

Chapter 2: Protecting the Ozone Layer

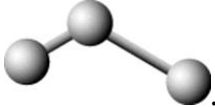
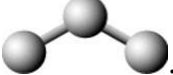
Student: _____

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

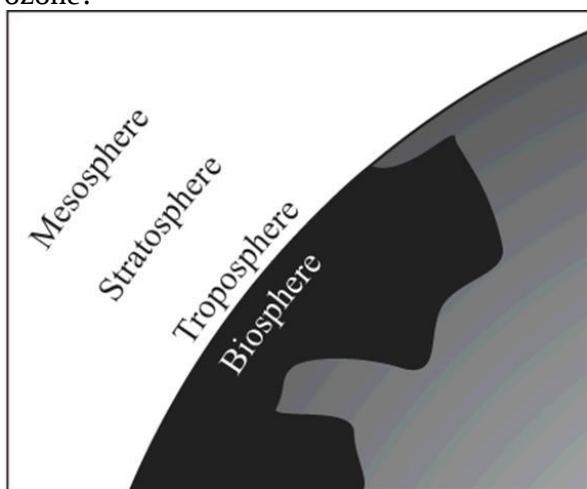
	# protons	# neutrons	# electrons
A.	10	9	10
B.	9	9	9
C.	10	9	9
D.	9	10	9

- 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.

31. How many protons, neutrons, and electrons are there in the neutral atom of $^{13}_6\text{C}$?

	# protons	# neutrons	# electrons
A.	7	6	7
B.	7	13	6
C.	6	7	6
D.	6	7	13

- A. A
B. B
C. C
D. D
32. Increasing wavelength of light goes in this order:
A. ultraviolet > visible > infrared.
B. visible > infrared > ultraviolet.
C. infrared > visible > ultraviolet.
D. ultraviolet > infrared > visible.
33. The wavelength of light in the X-ray region of the electromagnetic spectrum is
A. smaller than a virus.
B. intermediate between the size of a bacterial cell and a virus.
C. about the size of a bacterial cell.
D. larger than either a bacterial cell or a virus.
34. Which is one of the Lewis dot structures for ozone?
A. $\begin{array}{c} \cdot\ddot{\text{O}}:\ddot{\text{O}}:\ddot{\text{O}}: \\ \cdot\ddot{\text{O}}:\ddot{\text{O}}:\ddot{\text{O}}: \end{array}$
B. $\begin{array}{c} \cdot\ddot{\text{O}}:\ddot{\text{O}}:\ddot{\text{O}}: \\ \cdot\ddot{\text{O}}:\ddot{\text{O}}:\ddot{\text{O}}: \end{array}$
C. $\begin{array}{c} \cdot\ddot{\text{O}}:\ddot{\text{O}}:\ddot{\text{O}}: \\ \cdot\ddot{\text{O}}:\ddot{\text{O}}:\ddot{\text{O}}: \end{array}$
D. $\begin{array}{c} \cdot\ddot{\text{O}}:\ddot{\text{O}}:\ddot{\text{O}}: \\ \cdot\ddot{\text{O}}:\ddot{\text{O}}:\ddot{\text{O}}: \end{array}$
35. Stratospheric ozone is destroyed and formed at the same rate
A. above the equator.
B. above the Antarctic in its early spring.
C. above the Antarctic in its early fall.
D. above the equator and above the Antarctic in its early fall.
36. The mass number of an isotope of an element is the
A. sum of the number of its protons and electrons.
B. number of its protons.
C. sum of the number of its protons and neutrons.
D. sum of the number of its protons, neutrons, and electrons.

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

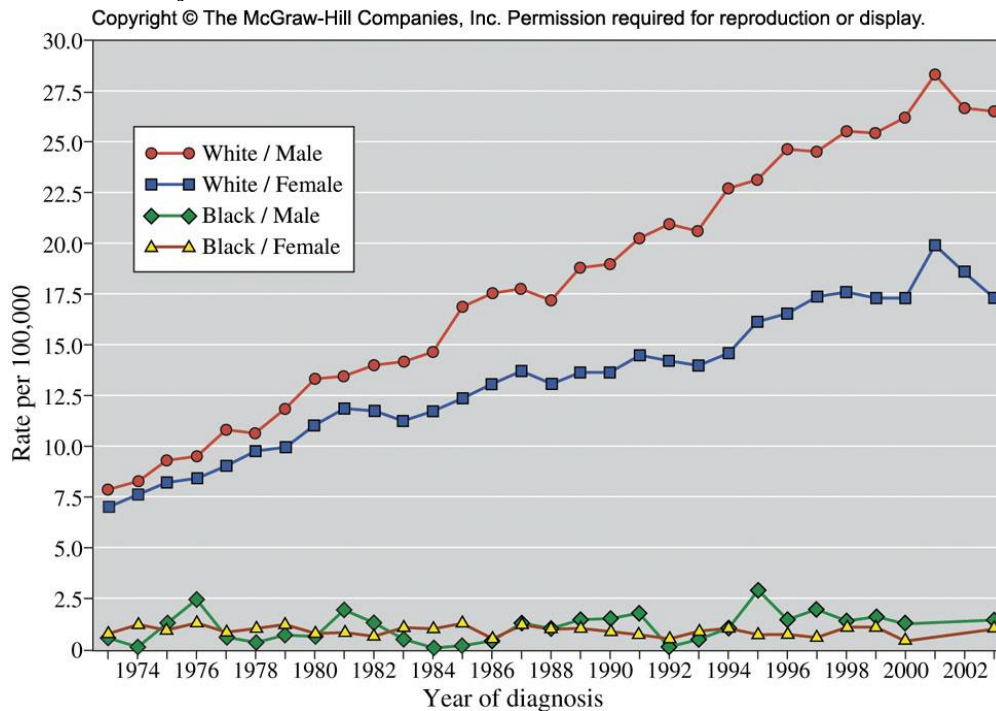
51. Halons differ from CFCs in that the atoms of _____ replace some _____ atoms.
- A. iodine; chlorine
 - B. hydrogen; chlorine
 - C. bromine; chlorine
 - D. silicon; carbon

