Study Guide Answers
Chapter 6

Name: ____________________

Date:________________ Per:________

$c = \lambda\nu$	**λ = wavelength**	**c = speed of light (3.0×10^8 m/s) * 2 sig figs**
$E = h\nu$	**ν = frequency**	**h = Planck's constant (6.6262×10^{-34} J•s)**
	E = energy	

1. What is the wavelength of a wave having a frequency of 3.76×10^{14} s^{-1}?

   $\lambda = c/\nu = (3.0 \times 10^8 \text{m/s}) / (3.76 \times 10^{14} \text{/s}) =$ $\boxed{8.0 \times 10^{-7} \text{ m}}$ *

2. What is the frequency of a 6.9×10^{-13} m wave?

   $\nu = c/\lambda = (3.0 \times 10^8 \text{m/s}) / (6.9 \times 10^{-13} \text{ m}) =$ $\boxed{4.3 \times 10^{20} \text{ /s}}$ *

3. How does the increased size of the energy level drop for an electron relate to the energy emitted?

   The greater the stability achieved by an electron moving to a ground state from an excited state, the greater the energy emitted. Generally, the greater the drop in terms of energy level, the greater the stability achieved. In the Rydberg equation the difference used to calculate the energy is based on the difference of the inverse squares, so not all drops of x energy levels are equal. For example: A drop of 2 levels from 3 to 1 gives $R(1/1^2 - 1/3^2) = 0.8889R$, where a drop of 2 levels from 4 to 2 gives $R(1/2^2 - 1/4^2) = 0.1875R$ (where R = the Rydberg constant). So, electrons dropping to the 1st energy level emit more energy because the electron is achieving greater stability.

4. What is the wavelength of a 1.528×10^{-13} J wave?

   λ = ?
   $E = 1.528 \times 10^{-13}$ J

   $E = h\nu$ (or $\nu = E/h$)

   Substitute into $\lambda = c/\nu$
   $\lambda = c/\nu E/h \rightarrow \lambda = hc/E$

   $\lambda = hc/E = (6.6262 \times 10^{-34} \text{J·s} \times 3.0 \times 10^8 \text{m/s}) / 1.528 \times 10^{-13} \text{ J} =$ $\boxed{1.3 \times 10^{-12} \text{ m}}$ *

5. What is the energy of a 9330cm wave?

   E = ?
   λ = 9330 cm (93.3 m)

   $E = h\nu$
   $\nu = c/\lambda$

   $E = hc/\lambda = (6.6262 \times 10^{-34} \text{J·s} \times 3.0 \times 10^8 \text{m/s}) / 93.3 \text{ m} =$ $\boxed{2.1 \times 10^{-27} \text{ J}}$ *

6. Write the quantum numbers for the **shaded** electron in the following diagrams:

   a. 3p orbitals [↑↓] [↑↓] [↑] — 3,1,-1,-1/2

   c. 4d orbitals [↑↓] [↑↓] [↑↓] [↑↓] [↑↓] — 4,2,0,-1/2

   b. 5s orbital [↑↓] — 5,0,0,+1/2

   d. 3d orbitals [↑↓] [↑] [↑] [↑] [↑] — 3,2,+2,+1/2

7. Fill in the following table regarding sublevels and orbitals.

Sublevel	Shape	Number of Orbitals	Maximum Number of Electrons
s	Sphere	1	2
p	Dumbbell	3	6
d	Clover	5	10
f	Many lobed	7	14

8. The distribution of electrons among orbitals is given by the atom's __electron configuration__.

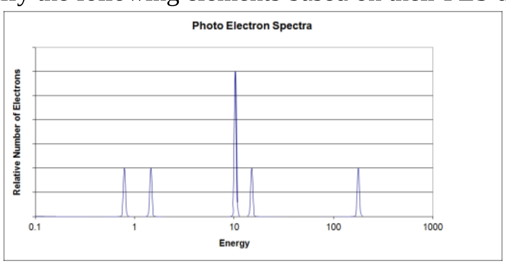
9. When electrons are located in the lowest energy orbitals possible the atom is said to be __grounded__.

