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Name:_____ Class:_____ Date:_____

Focus 01: Atoms

1. Visible light, microwaves, and x-rays travel through empty space at 3.00×10^8 m·s^{-1}. True or false?
   a. True
   b. False

ANSWER: a

2. Which of the following statements regarding electromagnetic radiation is true?
   a. Electromagnetic radiation with a wavelength of 400 nm travels faster than that with a wavelength of 600 nm.
   b. The frequency of electromagnetic radiation determines how fast it travels.
   c. Electromagnetic radiation with a wavelength of 400 nm has a frequency that is smaller than that with a wavelength of 600 nm.
   d. Electromagnetic radiation with a wavelength of 600 nm travels faster than that with a wavelength of 400 nm.
   e. Electromagnetic radiation with a wavelength of 600 nm has a frequency that is smaller than that with a wavelength of 400 nm.

ANSWER: e

3. Electromagnetic radiation encompasses which of the following?
   a. Microwaves.
   b. Alpha particles.
   c. Gamma radiation.
   d. A and C above.
   e. B and C above.

ANSWER: d

4. Which of the following is the highest frequency electromagnetic radiation?
   a. X-radiation.
   b. Ultraviolet.
   c. Visible light.
   d. Microwave.
   e. Radio.

ANSWER: a

5. Which of the following is the smallest wavelength electromagnetic radiation?
   a. Radio.
   b. Microwave.
   c. Ultraviolet.
   d. Visible blue light.
   e. Infrared.

ANSWER: c

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6. The ultraviolet range encompasses what wavelengths?
   a. 100 – 450nm.
   b. 530 – 580 nm.
   c. 1 – 50 nm.
   d. 10 – 80 nm.
   e. 420 – 500 nm.

ANSWER: a

7. Wavelength is defined how, in terms of electromagnetic radiation?
   a. The peak to peak distance between waves.
   b. The peak to trough distance between waves.
   c. The speed with which a wave traverses a distance.
   d. The amplitude with which a wave traverses a distance.
   e. The trough to peak distance between a wave as well as the speed the wave traverses this distance.

ANSWER: a

8. Which of the following statements regarding electromagnetic radiation is true?
   a. Electromagnetic radiation with a wavelength of 800 nm is in the ultraviolet range.
   b. Electromagnetic radiation with a wavelength of 900 nm is in the visible light range.
   c. Electromagnetic radiation with a wavelength of 400 nm is in the visible light range.
   d. Electromagnetic radiation with a wavelength of 600 nm is in the ultraviolet range.
   e. Electromagnetic radiation with a wavelength of 600 nm is in the visible light range.

ANSWER: e

9. Radiation with a wavelength of 2 – 10 pm is in what part of the electromagnetic spectrum?
   a. Radio waves.
   b. Microwave radiation.
   c. Ultraviolet radiation.
   d. X – radiation.
   e. Gamma radiation.

ANSWER: d

10. Radiation with a wavelength of 2.2 mm is most likely in what part of the electromagnetic spectrum?
   a. Cosmic rays.
   b. X – rays.
   c. Microwaves.
   d. Ultraviolet radiation.
   e. Gamma radiation.

ANSWER: c

11. What is the frequency of yellow light with a wavelength of 580 nm?

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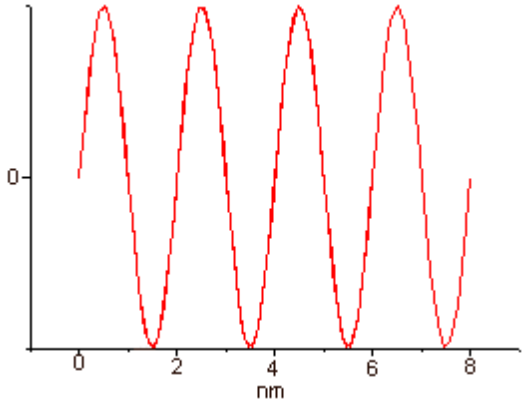
a. 5.2×10^{16} Hz
b. 1.9×10^{-17} Hz
c. 5.2×10^{14} Hz
d. 5.2×10^{12} Hz
e. 1.9×10^{-15} Hz

ANSWER: c

12. What is the wavelength of a radio station transmitting at 99.1 MHz?
a. 330 nm
b. 303 nm
c. 0.00303 m
d. 3.03 m
e. 0.330 m

ANSWER: d

13. Estimate the frequency of the wave shown below.



a. 1.5×10^{17} s^{-1}
b. 3.0×10^{17} s^{-1}
c. 1.0×10^{17} s^{-1}
d. 2.0×10^{17} s^{-1}
e. Not enough information is given to permit calculation of the frequency.

ANSWER: a

14. Which of the following has the highest energy per photon?
a. Infrared
b. Blue light
c. Green light
d. Orange light
e. Red light

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ANSWER: e

15. Which of the following has the lowest energy per photon?
    a. X-radiation
    b. Ultraviolet
    c. Visible light
    d. Microwave
    e. Radio

ANSWER: e

16. A laser emits a pulse of light with an energy of 575 mJ with a wavelength of 266 nm. How many photons did the laser emit?
    a. 7.42×10^{20} photons
    b. 7.42×10^{17} photons
    c. 2.16×10^{14} photons
    d. 2.31×10^{-19} photons
    e. 2.31×10^{26} photons

ANSWER: b

17. What is the wavelength of radiation with a frequency of 2.3×10^{13} Hz?
    a. 3.0×10^{8} m
    b. 7.6×10^{5} cm
    c. 7.6×10^{5} m
    d. 1.3×10^{-5} cm
    e. 1.3×10^{-5} m

ANSWER: e

18. Radiation with a frequency of 3.9×10^{14}/sec has what wavelength?
    a. 1.3×10^{6} m
    b. 7.7×10^{-7} cm
    c. 7.7×10^{-7} m
    d. 3.1×10^{6} m
    e. 1.3×10^{6} cm

ANSWER: c

19. What wavelength does radiation possess when its frequency is 2.1×10^{15} Hz?
    a. 4.1×10^{-7} cm
    b. 1.4×10^{-7} m

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c. 6.5×10^{6} m
d. 7.0×10^{6} m
e. 1.4×10^{-7} nm

ANSWER: b

20. What wavelength does radiation have when its frequency is 5.6×10^{13} Hz?
a. 5.4×10^{-9} m
b. 5.4×10^{-8} m
c. 5.4×10^{-7} m
d. 5.4×10^{-6} m
e. 5.4×10^{-6} cm

ANSWER: d

21. When radiation has a frequency of 6.9×10^{17} Hz, what is its wavelength?
a. 4.3×10^{-10} m
b. 3.4×10^{-10} m
c. 3.0×10^{-8} m
d. 2.3×10^{-9} m
e. 2.3×10^{-8} nm

