce the amount of CFCs produced in the world.
 - list of substitutes for CFCs.
 - way to destroy CFCs in the stratosphere.

20. What is the relationship between stratospheric levels of atomic chlorine and ozone?
- A. As chlorine increases, ozone increases.
 - B. As chlorine increases, ozone decreases.
 - C. As chlorine changes, the effect on the ozone level is unpredictable.
 - D. As chlorine changes, there is no effect of the ozone level.
21. In the periodic table, which elements typically have similar properties?
- A. those in the same rows
 - B. those related diagonally
 - C. those in the same columns
 - D. those on opposite sides
22. In the atmosphere over the Earth, where is the region with the highest concentration of ozone?



- A. troposphere
 - B. biosphere
 - C. mesosphere
 - D. stratosphere
23. The nucleus of an atom contains
- A. electrons and protons only.
 - B. protons only.
 - C. electrons, protons, and neutrons.
 - D. protons and neutrons only.
24. What distinguishes the atoms of one element from another?
- A. the number of neutrons
 - B. the number of protons plus neutrons
 - C. the number of protons
 - D. the number of neutrons plus electrons

25. When it reaches its largest size, the ozone hole over the Antarctic is
- A. about as large as North America.
 - B. about the same size as Texas.
 - C. smaller than Rhode Island.
 - D. about the same size as California.
26. Elements in the same column of the periodic table in the Groups labeled A tend to have similar chemical and physical properties because they have the same number of
- A. valence electrons.
 - B. protons.
 - C. protons plus electrons.
 - D. protons plus neutrons.
27. Isotopes of an element have the same number of _____, but different numbers of _____.
- A. electrons; protons
 - B. protons; neutrons
 - C. neutrons; protons
 - D. protons; electrons
28. When only one pair of shared electrons is involved in a covalent bond, the linkage is called a _____ bond.
- A. triple
 - B. single
 - C. double
 - D. resonant
29. The atomic number is the
- A. same as the mass number of an atom.
 - B. number of protons in a nucleus.
 - C. number of protons and neutrons in a nucleus.
 - D. number of neutrons in a nucleus.
30. The periodicity of the properties of elements is chiefly due to
- A. the numbers of electrons in the atoms of the elements.
 - B. the distribution of electrons in the atoms of the elements.
 - C. the numbers of neutrons and electrons in the atoms of the elements.
 - D. both the numbers of electrons in the atoms of the elements and the distribution of electrons in the atoms of the elements.

37. It is the _____ electrons that account for many of the chemical and physical properties of elements.

- A. innermost
- B. intermediate
- C. outermost
- D. transitional

38. Single bonds, double bonds, and triple bonds

- A. have 1, 2, and 3 shared electrons, respectively.
- B. have 2, 4, and 6 shared electrons, respectively.
- C. have 3, 6, and 9 shared electrons, respectively.
- D. are only possible between carbon atoms.

39. Light behaves like

- A. a particle.
- B. a wave.
- C. both a particle and a wave.
- D. neither a particle nor a wave.

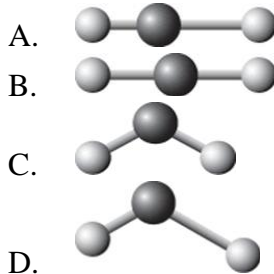
40. The "ozone layer" is found

- A. only around the equator.
- B. in the troposphere.
- C. in the stratosphere.
- D. in the mesosphere.

41. In reference to waves, frequency is the

- A. number of waves passing a fixed point in one second.
- B. height of the wave.
- C. distance between successive peaks in a wave.
- D. distance between a peak in a wave to the next trough.

42. The two chemical bonds and geometry of water are best represented by:



43. Which is/are part of the Chapman cycle in the stratosphere?

- A. Ozone is removed by its reaction with water vapor.
- B. Ozone is removed by an interaction with UV radiation.
- C. Ozone reacts with oxygen atoms to form oxygen molecules.
- D. Ozone is removed by an interaction with UV radiation and it reacts with oxygen atoms to form oxygen molecules.