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

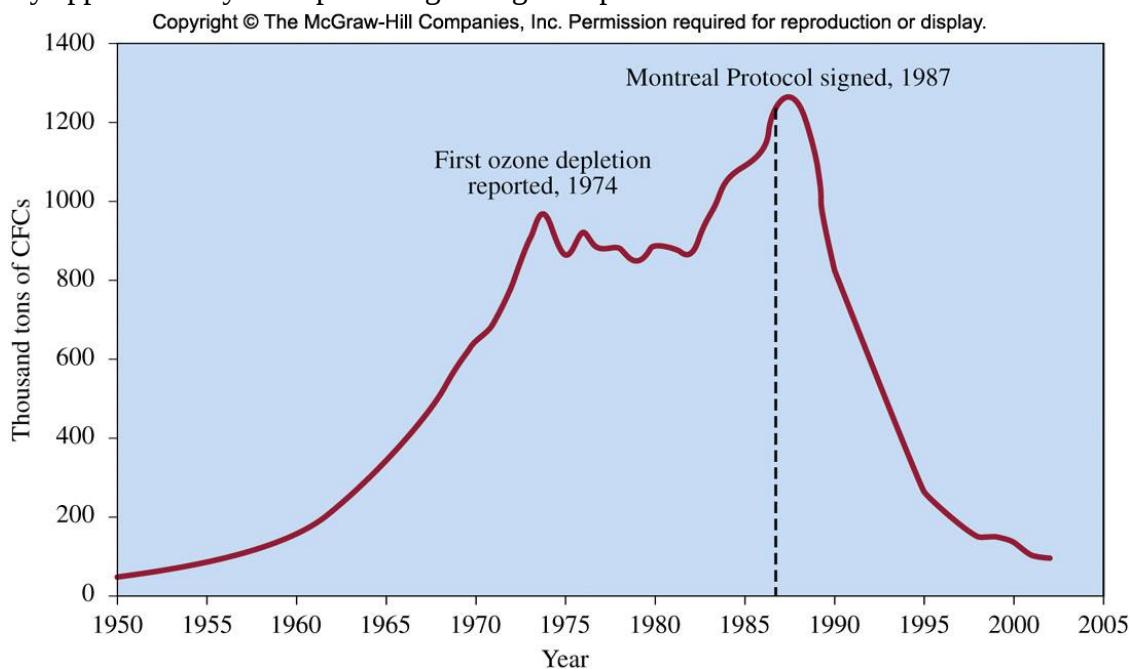
- A. boxes I and II only
 - B. boxes I and IV only
 - C. boxes II and III only
 - D. boxes II, III, and IV only
53. Yellow light has a wavelength of 580 nm. What is the frequency of this light?
- A. $2.39 \times 10^{-19} \text{ s}^{-1}$
 - B. $1.80 \times 10^{-7} \text{ s}^{-1}$
 - C. $5.17 \times 10^5 \text{ s}^{-1}$
 - 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?

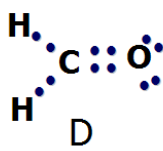
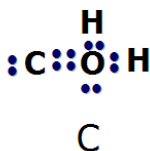
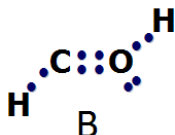
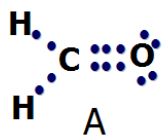


- A. 13%
 - B. 44%
 - C. 88%
 - D. 1100%
60. Which product of the ultraviolet decomposition of CFCs acts as the catalyst for ozone decomposition?
- A. oxygen atoms
 - B. chlorine atoms
 - C. fluorine atoms
 - D. hydrogen atoms
61. HCFCs have been developed to replace CFCs as refrigerants. Which property 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