ANSWER: a

22. What is the wavelength of radiation with a frequency of 1.1×10^{11} Hz?
a. 3.7×10^{2} m
b. 2.7×10^{-3} cm
c. 2.7×10^{-3} m
d. 3.7×10^{2} cm
e. 2.7×10^{-13} m

ANSWER: c

23. What is the frequency of radiation with a wavelength of 2.0 m?
a. 1.5×10^{8} Hz
b. 3.0×10^{8} Hz
c. 7.0×10^{-9} Hz
d. 7.0×10^{8} Hz
e. 1.5×10^{-8} Hz

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ANSWER: a

24. When radiation has a frequency of 1.5×10^{15} Hz, what is its wavelength?
    a. 3.0×10^{-11} m
    b. 4.2×10^{-7} m
    c. 2.0×10^{-7} cm
    d. 2.0×10^{-7} m
    e. 2.0×10^{-8} m

ANSWER: d

25. What is the wavelength of radiation with a frequency of 2.7×10^{18} m?
    a. 1.1×10^{-11} cm
    b. 1.1×10^{-11} m
    c. 9.9×10^{-11} m
    d. 9.9×10^{-11} cm
    e. 3.0×10^{-11} m

ANSWER: b

26. If radiation has a frequency of 3.1×10^{16} s^{-1}, what is its wavelength?
    a. 1.0×10^{8} cm
    b. 1.0×10^{-8} cm
    c. 1.0×10^{8} m
    d. 1.0×10^{-8} m
    e. 3.0×10^{-8} m

ANSWER: d

27. What is the wavelength of radiation that has a frequency of 4.9×10^{13} Hz?
    a. 6.1×10^{-6} m
    b. 6.1×10^{-6} cm
    c. 6.1×10^{6} m
    d. 1.6×10^{5} m
    e. 1.6×10^{-5} m

ANSWER: a

28. When radiation has a frequency of 5.2×10^{12} Hz, what is its wavelength?

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a. 5.8×10^{-5} cm
b. 1.7×10^{4} m
c. 1.7×10^{-4} m
d. 5.8×10^{-5} m
e. 5.8×10^{5} m

ANSWER: d

29. What magnitude of wavelength and frequency does X-radiation have?
a. Small wavelength and low frequency.
b. Small wavelength and high frequency.
c. Large wavelength and low frequency.
d. Large wavelength and high frequency.
e. Wavelength almost the same as that in visible light.

ANSWER: b

30. How is gamma radiation best described?
a. As very small wavelength and low frequency.
b. As wavelength very near that of the visible spectrum.
c. As large wavelength.
d. As very low frequency.
e. As very high frequency.

ANSWER: e

31. What type of wavelength is characteristic of radio waves?
a. Very large.
b. Very small.
c. Large or small depending on frequency.
d. Close to that of visible light.
e. None of the above; radio waves are not a form of radiation.

ANSWER: a

32. What is the general wavelength of visible light?
a. 1 – 100 nm
b. 100 – 400 nm
c. 420 – 700 nm
d. 750 – 1,000 nm
e. > 1,000 nm

ANSWER: c

33. Which of the following has the highest frequency?

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a. Microwave radiation
b. Infrared radiation
c. Visible light
d. Ultraviolet radiation
e. X-rays

ANSWER: e

34. Which of the following has the largest wavelengths?
a. Red visible light
b. Blue visible light
c. Microwaves
d. Ultraviolet radiation
e. Gamma radiation

ANSWER: c

35. Of the following, which wavelength range is visible to the human eye?
a. 950 nm
b. 870 nm
c. 770 nm
d. 500 nm
e. 380 nm

ANSWER: d

36. Which of the following corresponds to an X-radiation wavelength?
a. 0.0001 nm
b. 0.001 nm
c. 9 cm
d. 9 nm
e. 95 nm

ANSWER: d

37. Which of the following is a Lyman series UV band?
a. 121.6 nm
b. 221.6 nm
c. 434.0 nm
d. 121.6 cm
e. 410.2 nm

ANSWER: a

38. Of the following, which is a Balmer series visible band?
a. 954.6 nm

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b. 656.3 nm
c. 401.2 nm
d. 121.6 nm
e. 97.3 nm

ANSWER: b

39. Which of the following is a Lyman series line?
a. 954.6 nm
b. 656.3 nm
c. 486.1 nm
d. 434.0 nm
e. None of the above.

ANSWER: e

40. What is implied about an electron in an atom when it is observed that it has discrete spectral lines?
a. The electron is negatively charged.
b. The electron is oppositely charged from the proton.
c. The electron circles the nucleus.
d. The electron can have only certain energies.
e. The electron has negligible mass.

ANSWER: d

41. What does the term "black body" signify for an object?
a. The object is white hot.
b. The object is black to human sight.
c. The object absorbs and emits all wavelengths.
d. The object absorbs certain wavelengths of light preferentially.
e. There is no significance to the name.

ANSWER: c

42. In 1.0 s, a 60 W bulb emits 11 J of energy in the form of infrared radiation (heat) of wavelength 1850 nm. How many photons of infrared radiation does the lamp generate in 1.0 s?
a. 1.0×10^{29}
b. 1.0×10^{20}
c. 6.8×10^{-14}
d. 1.1×10^{-19}
e. 6.6×10^{23}

ANSWER: b

43. What is the energy in joules of a photon with a frequency of 5.6×10^{14} Hz?

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a. 3.7×10^{-21}
b. 6.8×10^{20}
c. 6.8×10^{-19}
d. 3.7×10^{-19}
e. 3.7×10^{19}

ANSWER: d

44. How many joules of energy does a photon have with a frequency of 6.8×10^{15} Hz?
a. 4.5×10^{28}
b. 5.6×10^{-18}
c. 4.5×10^{-18}
d. 5.6×10^{-19}
e. 4.5×10^{-23}

ANSWER: c

45. A photon with a frequency of 2.3×10^{16} Hz has how many joules of energy?
a. 1.5×10^{-17}
b. 1.5×10^{17}
c. 3.5×10^{-17}
d. 3.5×10^{17}
e. 3.0×10^{8}

ANSWER: a

46. What energy in joules does a photon with a frequency of 5.0×10^{14} Hz have?
a. 1.3×10^{-19} J
b. 3.3×10^{-19} J
c. 6.6×10^{-19} J
d. 6.6×10^{19} J
e. 3.3×10^{19} J