44. Free radicals are
- A. highly reactive chemical species.
 - B. species with unpaired electrons.
 - C. species such as $\text{H}\bullet$ and $\bullet\text{OH}$.
 - D. All of these correctly describe free radicals.
45. You wear sunscreen on your skin in order for the sunscreen to _____, thereby protecting your skin from some of the sun's radiation.
- A. reflect infrared radiation
 - B. reflect visible radiation and UV-B radiation
 - C. transmit UV-A and UV-B radiation
 - D. absorb UV-A and UV-B radiation
46. Chlorofluorocarbons rise to the stratosphere and
- A. react directly with stratospheric ozone to destroy it.
 - B. interact with UV energy to produce free radicals that destroy ozone.
 - C. interact with UV energy to produce free radicals that react with oxygen to create ozone.
 - D. react with free radicals to remove carbon dioxide.
47. Decreased stratospheric ozone concentrations may lead to
- A. increased incidences of melanomas.
 - B. a decreased production of crops such as wheat, sorghum, and peas.
 - C. an increased occurrence of cataracts.
 - D. All of these choices are correct.
48. Two isotopes of a particular element differ from one another by the number of
- A. neutrons.
 - B. protons.
 - C. protons, neutrons, and electrons.
 - D. protons plus electrons.
49. The chemical properties of the elements are chiefly due to the number
- A. of protons.
 - B. and distribution of the outer electrons.
 - C. and distribution of the inner electrons.
 - D. and distribution of the neutrons.
50. Results of the Montreal protocol include
- A. greatly reduced production of CFCs.
 - B. increased production of alternatives to CFCs.
 - C. recycling of CFCs.
 - D. All of these choices are correct.

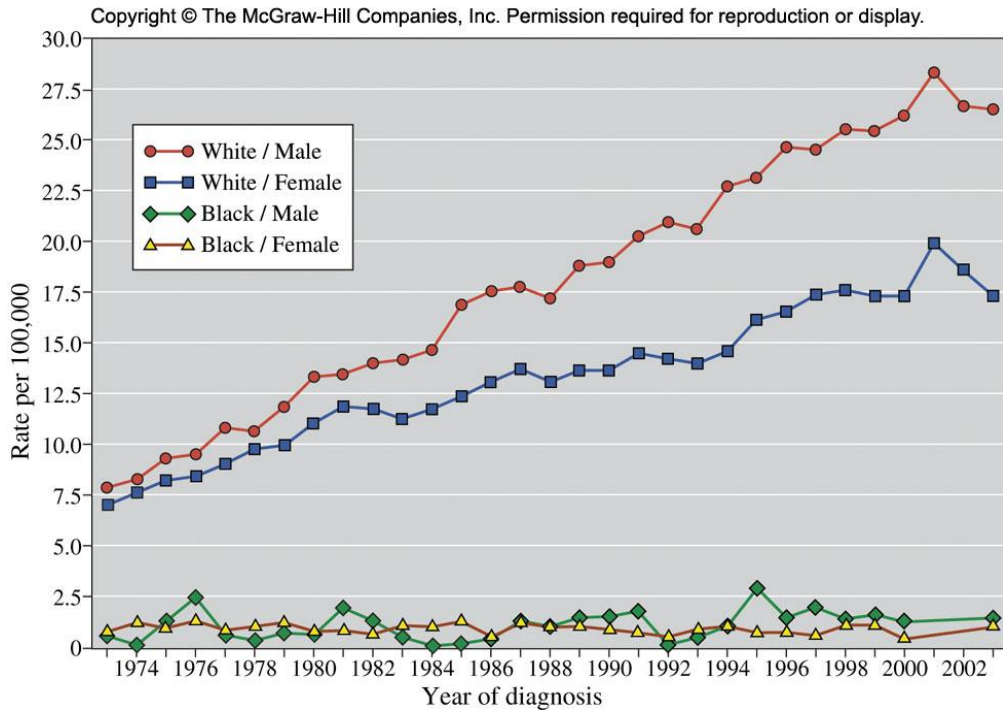
51. Halons differ from CFCs in that the atoms of _____ replace some _____ atoms.
- A. iodine; chlorine
 - B. hydrogen; chlorine
 - C. bromine; chlorine
 - D. silicon; carbon

