

PRACTICE PROBLEMS FOR CHAPTER 7 and 8 (Answers in the end)

- 7.1 The relationship between the speed, wavelength, and frequency of electromagnetic radiation is
- $\nu = \frac{c}{\lambda}$.
 - $\nu = \frac{\lambda}{c}$.
 - $\nu = c + \lambda$.
 - $\nu = \frac{\lambda + c}{\lambda}$.
 - $\nu = 1 + \frac{\lambda}{c}$.
- 7.4 Which of these types of radiation has the highest frequency?
- radio waves
 - infrared
 - microwaves
 - ultraviolet
 - visible
- 7.6 Blue light has a _____ frequency and a _____ wavelength than x-rays.
- higher, shorter
 - higher, longer
 - lower, lower
 - lower, longer
 - lower, shorter
- 7.11 What is the energy of **ONE MOLE** of photons with a wavelength of 375 nm? ($h = 6.63 \times 10^{-34} \text{ J} \cdot \text{s}$, one mole contains N photons, where $N = 6.02 \times 10^{23}$)
- $5.30 \times 10^{-19} \text{ J}$
 - $2.66 \times 10^{-18} \text{ J}$
 - $2.39 \times 10^5 \text{ J}$
 - $3.19 \times 10^5 \text{ J}$
 - $1.60 \times 10^6 \text{ J}$
- 7.14 The first ionization energy of lithium is $8.64 \times 10^{-19} \text{ J/atom}$. Calculate the minimum frequency of light that is required to ionize a lithium atom. (Planck's constant is $6.63 \times 10^{-34} \text{ J} \cdot \text{s}$.)
- $1.46 \times 10^{-15} \text{ s}^{-1}$
 - $1.46 \times 10^{-12} \text{ s}^{-1}$
 - $1.30 \times 10^{12} \text{ s}^{-1}$
 - $5.70 \times 10^{14} \text{ s}^{-1}$
 - $1.30 \times 10^{15} \text{ s}^{-1}$
- 7.16 The square of the wave function, ψ^2 , of an electron in an atom
- describes the energy of the electron.
 - specifies the momentum of the electron.
 - gives the probability of finding the electron in a region of space.
 - is proportional to the velocity of the electron.
 - is inversely proportional to the distance between the electron and the nucleus.

- 7.18 From the Bohr model of the hydrogen atom we can conclude that the energy required to excite an electron from $n = 2$ to $n = 3$ is _____ the energy to excite an electron from $n = 3$ to $n = 4$.
- less than
 - greater than
 - equal to
 - either equal to or less than
 - either equal to or greater than

The following choices are for Questions 7.22 through 7.24.

- Rutherford
 - de Broglie
 - Bohr
 - Thomson
 - Heisenberg
- 7.22 Who measured the charge of an electron?
- 7.23 Whose postulates account for the line spectrum of an atom?
- 7.24 Who discovered the nucleus of an atom?
- 7.25 Einstein's work on the photoelectric effect made extensive use of the equation
- $E = mc^2$.
 - $v = c/\lambda$
 - $E = -\frac{R_H}{n^2}$.
 - $E = h\nu$.
 - $\Delta E = -R_H \left(\frac{1}{n_2^2} - \frac{1}{n_1^2} \right)$.
- 7.27 All the following statements about the quantum numbers are true **EXCEPT**
- n has integral values from 1 to ∞ .
 - l has values from 1 to $n - 1$.
 - m_l has $2l + 1$ values.
 - m_l has values of $+1$ to -1 , including zero.
 - m_s has values of $+\frac{1}{2}$ and $-\frac{1}{2}$.
- 7.33 Which of the following sets of quantum numbers is **NOT** permissible?
- $n = 1, l = 0, m_l = 0, m_s = +\frac{1}{2}$
 - $n = 4, l = 0, m_l = 0, m_s = +\frac{1}{2}$
 - $n = 3, l = 3, m_l = -3, m_s = -\frac{1}{2}$
 - $n = 2, l = 1, m_l = 1, m_s = -\frac{1}{2}$
 - $n = 2, l = 0, m_l = 0, m_s = +\frac{1}{2}$
- 7.35 All the following statements are true **EXCEPT**
- the $n = 2$ energy level has d orbitals.