ANSWER: b

47. A photon with a frequency of 1.2×10^{15} Hz has what energy?
a. 8.0×10^{-19} J
b. 1.0×10^{-19} J
c. 8.0×10^{19} J

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d. 5.5×10^{-49} J

e. 5.5×10^{49} J

ANSWER: a

48. What is the frequency of a photon with energy of 2.3×10^{-17} J?

a. 3.4×10^{-16} Hz

b. 3.4×10^{16} Hz

c. 6.8×10^{-16} Hz

d. 6.8×10^{16} Hz

e. 2.8×10^{-15} Hz

ANSWER: b

49. A photon with energy of 3.9×10^{-17} J has what frequency?

a. 6.6×10^{-34} Hz

b. 3.7×10^{15} Hz

c. 3.7×10^{-15} Hz

d. 2.7×10^{14} Hz

e. 2.7×10^{-14} Hz

ANSWER: d

50. What is the frequency of a photon that has an energy of 5.4×10^{-18} J?

a. 1.6×10^{-34} Hz

b. 1.2×10^{16} Hz

c. 1.2×10^{-16} Hz

d. 8.1×10^{15} Hz

ANSWER: d

51. A photon with an energy of 1.8×10^{-19} J possesses what frequency?

a. $7.2 \times 10\text{-}14\ s^{-1}$

b. $2.7 \times 10^{15}\ s^{-1}$

c. $2.7 \times 10^{-14}\ s^{-1}$

d. $2.7 \times 10^{14}\ s^{-1}$

e. $7.2 \times 10^{15}\ s^{-1}$

ANSWER: d

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52. If a photon has an energy of 4.0×10^{-16} J, what will its frequency be?
    a. 6.0×10^{17} Hz
    b. 6.0×10^{16} Hz
    c. 3.9×10^{17} Hz
    d. 1.8×10^{-17} Hz
    e. 1.3×10^{20} Hz

ANSWER: a

53. When a photon has an energy of 1.3×10^{-20} J, what will its frequency be?
    a. 1.9×10^{14} Hz
    b. 9.1×10^{20} Hz
    c. 1.9×10^{13} Hz
    d. 9.1×10^{-19} Hz
    e. 6.0×10^{13} Hz

ANSWER: c

54. What is the energy of a photon with a frequency of 3.8×10^{14} Hz?
    a. 1.5×10^{-15} J
    b. 3.8×10^{14} J
    c. 8.3×10^{-14} J
    d. 3.8×10^{-19} J
    e. 1.5×10^{-15} J

ANSWER: b

55. What is the energy of a mole of photons with a frequency of 1.2×10^{14} Hz?
    a. 4.8×10^{-4} J/mol
    b. 3.8×10^{4} J/mol
    c. 4.8×10^{4} J/mol
    d. 3.8×10^{-4} J/mol
    e. 8.4×10^{5} J/mol

ANSWER: c

56. What is the energy of a mole of photons with a frequency of 3.8×10^{14} Hz?
    a. 1.5×10^{5} J/mol
    b. 1.5×10^{-5} J/mol

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c. 6.7×10^{-7} J/mol

d. 6.7×10^{7} J/mol

e. 3.8×10^{-5} J/mol

ANSWER: a

57. When a mole of photons has the frequency 4.2×10^{15} Hz, what is its energy?

a. 1.7×10^{-6} J/mol

b. 5.9×10^{-7} J/mol

c. 5.9×10^{7} J/mol

d. 6.2×10^{8} J/mol

e. 1.7×10^{6} J/mol

ANSWER: e

58. What is the energy of a mole of photons with a frequency of 2.9×10^{15} s^{-1}?

a. 1.2×10^{6} J/mol

b. 1.2×10^{9} J/mol

c. 8.3×10^{-7} J/mol

d. 8.3×10^{7} J/mol

e. 6.7×10^{6} J/mol

ANSWER: a

59. What is the energy of a mole of photons with a frequency of 3.2×10^{16} Hz?

a. 1.3×10^{7} J/mol

b. 1.3×10^{-7} J/mol

c. 3.2×10^{16} J/mol

d. 7.7×10^{-8} J/mol

e. 7.7×10^{8} J/mol

ANSWER: a

60. A mole of photons with a frequency of 7.5×10^{16} Hz has what energy?

a. 3.0×10^{-7} J/mol

b. 4.2×10^{6} J/mol

c. 3.3×10^{-8} J/mol

d. 3.0×10^{7} J/mol

e. 3.3×10^{8} J/mol

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ANSWER: d

61. What is the energy of a mole of photons with a frequency of 6.9×10^{14} Hz?
    a. 2.8×10^{5} J/mol
    b. 8.3×10^{4} J/mol
    c. 8.3×10^{-4} J/mol
    d. 3.8×10^{6} J/mol
    e. 2.8×10^{-6} J/mol

ANSWER: a

62. A mole of photons with a frequency of 3.1×10^{14} Hz has what energy?
    a. 1.2×10^{-5} J/mol
    b. 8.3×10^{-7} J/mol
    c. 8.3×10^{7} J/mol
    d. 7.1×10^{7} J/mol
    e. 1.2×10^{5} J/mol

ANSWER: e

63. What is the energy of a mole of photons with a frequency of 5.8×10^{15} s^{-1}?
    a. 2.3×10^{-5} J/mol
    b. 2.3×10^{6} J/mol
    c. 4.9×10^{6} J/mol
    d. 4.9×10^{-5} J/mol
    e. 5.8×10^{-15} J/mol

ANSWER: b

64. What is the energy of a mole of photons with a frequency of 9.1×10^{15} Hz?
    a. 3.6×10^{-5} J/mol
    b. 3.6×10^{6} J/mol
    c. 2.8×10^{-7} J/mol
    d. 2.8×10^{7} J/mol
    e. 7.0×10^{6} J/mol

ANSWER: b

65. When a mole of photons has the energy 3.3×10^{7} J, what is its frequency?

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a. 2.6×10^{-15} Hz
b. 2.6×10^{16} Hz
c. 8.2×10^{-15} Hz
d. 8.2×10^{16} Hz
e. 13.3×10^{-7} Hz

ANSWER: d

66. When a mole of photons possesses an energy of 2.4×10^{7} J, what is its frequency?

a. 1.6×10^{-15} Hz
b. 6.1×10^{-16} Hz
c. 6.1×10^{16} Hz
d. 1.6×10^{5} Hz
e. 4.2×10^{16} Hz

ANSWER: c

67. A lawyer who received a speeding ticket argues that because of the Heisenberg uncertainty principle the radar reading is uncertain. The judge, who happens to have a science degree, rules against the lawyer. Which of the following statements is true?

a. The judge is incorrect because the uncertainty in position is large.
b. The judge is correct because the car is so massive that the uncertainty in speed is very small.
c. The judge is correct because the uncertainty in momentum is very large.
d. The judge is incorrect because radar has only wave characteristics.
e. The judge is incorrect because $(m\Delta v)(\Delta x) \geq \frac{1}{2}h$.