52. Which choice includes only polyatomic substances?

Box I	Ar, Na, and Fe
Box II	H ₂ O, CCl ₂ F ₂ , and CO ₂
Box III	NH ₃ , CH ₄ , and SO ₂
Box IV	P ₄ , S ₈ , and O ₂

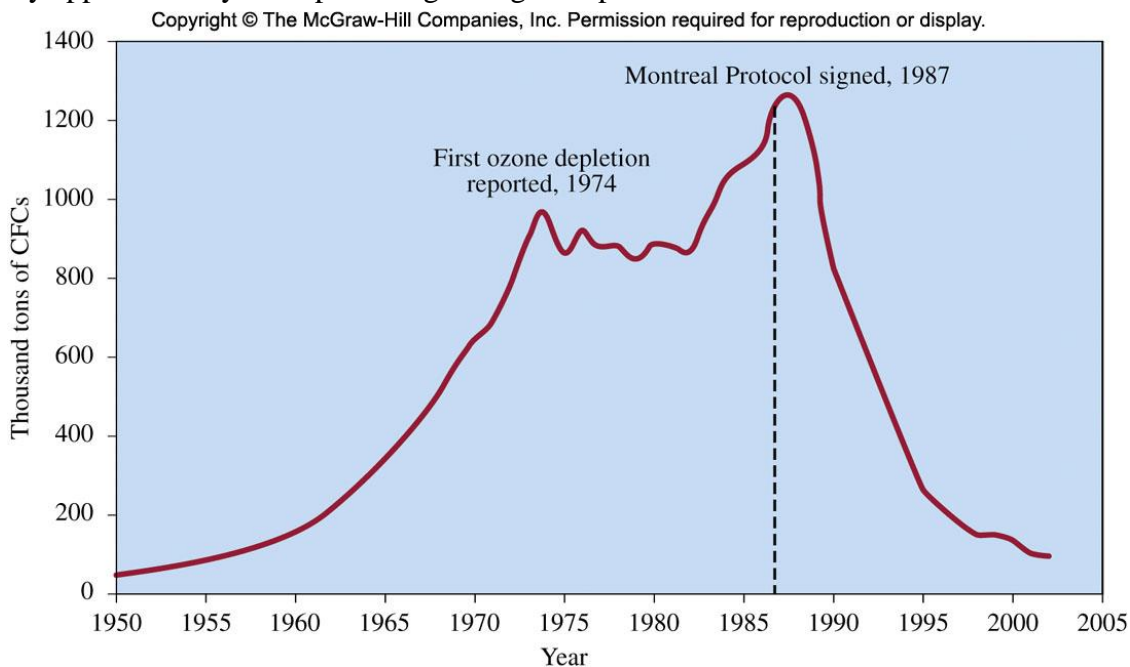
- A. boxes I and II only
 - B. boxes I and IV only
 - C. boxes II and III only
 - D. boxes II, III, and IV only
53. Yellow light has a wavelength of 580 nm. What is the frequency of this light?
- A. $2.39 \times 10^{-19} \text{ s}^{-1}$
 - B. $1.80 \times 10^{-7} \text{ s}^{-1}$
 - C. $5.17 \times 10^5 \text{ s}^{-1}$
 - D. $5.17 \times 10^{14} \text{ s}^{-1}$
54. WUKF FM transmits at 93.5 MHz. What is the wavelength of the electromagnetic radiation that carries the station's signal?
- A. $6.42 \times 10^{-9} \text{ m}$
 - B. 3.21 m
 - C. $3.21 \times 10^6 \text{ m}$
 - D. $3.12 \times 10^{15} \text{ m}$
55. UV-B radiation has a frequency of approximately 10^{17} s^{-1} . What is the energy of a photon of this light?
- A. $1.99 \times 10^{-42} \text{ J}$
 - B. $6.63 \times 10^{-17} \text{ J}$
 - C. $4.19 \times 10^8 \text{ J}$
 - D. $1.51 \times 10^{50} \text{ J}$
56. Which region of the ultraviolet spectrum is absorbed least by the atmosphere?
- A. UV-A
 - B. UV-B
 - C. UV-C
 - D. They are all absorbed approximately equally.