- b. the 2p orbitals can have a maximum of 6 electrons.
 - c. the s orbital has a spherical shape.
 - d. there are 5 d orbitals in a set.
 - e. the fourth major energy level has one set of f orbitals.
- 7.41 Which of the following orbital representations is (are) allowed?
- 1. 3s
 - 2. 3p
 - 3. 3d
- a. 1 only
 - b. 2 only
 - c. 3 only
 - d. 1 and 2 only
 - e. 1, 2, and 3
- 7.43 Which of the following sets of quantum numbers refers to a 3d orbital?
- a. $n = 2, l = 2, m_l = 2, m_s = +1/2$
 - b. $n = 3, l = 2, m_l = 2, m_s = +1/2$
 - c. $n = 4, l = 2, m_l = 2, m_s = -1/2$
 - d. $n = 4, l = 3, m_l = 3, m_s = -1/2$
 - e. $n = 5, l = 4, m_l = 3, m_s = +1/2$
- 7.51 The possible value(s) of the magnetic quantum number m_l for a 5d electron is (are)
- a. 0, 1, 2, 3.
 - b. 1, 2, 3, 4.
 - c. 2, 1, 0, -1, -2.
 - d. 3, 2, 1, 0, -1, -2, -3.
 - e. 4.

PRACTICE PROBLEMS FOR CHAPTER 8. (Answers in the end)

8.4 The n and l quantum numbers of the “last” electron of an element are $n = 5$ and $l = 1$. The element could be a

1. metal.
2. nonmetal.
3. metalloid.

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

8.7 The maximum number of electrons that can be accommodated in a p subshell is

- a. 2.
- b. 4.
- c. 6.
- d. 8.
- e. 10.

8.11 The Pauli exclusion principle requires that

- a. both the position of an electron and its momentum cannot be known simultaneously very accurately.
- b. the wavelength and mass of a subatomic particle are related by $\lambda = h/mv$.
- c. the wavelength of a photon of light times its frequency is equal to the speed of light.
- d. no two electrons in the same atom can have the same set of four quantum numbers.
- e. an electron can have either particle character or wave character

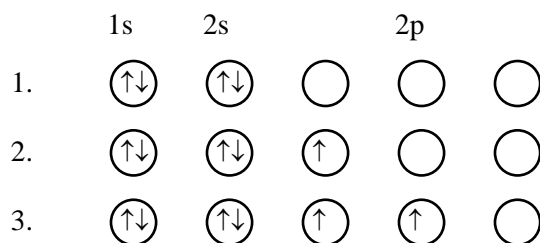
8.14 The total number of electrons in ALL p orbitals in a nickel atom is

- a. 6.
- b. 12.
- c. 18.
- d. 24.
- e. 30.

8.17 From a consideration of electronic configurations, which of the elements indicated below would be classified as a **TRANSITION** element?

- a. $1s^2, 2s^2, 2p^2$
- b. $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$
- c. $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
- d. $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^2$
- e. $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6$

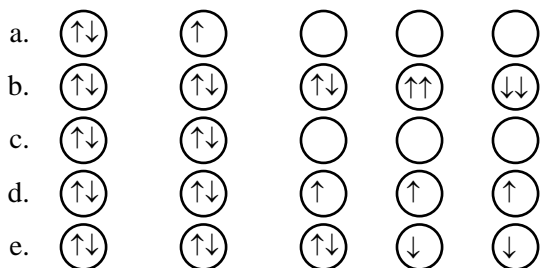
8.18 Which of the following orbital diagrams represents a paramagnetic atom?



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

8.20 Which of the following orbital diagrams is **IMPOSSIBLE** according to the Pauli exclusion principle?





- 8.23 Which ground-state electron configuration is **INCORRECT**?
- Cr: $[\text{Ar}] 3d^6$
 - Ca: $[\text{Ar}] 4s^2$
 - Na: $1s^2 2s^2 2p^6 3s^1$
 - Zn: $[\text{Ar}] 3d^{10} 4s^2$
 - Kr: $[\text{Ar}] 3d^{10} 4s^2 4p^6$
- 8.27 The ground-state electron configuration of a Fe^{2+} ion is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$. Therefore, Fe^{2+} is
- diamagnetic.
 - paramagnetic with one unpaired electron.
 - paramagnetic with two unpaired electrons.
 - paramagnetic with four unpaired electrons.
 - paramagnetic with five unpaired electrons.
- 8.30 Which of the following statements about different elements are true?
- As is a metalloid and Se is a nonmetal.
 - Cu is a transition element and Ge is a metalloid.
 - Both F and I are halogens.
- 1 only
 - 2 only
 - 3 only
 - 1 and 2 only
 - 1, 2 and 3
- 8.33 Where on the periodic table are the most nonmetallic elements found?
- top of Group VIIA
 - top of Group IA
 - top of Group IB
 - bottom of Group VIA
 - bottom of Group IIA
- 8.38 A periodic law based on atomic masses would necessitate ${}_{52}\text{Te}$ and ${}_{53}\text{I}$ changing places in the periodic table. This was not done in the early periodic table because
- it was thought that the atomic masses may be in error.
 - iodine contains one naturally occurring isotope, whereas tellurium consists of several isotopes.
 - a periodic law based on atomic masses is not valid.
 - the tellurium samples could contain a heavy impurity.
 - iodine behaves chemically like chlorine and bromine.
- 8.41 $1s^2 2s^2 2p^6 3s^2 3p^4$

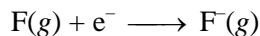
Atoms of an element X have the electronic configuration shown above. The compound most likely formed with scandium is

- a. ScX.
- b. ScX₂.
- c. Sc₃X₂.
- d. Sc₂X₃.
- e. Sc₂X₅.