ANSWER: b

68. Calculate the wavelength of a motorcycle of mass 275 kg traveling at a speed of 125 km·hr^{-1}.

a. 6.94×10^{-38} m
b. 1.93×10^{-38} m
c. 1.93×10^{-41} m
d. 2.41×10^{-36} m
e. 2.08×10^{-29} m

ANSWER: a

69. You are caught in a radar trap and hope to show that the speed measured by the radar gun is in error because of the uncertainty principle. If you assume that the uncertainty in your position is large, say about 10 m, and that the car has a mass of 2150 kg, what is the uncertainty in the velocity?

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a. 1×10^{-33} m·s^{-1}
b. 1×10^{-19} m·s^{-1}
c. 1×10^{33} m·s^{-1}
d. 1×10^{38} m·s^{-1}
e. 1×10^{-38} m·s^{-1}

ANSWER: e

70. In everyday life, we have no difficulty in measuring both the velocity and position of objects. True or false?
a. True
b. False

ANSWER: a

71. Light of wavelength 242 nm ionizes a sodium ion in the gas phase; what is the ionization energy of sodium?
a. 8.20 kJ·mol^{-1}
b. 988 kJ·mol^{-1}
c. 198 kJ·mol^{-1}
d. 494 kJ·mol^{-1}
e. 247 kJ·mol^{-1}

ANSWER: d

72. Calculate the velocity of an oxygen molecule, given that it has a de Broglie wavelength of 0.0140 nm.
a. 890. m·s^{-1}
b. 3.00×10^{8} m·s^{-1}
c. 1780 m·s^{-1}
d. 445 m·s^{-1}
e. 8.90 m·s^{-1}

ANSWER: a

73. Which of the following experiments most directly supports de Broglie's hypothesis of the wave nature of matter?
a. Black-body radiation
b. The photoelectric effect
c. α-particle scattering by a metal foil
d. Electron diffraction by a crystal
e. The emission spectrum of the hydrogen atom

ANSWER: d

74. The Bohr radius for an electron in the ground state of a hydrogen atom is 52.9 pm. The Bohr radius for an

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electron in the $n = 2$ state of He^+ is

a. 211.6 pm.
b. 105.8 pm.
c. 26.5 pm.
d. 52.9 pm.
e. 13.2 pm.

ANSWER: b

75. The first line (lowest energy) in the Balmer series appears at 15,233 cm^{-1}. The second line appears at

a. 109,678 cm^{-1}.
b. 5,699 cm^{-1}.
c. 20,565 cm^{-1}.
d. 30,466 cm^{-1}.
e. 20,311 cm^{-1}.

ANSWER: c

76. In a one-dimensional particle in a box, for $n = 6$, how many wavelengths equal the size of the box?

a. 0
b. 3
c. 1
d. 12
e. 6

ANSWER: b

77. In a one-dimensional particle in a box, for Ψ_4, how many nodes are predicted?

a. 1
b. 3
c. 0
d. 2
e. 4

ANSWER: b

78. In a one-dimensional particle in a box, the zero-point energy corresponds to

a. a node.
b. $n = 0$.
c. $n = 1$.
d. A quantum state where the uncertainty principle is not valid.
e. $\Psi^2 = 0$.

ANSWER: c

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79. If an electron is confined to a one-dimensional box 200 pm in length, calculate the zero-point energy.
   a. 1.51×10^{-18} J
   b. 6.04×10^{-18} J
   c. 1.51×10^{-20} J
   d. 1.21×10^{-19} J
   e. 1.21×10^{-17} J

ANSWER: a

80. An electron is confined to a one-dimensional box 200 pm in length, calculate the wavelength of light required to promote the electron from the ground state to the first excited state.
   a. 329 pm
   b. 263 pm
   c. 165 pm
   d. 439 pm
   e. 1320 pm

ANSWER: d

81. Which of the following statements is incorrect?
   a. For a one-dimensional particle in a box, as the mass of the particle becomes larger the separation between neighboring energy levels increases.
   b. For a one-dimensional particle in a box, the separation between neighboring energy levels increases as the length of the container increases.
   c. For a one-dimensional particle in a box, the energy separation between neighboring energy levels has the value $h^2/8mL^2$ when the walls of the box are infinitely far apart.
   d. Argon atoms in a cylinder can be treated as though their translational energy were quantized.
   e. A billiard ball on a table has a completely negligible zero-point energy.

ANSWER: e

82. If a particle is confined to a one-dimensional box of length 300 pm, for Ψ_3 the particle has zero probability of being found at
   a. 100 and 200 pm, respectively.
   b. 150 pm only.
   c. 50, 150, and 250 pm, respectively.
   d. 50 and 250 pm, respectively.
   e. 75, 125, 175, and 225 pm, respectively.

ANSWER: a

83. If a particle is confined to a one-dimensional box of length 300 pm, for Ψ_3 the particle is most likely to be found at

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a. 0 pm.
b. 50, 150, and 250 pm, respectively.
c. 17.3 pm.
d. 300 pm.
e. 100 and 200 pm, respectively.

ANSWER: b

84. What is the probability of finding an electron in a small region of a hydrogen 1*s* orbital at a distance $3a_0$ from the nucleus relative to the probability of finding it in the same small region located at the nucleus?

a. 14%
b. 0.25%
c. 22%
d. 1.8%
e. 5.0%

ANSWER: b

85. Which of the following emission lines corresponds to part of the Balmer series of lines in the spectrum of a hydrogen atom?

(a) $n_2 \rightarrow n_1$ (b) $n_4 \rightarrow n_2$ (c) $n_4 \rightarrow n_1$ (d) $n_3 \rightarrow n_2$ (e) $n_4 \rightarrow n_3$

a. (b) and (d)
b. (a), (d), and (e)
c. (a) and (c)
d. (e)
e. (b) and (c)

ANSWER: a

86. Calculate the longest-wavelength line in the Balmer series for hydrogen.

a. 182 nm
b. 657 nm
c. 536 nm
d. 122 nm
e. 486 nm

ANSWER: b

87. The Balmer series of lines for the hydrogen atom are found only in the visible region of the spectrum. True or false?

a. True
b. False

ANSWER: b

88. What is the shortest-wavelength line in the emission spectrum of the hydrogen atom?

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a. 182 nm
b. 100 nm
c. 122 nm
d. 91.2 nm
e. 1.00 nm

ANSWER: d

89. Which of the following statements with respect to the photoelectric effect is incorrect?
a. A plot of the kinetic energy of the ejected electrons versus the frequency of the incident radiation has a slope that is equal to the value of the work function.
b. All metals have a unique work function.
c. The kinetic energy of the ejected electrons does not increase with the intensity of the incident radiation.
d. A plot of the kinetic energy of the ejected electrons versus the frequency of the incident radiation is linear.