57. From 1974 to 2002, the chance that a white male would be diagnosed with melanoma skin cancer rose by



- A. 18%.
 B. 31%.
 C. 100%.
 D. 225%.
58. In the Chapman cycle, ozone formation depends upon a sufficient concentration of oxygen atoms. Which step in the Chapman cycle produces oxygen atoms?
- A. absorption of light ($\lambda \leq 320$ nm) by ozone
 B. absorption of light ($\lambda \leq 320$ nm) by oxygen
 C. absorption of light ($\lambda \leq 242$ nm) by ozone
 D. absorption of light ($\lambda \leq 242$ nm) by oxygen

59. By approximately what percentage did global production of CFCs fall from 1987 to 2000?

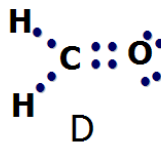
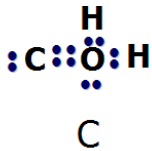
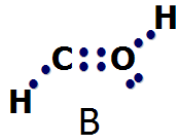
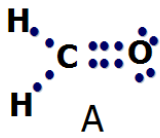


- A. 13%
 - B. 44%
 - C. 88%
 - D. 1100%
60. Which product of the ultraviolet decomposition of CFCs acts as the catalyst for ozone decomposition?
- A. oxygen atoms
 - B. chlorine atoms
 - C. fluorine atoms
 - D. hydrogen atoms
61. HCFCs have been developed to replace CFCs as refrigerants. Which property of these new compounds makes them environmentally superior to CFCs?
- A. Greater reactivity leads to decomposition at elevations below the stratospheric ozone concentration maximum.
 - B. Lower reactivity makes them stable even in the intense ultraviolet light in the stratosphere.
 - C. Their higher molecular weight prevents them from reaching the stratosphere.
 - D. They do not contain chlorine.

62. HCFCs are a temporary solution to the problem of ozone depletion and will be replaced over the next 20 years by which class of compounds?

- A. HFCs
- B. CFCs
- C. halons
- D. HFBCs

63. Which Lewis structure for formaldehyde (CH_2O) is correct?



- A. A
- B. B
- C. C
- D. D

64. Why are HFCs environmentally superior to the currently used HCFCs?

- A. HFCs are not flammable.
- B. HFCs do not contain chlorine.
- C. HFCs are lighter and may be transported more easily.
- D. HFCs are less reactive than HCFCs.

65. CFCs were originally developed to replace which refrigerant compound(s)?

- A. ice
- B. HCFCs
- C. ammonia and sulfur dioxide
- D. propane

Chapter 2: Protecting the Ozone Layer **Key**

1. A
2. D
3. D
4. B
5. D
6. C
7. D
8. D
9. C
10. C
11. B
12. D
13. B
14. A
15. C
16. D
17. D
18. B
19. B
20. B
21. C
22. D
23. D
24. C
25. A
26. A
27. B
28. B
29. B

30. D
31. C
32. A
33. A
34. D
35. D
36. C
37. C
38. B
39. C
40. C
41. A
42. C
43. D
44. D
45. D
46. B
47. D
48. A
49. B
50. D
51. C
52. D
53. D
54. B
55. B
56. A
57. D
58. D
59. C
60. B

- 61. A
- 62. A
- 63. D
- 64. B
- 65. C