8.45 Which of the following atoms has the **LARGEST** atomic radius?

- a. Sr b. Mg c. P d. I e. Kr

8.48 The electron affinity value expected for the process



would be

- a. a large negative number.
- b. a small negative number.
- c. zero.
- d. a small positive number.
- e. a large positive number.

8.55 Which one of the following elements would be expected to have the **SMALLEST** atomic radius?

- a. Li
- b. Cs
- c. F
- d. Br
- e. I

8.56 Which of the following elements has the **SMALLEST** first ionization energy?

- a. ¹⁵P b. ¹⁹K c. ⁶C d. ¹²Mg e. ¹⁸Ar

The following choices are for Questions 8.57 through 8.59.

- a. $\text{I}(g) + e \longrightarrow \text{I}^{-}(g)$
- b. $\text{I}_2(g) \longrightarrow 2\text{I}(g)$
- c. $\text{I}(g) \longrightarrow \text{I}^{+}(g) + e$
- d. $\text{Na}(g) + \text{I}(g) \longrightarrow \text{NaI}(s)$
- e. $\text{Na}(s) + \frac{1}{2}\text{I}_2(s) \longrightarrow \text{NaI}(s)$

8.57 Which process represents the heat of formation?

8.58 Which process represents the electron affinity?

8.59 Which process represents the ionization energy?

8.64 Which of the following properties, in general, increase as we move left to right across a period in the periodic table?

- 1. atomic radius
- 2. ionization energy
- 3. metallic character

- a. 1 only
- b. 2 only
- c. 3 only
- d. 1 and 2 only
- e. 2 and 3 only

8.68 Which element forms the most acidic oxide?

- a. In b. B c. Al d. Tl e. Ga

8.75 Consider the ions of S^{2-} , O^{2-} , F^- , Na^+ , Mg^{2+} . Which of the following presents the radius of the ions from largest to smallest?

- a. S^{2-} , O^{2-} , F^- , Na^+ , Mg^{2+}
- b. O^{2-} , F^- , Na^+ , Mg^{2+} , S^{2-}
- c. Mg^{2+} , Na^+ , F^- , O^{2-} , S^{2-}
- d. Mg^{2+} , S^{2-} , Na^+ , F^- , O^{2-}
- e. O^{2-} , S^{2-} , F^- , Na^+ , Mg^{2+}

Answers:

8.4 *e. 1, 2, and 3

8.7 *c. 6.

8.11 *d. no two electrons in the same atom can have the same set of four quantum numbers.

8.14 *b. 12.

8.17 *d. $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^2$

8.18 *e. 2 and 3 only

8.20 *b. $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\uparrow$ $\downarrow\downarrow$

8.23 *a. Cr: $[Ar] 3d^6$

8.27 *d. paramagnetic with four unpaired electrons.

8.30 *e. 1, 2 and 3

8.33 *a. top of Group VIIA

8.38 *e. iodine behaves chemically like chlorine and bromine.

8.41 *d. Sc_2X_3 .

8.45 *a. Sr

8.48 *a. a large negative number.

8.55 *c. F

8.56. *b. ${}_{19}K$

8.57 *e.

8.58 *a.

8.59 *c.

8.64 *b. 2 only

8.68 *b. B

8.75 *a. S^{2-} , O^{2-} , F^- , Na^+ , Mg^{2+}

Answers:

7.1 *a. $\nu = \frac{c}{\lambda}$.

7.4

*d. ultraviolet

7.6

*d. lower, longer

7.11

*d. $3.19 \times 10^5 \text{ J}$

7.14

*e. $1.30 \times 10^{15} \text{ s}^{-1}$

7.16

*c. gives the probability of finding the electron in a region of space.

7.18

*b. greater than

7.22

*d.

7.23

*c.

7.24

*a.

7.25

*d. $E = h\nu$.

7.27

*b. l has values from 1 to $n - 1$.

7.33

*c. $n = 3, l = 3, m_l = -3, m_s = -\frac{1}{2}$

7.35

*a. the $n = 2$ energy level has d orbitals.

7.41

*e. 1, 2, and 3

7.43

*b. $n = 3, l = 2, m_l = 2, m_s = +1/2$

7.51

*c. 2, 1, 0, -1, -2.