ANSWER: a

90. Which of the following is expected to approximate the value of the wavelength of a 5-g bullet traveling at 1300 miles per hour?
a. 2 m
b. 2×10^{-34} m
c. 200 pm
d. 2 pm

ANSWER: b

91. Estimate the minimum uncertainty in the position of an electron of mass 9.109×10^{-31} kg, given that its speed is unknown to within $\pm 3.00 \times 10^{5}$ m·s^{-1}.
a. 386 pm
b. 386×10^{-12} m
c. 193 pm
d. 1.93×10^{-12}

ANSWER: c

92. The four π electrons of 1,3-butadiene can be modeled as particles in a box. If the length of 1,3-butadiene (L) is 0.56 nm, calculate the energy of the lowest energy transition. _____
ANSWER: 9.6×10^{-19} J

93. Carotene, which is partly responsible for the color of carrots, has 22 π electrons in a conjugated system and a length of about 3 nm. The lowest energy transition in carotene is from n = _____ to n = ___.
ANSWER: 11; 12

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94. Comparing the lowest energy transition, ΔE, in1,3-butadiene(A) and 1,3,5,7-octatetraene(B), ΔE_A is greater than ΔE_B. True or false?

a. True
b. False

ANSWER: a

95. The zero-point energy in 1,3-butadiene is larger than in 1,3,5,7-octatetraene. True or false?

a. True
b. False

ANSWER: a

96. Which of the following metals has the lowest work function?

a. Be
b. Sr
c. Li
d. Rb

ANSWER: d

97. The square of the amplitude of a wave determines the intensity of the radiation. True or false?

a. True
b. False

ANSWER: a

98. A node is a point at which the wave function becomes zero. True or false?

a. True
b. False

ANSWER: b

99. The planet Mercury has a maximum intensity of solar radiation of 3700 nm on the sunlit side. What is the temperature of the surface of Mercury on the sunlit side? The empirical value of the constant in Wien's law is 2.9 K·mm.

a. 510^oC
b. 780^oC
c. 1100^oC
d. 290^oC
e. 543^oC

ANSWER: a

100. Which of the following is Wien's law?

a. The maximum intensity of black-body radiation, λ_{max}, is inversely proportional to the temperature.

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b. λ_{max} = constant × T where λ_{max} is the intensity of black-body radiation and T is the temperature in K.

c. λ_{max} = constant × T^4 where λ_{max} is the intensity of black-body radiation and T is the temperature in K.

d. The maximum intensity of black-body radiation, λ_{max}, increases as the temperature increases.

e. T = 2.9 K.mm × λ_{max} where λ_{max} is the intensity of black-body radiation and T is the temperature in K.

ANSWER: a

101. Consider a one-dimensional particle in a box of length 2L and one of length 3L. Which of the following is true?

a. The energy levels n = 1 and n = 2 are closer together for the box of length 3L.
b. The energy levels n = 1 and n = 2 are closer together for the box of length 2L.
c. The energy levels for the box of length 3L are all higher than those for the box of length 2L.
d. The zero-point energy of the two boxes is the same.
e. The zero-point energy of the box of length 2L is smaller than that of the box of length 3L.

ANSWER: a

102. All the orbitals of a given shell of He^+ are degenerate regardless of the value of the orbital angular momentum. True or false?

a. True
b. False

ANSWER: a

103. The total number of orbitals in a shell with principal quantum number 5 is

a. 32.
b. 50.
c. 25.
d. 40.
e. 5.

ANSWER: c

104. Which set of quantum numbers, n, l, m_l, could correspond to one of the highest energy electrons in Zr?

a. 4, 2, –2
b. 4, 2, +3
c. 3, 2, –2
d. 4, 3, –2

ANSWER: a

105. Which set of quantum numbers could correspond to a 4f orbital?

a. n = 4, l = 4, m_l = +3

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b. $n = 4, l = 3, m_l = +4$

c. $n = 4, l = 3, m_l = –3$

d. $n = 3, l = 2, m_l = +1$

e. $n = 3, l = 2, m_l = 0$

ANSWER: c

106. Which set of quantum numbers corresponds to the electrons in He?

a. $n = 1, l = 0, m_l = 1$

b. $n = 1, l = 0, m_l = 0$

c. $n = 1, l = 1, m_l = –0$

d. $n = 1, l = 0, m_l = -1$

e. $n = 1, l = 2, m_l = 0$

ANSWER: b

107. Which set of quantum numbers cannot exist for an electron?

a. $n = 1, l = 0, m_l = 0, m_s = +½$

b. $n = 2, l = 1, m_l = 1, m_s = +½$

c. $n = 3, l = 0, m_l = 0, m_s = +½$

d. $n = 1, l = 0, m_l = 1, m_s = −½$

e. $n = 2, l = 1, m_l = −1, m_s = −½$

ANSWER: d

108. What is the only secondary quantum number associated with the 4s orbital?

a. $l = 0$

b. $l = 1$

c. $l = 2$

d. $l = 3$

e. $l = 4$

ANSWER: a

109. What are the possibilities of the spin quantum number for Mg?

a. $m_s = 1$

b. $m_s = 0$

c. $m_s = +½$

d. $m_s = –½$

e. Both C and D

ANSWER: e

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110. What is the principle quantum number for gallium?
a. $n = 1$
b. $n = 2$
c. $n = 3$
d. $n = 4$
e. $n = 5$
ANSWER: d

111. What is the l corresponding to the outermost p electrons in sulfur?
a. $l = 0$
b. $l = 1$
c. $l = 2$
d. $l = 3$
e. $l = 4$
ANSWER: b

112. How many total nodal planes are present in the 3d orbitals?
a. 15
b. 0
c. 5
d. 20
e. 10
ANSWER: e

113. How many nodes are present in a 3s- and a 3p-orbital, respectively?
a. 2; 1
b. 0; 1
c. 0; 2
d. 1; 1
e. 2; 2
ANSWER: e

114. Nodal planes in orbitals can be accounted for by the wavelike behavior of electrons.
a. True
b. False
ANSWER: a

115. How many nodal planes are present in an f orbital?
a. 2
b. 3
c. 7

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d. 4
e. 5

ANSWER: b

116. Which of the following statements is true?
a. A 2s orbital has one nodal plane.
b. An electron in a p-orbital has zero probability of being found at the nucleus.
c. A p-orbital has a spherical boundary surface.
d. An s-orbital becomes more dense as the distance from the nucleus increases.
e. An electron in an s-orbital has a zero probability of being found at the nucleus.

ANSWER: b

117. Where is the nodal plane in a 1s orbital?
a. Along the *x*-axis.
b. Along the *y*-axis.
c. Along the *z*-axis.
d. Mid-way between the *x* and *y*-axes.
e. There is none.