Study Guide Answers
Chapter 6

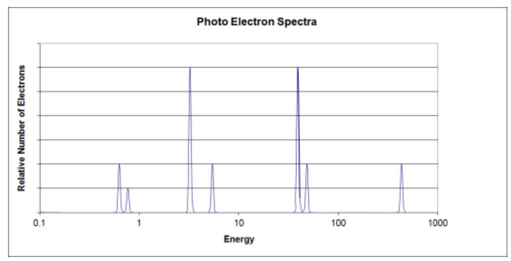
Name: ______________________

Date:________________ Per:________

10. When electrons absorb energy, they are said to be ___excited_______________________________.
11. As electrons lose energy, they give off that energy in the form of ____photons of EM radiation__________.
12. How many sub-levels are completely filled in:
    - a. Sn _10_.
    - b. V _6_.
    - c. Ga _7_.
    - d. Zn _7_.
    - e. I^- _11_.
13. How many orbitals are partially filled in:
    - a. As _3_.
    - b. Fe _4_.
    - c. Ag _1_.
    - d. Zr _2_.
    - e. Se^{2-} _0_.
14. Write the complete electron configuration for the following elements:
    - a. Cl ___$1s^22s^2p^63s^2p^5$___
    - b. Kr ___$1s^22s^2p^63s^2p^64s^23d^{10}4p^6$___
    - c. Sc ___$1s^22s^2p^63s^2p^64s^23d^1$___
    - d. K ___$1s^22s^2p^63s^2p^64s^1$___
    - e. Li ___$1s^22s^1$___
    - f. Sn $1s^22s^2p^63s^2p^64s^23d^{10}4p^65s^24d^{10}5p^2$
15. Identify the following elements based on their PES data:

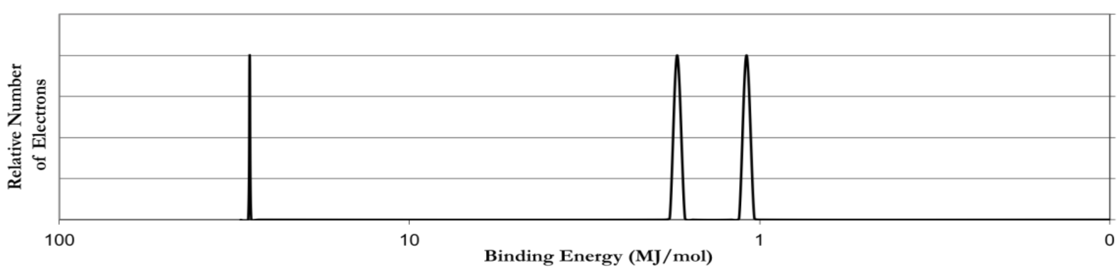


The element is _____silicon_____.



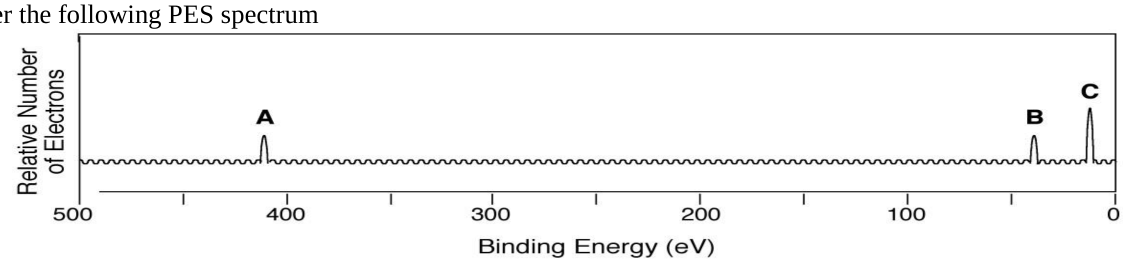
The element is _____scandium_____.

16. Refer to the PES spectrum below. Make note of the relative energies of each peak.



    - a. How do the peak heights compare? What does this tell us about the relative number of electrons represented by each? ____All peaks have same intensity representing that the relative numbers of electrons at each binding energy are equal. All energies represent 2 electrons.________
    - b. If the peaks shown represent all electrons in this atom, identify the element. ____carbon ($1s^22s^2p^2$)________
    - c. Which peak represents the core (innermost) electrons? Explain. _The left most peak occurring at approximately 50MJ/mol (highest energy representing the 1s sublevel)________

17. Consider the following PES spectrum



Study Guide
Chapter 6

Name: ________________________

Date:________________ Per:________

a. Using the plot, write the electron configuration of the element, and identify it. __$1s^2 2s^2 p^4$ oxygen______________

b. Label each peak with the appropriate shell and subshell.

c. Suggest a reason for the huge jump in energy between peak A and peak B._____Core electrons (A) shield valence electrons (B), lowering effective nuclear charge. Furthermore, B electrons are farther from nucleus lowering coulombic attraction (further lowering effective nuclear charge).____

d. This element has a very high first ionization energy *and* a very high electron affinity. Would you expect it to form a cation or anion? What would be the charge of the ion? Justify your answers. High first ionization energy and high electron affinity are properties of non-metals, increasing with effective nuclear charge. This element would form a anion as it would be unlikely to lose electrons (high first ionization energy) and would release a great deal of energy upon adding electrons (high electron affinity). Given that it appears to have 4 electrons in the 2p sublevel, this element would likely ionize by gaining 2 electrons, forming a 2- charge. ______________________________

e. Write the electron configuration for the ion.____$1s^2 2s^2 p^6$ (isoelectronic with neon)__________________________

f. How would the radius of the ion compare to the radius of the neutral atom. Use Coulomb's law to justify your response._When the atom ionizes by gaining electrons, it becomes larger due to the spreading of the nuclear charge among a greater number of electrons and the increased electron repulsion between electrons in the electron cloud.