Differentiated Chemistry: Ch. 6 Worksheet. Name Answer Key

Be sure to write in complete sentences and show all your work.

1. What does it mean to say that the energies of the electrons in hydrogen atoms are quantized?

Electrons gain and lose incremental amounts of energies as they move between energy levels. These quanta of energy are absorbed or released causing the electrons to move.

2. What is the energy of an electron, in electron-volts, in the n = 7 energy level of a hydrogen atom.

$E = -R_H \frac{Z^2}{n^2} = \frac{-2.179\times10^{-18}\,J \cdot 1^2}{7^2} = -4.45\times10^{-20}\,J$

$1eV = 1.602\times10^{-19}\,J$

$= -0.278\,eV$

3. FM-104, an FM radio station, broadcasts at a frequency of $1.039 \times 10^8\ s^{-1}$ (103.9 megahertz). What is the wavelength of these waves in meters?

$\lambda = \frac{c}{\upsilon}$ $\qquad \frac{m \,\|\, 2.998\times10^8\,m \,|\, s}{s \,|\, 1.039\times10^8} = 2.885\,m$

4. When heated, lithium atoms emit photons of red light with a wavelength of 6708 Å. What is the energy in joules and the frequency of this light?

$\upsilon = \frac{c}{\lambda}$ $\qquad \frac{\|\, 2.998\times10^8\,m \,|\, s}{6708\,Å \,|\, \frac{1\times10^{10}\,Å}{1\,m}} = \boxed{4.469\times10^{14}\,s^{-1}}$

$\frac{\|\, 2.998\times10^8\,m \,|\, s}{6708\,Å \,|\, \frac{1\times10^{10}\,Å}{1\,m} \,|\, 6.626\times10^{-34}\,J\cdot s} = \boxed{2.961\times10^{-19}\,J}$

5. In the Helium ion, He^{+1}, one electron moves from the n = 3 to the n = 1 energy levels, calculate the energy change, frequency, wavelength and type of wave that is emitted.

$E = -R_H\left(\frac{Z^2}{n_f^2} - \frac{Z^2}{n_i^2}\right) = -2.179\times10^{-18}\,J\left(\frac{1^2}{3^2} - \frac{1^2}{1^2}\right) = \boxed{7.75\times10^{-18}\,J}$

$\upsilon = E/h = 7.75\times10^{-18}\,J / 6.626\times10^{-34}\,J\cdot s = \boxed{1.17\times10^{19}\,s^{-1}}$

$\lambda = 2.998\times10^8\,m/s \,/\, 1.17\times10^{19}\,s^{-1} = 2.56\times10^{-8}\,m$

$= 25.6\,nm$

$\Rightarrow$ U.V.

6. Using Bohr's Model of the atom and Planck's concept of the quantum, explain how Einstein proposed an explanation of the photoelectric effect.

The photo electric effect states that atoms can absorb a certain amount of e.m.r. and electrons can be liberated as an electric current. Electrons can be "excited" by absorbing photons/quanta and move to a higher energy level. If the quanta is appropriate, the e^- can be released w/ a critical energy

7. The de Broglie wavelength of a particle of mass 6.86×10^{-27} kg is 5.03×10^{-15} m. How fast is the particle traveling? Use the following equation: $\lambda = h/mv$

$\lambda = h/mv$ $\qquad \frac{\|\, 6.626\times10^{-34}\,J\cdot s \,|\, 6.86\times10^{-27}\,kg \,|\, 5.03\times10^{-15}\,m \,|\, \frac{kg\cdot m^2}{1J\cdot s^2}}$

$V = \frac{h}{m\cdot\lambda}$

$= 1.92\times10^7\,m/s$

$1J = 1N\cdot m$

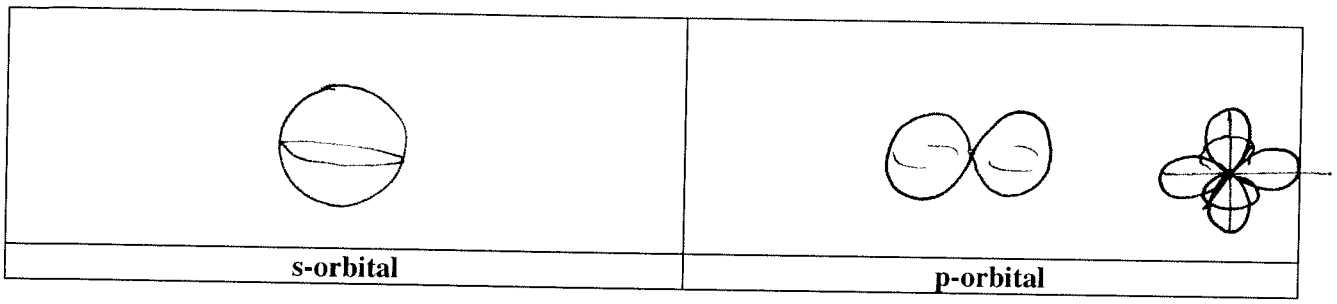
$1N = 1kg\cdot\frac{m}{s^2}$

$1J = kg\cdot m^2$

8. For each quantum number, list the symbol and give a brief description.

Quantum #	Symbol	Description
Principal	n	describes the energy levels (Bohr) - periods on P.T.
Subshell	ℓ	describes the types of orbitals that comprise the sublevels of an energy level
Magnetic	m_ℓ	describes the different orientations of orbitals within a subshell
Spin	m_s	describes one of two spins electrons can have in an orbital

9. Draw a representation of an energy levels subshell containing these orbitals.



s-orbital	p-orbital

10. Complete the following table to indicate the total number of orbitals in each energy level (n). In the remaining columns, specify how many of those orbitals are s, p, d, and f.

Level *n*	Total # of orbitals	# of *s*-orbitals	# of *p*-orbitals	# of *d*-orbitals	# of *f*-orbitals
1	1	1	–	–	–
2	4	1	3	–	–
3	9	1	3	5	–
4	16	1	3	5	7

11. Write electron configurations and orbital diagrams for sodium and oxygen. Using these two sets of information explain why sodium oxide has the chemical formula Na_2O.

Na: $1s^2 2s^2 2p^6 3s^1$ O: $1s^2 2s^2 2p^4$

$\uparrow\downarrow$: $\uparrow\downarrow$, $\uparrow\downarrow\ \uparrow\downarrow\ \uparrow$: $\uparrow$ $\uparrow\downarrow$: $\uparrow\downarrow$, $\uparrow\downarrow\ \uparrow\ \uparrow$

Sodium has one valence which could be lost to the oxygen valence shell. But with Oxygen having 2 empty spots, it would require 2 sodium atoms.