ANSWER: e

118. What shape do the p-orbitals have that each accommodates one nodal plane?
a. A spherical shape.
b. A dumbbell shape centered at the nucleus.
c. A clover leaf shape centered at the nucleus.
d. A clover leaf shape centered above and below the nucleus.
e. A toroidal shape around a dumbbell.

ANSWER: b

119. Which set of orbitals encompass two shapes?
a. The s orbitals.
b. The p orbitals.
c. The d orbitals.
d. Both B and C, above.
e. Both A and C, above.

ANSWER: c

120. Which of the following statements is true?
a. The s orbital is spherical.
b. The s orbital has no nodal planes.
c. The s orbital is symmetrical.
d. The s orbital is associated with the *l* quantum number 0.

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e. All of the above.

ANSWER: e

121. Where is the nodal plane for the p_x orbital?

a. On the *x*-*z* plane.

b. On the *y*-*z* plane.

c. On the *x*-*y* plane.

d. Midway between the *x*-*y* and the *y*-*z* plane.

e. The p_x orbital does not have a nodal plane.

ANSWER: b

122. Which orbitals have the greatest number of nodes?

a. The s orbitals.

b. The p orbitals.

c. The d orbitals.

d. The f orbitals.

e. All orbitals have the same number of nodes.

ANSWER: d

123. The three quantum numbers for an electron in a hydrogen atom in a certain state are $n = 4$, $l = 1$, $m_l = 1$. The electron is located in what type of orbital?

a. 4s

b. 3p

c. 3d

d. 4d

e. 4p

ANSWER: e

124. The three quantum numbers for an electron in a hydrogen atom in a certain state are $n = 4$, $l = 2$, $m_l = 1$. The electron is located in what type of orbital?

a. 4p

b. 3p

c. 4s

d. 4d

e. 3d

ANSWER: d

125. Which of the following statements is true?

a. A p-electron penetrates more than an s-electron through the inner shells of an atom.

b. A p-electron penetrates less than a d-electron through the inner shells of an atom.

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c. A p-electron has a nonzero probability density at the nucleus.
d. A d-electron has a nonzero probability density at the nucleus.
e. A p-electron experiences a smaller effective nuclear charge than an s-electron.

ANSWER: e

126. How many unpaired electrons are in a chromium atom?
a. 0
b. 5
c. 6
d. 4
e. 3

ANSWER: c

127. How many unpaired electrons are in a calcium atom?
a. 1
b. 2
c. 3
d. 4
e. 5

ANSWER: b

128. An aluminum atom contains how many unpaired electrons?
a. 7
b. 6
c. 5
d. 4
e. 3

ANSWER: e

129. How many *f* electrons are in a gadolinium atom?
a. 7
b. 6
c. 5
d. 4
e. 3

ANSWER: a

130. How many unpaired electrons are in a chromium trivalent ion?
a. 0
b. 5
c. 6

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d. 4
e. 3

ANSWER: e

131. How many unpaired electrons are in a xenon atom?
a. 0
b. 1
c. 2
d. 3
e. 4

ANSWER: a

132. A chloride ion contains how many unpaired electrons?
a. 8
b. 6
c. 4
d. 2
e. 0

ANSWER: e

133. Write the ground-state electron configuration of a europium atom.
a. $[Xe]5d^7 6s^2$
b. $[Xe]4f^2 5d^5 6s^2$
c. $[Xe]4f^9$
d. $[Xe]4f^7 6s^2$
e. $[Xe]4f^5 5d^2 6s^2$

ANSWER: d

134. Write the ground-state electron configuration of a terbium atom.
a. $[Xe]4f^{11}$
b. $[Xe]4f^{10} 6s^1$
c. $[Xe]4f^9 6s^2$
d. $[Xe]4f^4 5d^5 6s^2$
e. $[Xe]4f^6 5d^5$

ANSWER: c

135. Write the ground-state electron configuration of a lead atom.
a. $[Xe]4f^{14} 5d^5 6s^1 6p^6 7s^2$

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b. $[Xe]4f^{14}5d^{10}6s^{2}6p^{2}$
c. $[Xe]4f^{14}5d^{10}6s^{1}6p^{3}$
d. $[Xe]4f^{14}5d^{10}6p^{4}$
e. $[Xe]4f^{14}5d^{9}6s^{2}6p^{3}$

ANSWER: b

136. Write the ground-state electron configuration of Ru^{2+}.
a. $[Kr]4d^{5}5s^{1}$
b. $[Kr]4d^{7}$
c. $[Kr]4d^{5}5p^{1}$
d. $[Kr]4d^{8}$
e. $[Kr]4d^{6}$

ANSWER: e

137. Write the ground-state electron configuration of a samarium atom.
a. $[Xe]4f^{7}5d^{1}$
b. $[Xe]5d^{8}$
c. $[Xe]4f^{7}6s^{1}$
d. $[Xe]4f^{8}$
e. $[Xe]4f^{6}6s^{2}$

ANSWER: e

138. Write the ground-state electron configuration of a tin(IV) ion.
a. $[Kr]4d^{3}5s^{1}5p^{6}$
b. $[Kr]4d^{4}5p^{6}$
c. $[Kr]4d^{5}5s^{2}5p^{3}$
d. $[Kr]4d^{5}5p^{5}$
e. $[Kr]4d^{10}$

ANSWER: e

139. Write the ground-state electron configuration of In^{+}.
a. $[Kr]4d^{7}5s^{2}5p^{3}$
b. $[Kr]4d^{8}5s^{1}5p^{3}$
c. $[Kr]4d^{5}5s^{1}5p^{6}$
d. $[Kr]4d^{10}5s^{2}$

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e. $[Kr]4d^{10}5s^{1}5p^{1}$

ANSWER: d

140. Write the ground-state electron configuration of Tl^{+}.

a. $[Xe]4f^{14}5d^{10}6p^{2}$

b. $[Xe]4f^{14}5d^{10}6s^{2}$

c. $[Xe]4f^{14}5d^{10}6s^{1}6p^{1}$

d. $[Xe]4f^{14}5d^{8}6s^{1}6p^{3}$

e. $[Xe]4f^{14}5d^{5}6s^{1}6p^{6}$

ANSWER: b

141. Write the ground-state electron configuration of Pb^{2+}.

a. $[Xe]4f^{14}5d^{5}6s^{1}6p^{6}$

b. $[Xe]4f^{14}5d^{10}6s^{2}$

c. $[Xe]4f^{14}5d^{5}6s^{2}6p^{5}$

d. $[Xe]4f^{14}5d^{10}6s^{1}6p^{1}$

e. $[Xe]4f^{14}5d^{10}6p^{2}$

ANSWER: b

142. Write the ground-state electron configuration of Sb^{3+}.

a. $[Kr]4d^{8}5s^{1}5p^{3}$

b. $[Kr]4d^{5}5s^{1}5p^{6}$

c. $[Kr]4d^{10}5p^{2}$

d. $[Kr]4d^{10}5s^{1}5p^{1}$

e. $[Kr]4d^{10}5s^{2}$

ANSWER: e

143. Write the ground-state electron configuration of Sb.

a. $[Kr]4d^{8}5s^{1}5p^{3}$

b. $[Kr]4d^{5}5s^{1}5p^{6}$

c. $[Kr]4d^{10}5p^{2}$

d. $[Kr]4d^{10}5s^{2}5p^{3}$

e. $[Kr]4d^{10}5s^{2}$

ANSWER: d

144. What is the ground-state electron configuration of Rb^{+}?

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a. [Kr]
b. $[Kr]5s^1$
c. [Ar]
d. $[Ar]4s^1$
e. $[Kr]4d^{10}$

ANSWER: a

145. For F^-, write the ground-state electron configuration.

a. $[Ne]2p^5$
b. [Ne]
c. [Ar]
d. $[He]2p^5$
e. $[He]1s^2$

ANSWER: b

146. Write the ground-state electron configuration of Fe^{3+}.

a. $[Ar]3d^54s^2$
b. $[Ar]3d^34s^2$
c. $[Ar]3d^34s^0$
d. $[Ar]3d^64s^1$
e. $[Ar]3d^34s^3$

ANSWER: b

147. What is the ground-state electron configuration of Nb?

a. $[Kr]4d^45s^1$
b. $[Kr]4d^55s^2$
c. $[Kr]5d^34s^2$
d. $[Kr]5d^35s^2$
e. $[Kr]4d^35s^2$

ANSWER: e

148. Write the ground-state electron configuration of Cl^+.

a. $[Ne]3s^23p^4$
b. $[Ne]3s^23p^5$
c. $[Ne]3s^13p^4$
d. $[Ne]3s^23p^6$

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e. $[Ar]3s^2 3p^4$

ANSWER: a

149. All the following can have the ground-state electron configuration $[Xe]4f^{14}5d^{10}$ except
a. Pb^{4+}.
b. Hg^{2+}.
c. Bi^{5+}.
d. Tl^{+}.
e. Au^{+}.

ANSWER: d

150. All the following can have the ground-state electron configuration $[Kr]4d^{10}$ except
a. Cd^{2+}.
b. Ag^{+}.
c. Pd.
d. In^{+}.
e. Sn^{4+}.

ANSWER: d

151. Which of the following has the smallest atomic radius?
a. Cl
b. P
c. S
d. Si
e. Al

ANSWER: a

152. Which of the following has the largest atomic radius?
a. S^{2-}
b. Cl
c. Cl^{-}
d. K^{+}
e. S

ANSWER: a

153. Rank the following atoms in order of increasing atomic radius: N, Cl, K, Ca, and P
a. N < Cl < P < K < Ca
b. Cl < P < N < K < Ca

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c. Cl < N < P < Ca < K
d. N < Cl < P < Ca < K
e. K < Ca < P < Cl < N

ANSWER: d

154. Which of the following species is isoelectronic with S^{2-}?
a. Mg^{2+}
b. Rb^{+}
c. Ar
d. As^{3-}
e. Br^{-}

ANSWER: c

155. Which of the following species is isoelectronic with Kr?
a. K^{+}
b. Cl^{-}
c. Ar
d. Xe
e. Sr^{2+}

ANSWER: e

156. Which of the following species is isoelectronic with As^{3-}?
a. Na^{+}
b. Cl^{-}
c. Ar
d. Kr
e. Ba^{2+}

ANSWER: d

157. Si^{4+} is isoelectronic with which of the following?
a. K^{+}
b. Ne
c. Kr
d. Cl^{-}
e. Sr^{2+}

ANSWER: b

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158. Which of the following atoms or ions is isoelectronic with Be^{2+}?

a. Na^{+}
b. Br^{-}
c. He
d. Xe
e. He^{+}

ANSWER: c

159. Which of the following has the largest atomic radius?

a. F
b. O
c. N
d. C
e. B

ANSWER: e

160. Of the following, which has the largest atomic radius?

a. Ga
b. Ge
c. As
d. Se
e. Br

ANSWER: a

161. Which of the following species is isoelectronic with Ra^{2+}?

a. I^{-}
b. Kr
c. Xe
d. Rn
e. Fr

ANSWER: d

162. From the data below, which element is likely to be a metal?

Element	First ionization energy, $kJ \cdot mol^{-1}$
1	1310
2	1011
3	418
4	2080

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5	947

a. 2
b. 5
c. 3
d. 1
e. 4

ANSWER: c

163. From the data below, which elements are likely to be nonmetals?

Element	First ionization energy, kJ·mol^{-1}
1	1310
2	980
3	418
4	2080
5	947

a. 3 and 5
b. 3 only
c. 1 and 4
d. 1 and 2
e. 2 and 5

ANSWER: c

164. From the data below, which elements have only one valence electron?

Element	First ionization energy, kJ·mol^{-1}	Second ionization energy, kJ·mol^{-1}
1	519	7300
2	900	1760
3	799	2420
4	494	4560
5	418	3070

a. 1, 4, and 5
b. 2 and 3
c. 1 only
d. 2 only
e. 4 and 5

ANSWER: a

165. Rank the following atoms in order of increasing first ionization energy: He, C, F, K, Al

a. F < He < C < Al < K

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b. K < Al < C < F < He
c. K < C < Al < He < F
d. Al < K < F < C < He
e. Al < K < C < F < He

ANSWER: b

166. Which of the following is likely to form ions two units lower in charge than expected from the group number?
a. Tl
b. Hg
c. Zn
d. Se
e. Cd

ANSWER: a

167. Which of the following is likely to form ions two units lower in charge than expected from the group number?
a. Hg
b. Cd
c. Sb
d. Ge
e. Zn

ANSWER: c

168. Given the elements Cl, Ge, and K and three values of possible first ionization energies, 418, 1255, 784 $kJ \cdot mol^{-1}$, match the atoms with their first ionization energies.
a. Cl (418), Ge (784), and K (1255 $kJ \cdot mol^{-1}$)
b. Cl (1255), Ge (784), and K (418 $kJ \cdot mol^{-1}$)
c. Cl (784), Ge (1255), and K (418 $kJ \cdot mol^{-1}$)
d. Cl (1255), Ge (418), and K (784 $kJ \cdot mol^{-1}$)
e. Cl (418), Ge (1255), and K (784 $kJ \cdot mol^{-1}$)

ANSWER: b

169. If the second ionization energy of copper is 1958 $kJ \cdot mol^{-1}$, the first ionization energy is likely to be greater than 1958 $kJ \cdot mol^{-1}$. True or false?
a. True
b. False

ANSWER: b

170. Consider the following ground-state electronic configurations. Which atom has both the highest first

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ionization energy and the highest electron affinity?

a. [Ne] $3s^2 3p^5$
b. [Ne] $3s^2 3p^3$
c. [Ne] $3s^2 3p^1$
d. [Ne] $3s^2 3p^4$

ANSWER: a

171. Which atom has the highest first ionization energy?

a. Mg
b. Ca
c. Sr
d. Ba

ANSWER: a

172. Which atom has the highest second ionization energy?

a. Cs
b. Na
c. Li
d. K

ANSWER: c

173. Consider the following ground-state electronic configurations. Which atom has the highest electron affinity?

a. [He] $2s^2 2p^5$
b. [He] $2s^2 2p^3$
c. [He] $2s^2 2p^1$
d. [He] $2s^2 2p^4$

ANSWER: a

174. Which atom has the highest first ionization energy?

a. Pb
b. Sn
c. Ge
d. Si

ANSWER: d

175. Which atom has the lowest electron affinity?

a. Al
b. Si

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c. P
d. S

ANSWER: a

176. Consider the following ground-state electronic configurations. Which atom has the lowest first ionization energy?

a. [Ne] $3s^2 3p^5$
b. [Ne] $3s^2 3p^3$
c. [Ne] $3s^2 3p^1$
d. [Ne] $3s^2 3p^4$

ANSWER: c

177. In each pair, which ionization reaction is larger?

(a) I_3 of B; or I_3 of Be _____

(b) I_4 of C; or I_3 of B _____

ANSWER: (a) I_3 of Be; (b) I_4 of C

178. What are the subshell notation and the number of orbitals having the quantum numbers $n = 4$, $l = 3$?

a. 4d and 5
b. 4p and 3
c. 3f and 7
d. 3d and 5
e. 4f and 7

ANSWER: e

179. What are the subshell notation and the number of orbitals having the quantum numbers $n = 4$, $l = 2$?

a. 4d and 10
b. 4f and 14
c. 4d and 5
d. 4p and 3
e. 4f and 7

ANSWER: c

180. Which of the following would be most reactive with air and water?

a. Ba
b. Mg
c. Ga
d. Br

ANSWER: a

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181. Which of the following has similar properties to Al?
a. Li
b. Be
c. Si
d. Ga
e. Mg
ANSWER: b

182. Which of the following elements has the least metal character?
a. In
b. Ge
c. Te
d. I
e. Tl
ANSWER: d

183. All the following are metalloids except:
a. B.
b. As.
c. Ge.
d. Sb.
e. Si.
ANSWER: a

184. All the following are metals except:
a. Cd.
b. Zn.
c. Ge.
d. Al.
e. Ga.
ANSWER: c

185. All the following are transition metals except:
a. Cd.
b. Cu.
c. Pd.
d. Pb.
e. Ag.
ANSWER: d

186. All the following are non-metals except

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a. C.
b. S.
c. Ga.
d. Se.
e. Cl.

ANSWER: c

187. Which of the following is not a metal?
a. Ba.
b. Br.
c. Ga.
d. Al.
e. Hg.

ANSWER: b

188. Of the following, which is not an alkali metal?
a. Cs.
b. Fr.
c. K.
d. Rb.
e. Re.

ANSWER: e

189. All the following are diatomic gases except
a. Hydrogen.
b. Fluorine.
c. Oxygen.
d. Neon.
e. Nitrogen.

ANSWER: d

190. How many nodal planes are expected for 2*s* and 4*f* orbitals, respectively?
a. 0 and 4
b. 0 and 3
c. 2 and 4
d. 1 and 4
e. 1 and 3

ANSWER: b

191. Which of the following subshells cannot exist in an atom?
a. 4d

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b. 5g
c. 5f
d. 4f
e. 3f

ANSWER: e

192. What is the inert-pair effect?

ANSWER: The inert-pair effect is the tendency to form ions two units lower in charge than expected from the group number.

193. When an electron is added to a gaseous chlorine atom, 349 $kJ \cdot mol^{-1}$ of energy is released. What is the ionization energy of a gaseous chloride ion?

ANSWER: $+349\ kJ \cdot mol^{-1}$

194. Which of the following atoms has the highest electron affinity?

a. Ar
b. P
c. Al
d. Si

ANSWER: d

195. Because of fluorine's high electronegativity, less energy is required to make F^{2-} from F^{-} than to make O^{2-} from O^{-}. True or false?

a. True
b. False

ANSWER: b

196. Which of the following has the largest effective nuclear charge?

a. F
b. Na
c. Li
d. He
e. N

ANSWER: a

197. Which of the following has the largest radius?

a. P^{3-}
b. Cl^{-}
c. K^{+}
d. Cl

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e. N^{3-}

ANSWER: a

198. Which of the following has the largest radius?
a. Cr
b. Cl
c. Cu
d. Gd
e. Ga

ANSWER: d

199. Which of the following has the smallest radius?
a. P^{+5}
b. P^{3-}
c. N^{+5}
d. N
e. N^{3-}

ANSWER: c

200. Which of the following has the largest radius?
a. Fe^{3+}
b. Fe^{2+}
c. Fe
d. F
e. F^{-}

ANSWER: c

201. Which of the following has the largest effective nuclear charge?
a. Al
b. Si
c. P
d. S
e. Cl

ANSWER: e

202. Which of the following has the largest radius?
a. N^{3-}
b. F^{-}

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c. H^+
d. He
e. O^{2-}

ANSWER: a

203. Which of the following has the smallest radius?
a. B^{3+}
b. C^{4+}
c. Fe^{2+}
d. Fe
e. Fe^{3+}

ANSWER: e

204. How many unpaired electrons exist in the ground state of a Cu^+ ion?
a. 0
b. 2
c. 1
d. 3
e. 5

ANSWER: a

205. Which of the following pairs of elements has members with similar properties?
a. B and Si
b. Li and Be
c. Mg and Al
d. Na and Ca
e. Se and I

ANSWER: a

206. Which of the following pairs of elements has members with similar properties?
a. Mg and Al
b. Li and Be
c. Mg and Ge
d. Na and Ca
e. None of the above.

ANSWER: e

207. Which quantum number is independent of the others?
a. The principle quantum number

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b. The azimuthal quantum number
c. The magnetic quantum number
d. The spin quantum number
e. None, there is some form of dependence for each.

ANSWER: d

208. Why is gamma radiation one of the most harmful forms of radiation to living organisms?
a. It can ionize covalent bonds, and destroy cells.
b. It has low frequency and high wavelength.
c. It has lower frequency than beta radiation.
d. It is not a dangerous form of radiation; X-rays are more damaging.

ANSWER: a

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