Chem 1104 - 2018 Summer Problem Set #7

1. Calculate the wavelength in meters of electromagnetic radiation with a frequency of 5.5×10^{15} Hz.

2. The photoelectric effect consists of the emission of electrons from the surface of a metal when the metal is exposed to light. A photon with a minimum energy of 3.87×10^{-19} J is necessary to eject an electron from the metal barium. a) What frequency and wavelength(in nanometers) corresponds to this value? b) Will blue light with a wavelength of 450 nm work?

3. a) What is the de Broglie wavelength (in meters) of a baseball weighing 145 g and travelling at 156 km/h(must convert to m/s)?

b) Calculate the mass(in mg) of a flying mosquito with a de Broglie wavelength of 3.10×10^{-31} m and speed of 1.38 m/s?

4. a) What is the wavelength (in nanometers) of electromagnetic radiation which corresponds to the transition from the n = 6 level to the n = 1 level in the hydrogen atom?

b) A hydrogen atom emits electromagnetic radiation with a wavelength of 434.0 nm when an electron moves from an outer energy level to the n = 2 level. What energy level is the electron initally located?

5. a) Calculate the uncertainty in the velocity of a 1.00 g particle if the uncertainty in the position is 0.0100 nm.

b) Calculate the uncertainty in the position of a proton(mass = 1.67×10^{-24} g) if the uncertainty in the velocity of the proton is 1.00 m/s.

6. Write the electron configuration for the following atoms and ions using both the complete notation and shorthand notation. a) Ba; b) Pb; c) Nb^{2+}; d) Xe; e) Lu^{+}

7. State the number of unpaired electrons for each of the species in Question #6 and determine if they are paramagnetic or diamagnetic.

8. State the orbital that corresponds to the following quantum numbers:
a) n = 2, l = 1, m_l = 1; b) n = 4, l = 3, m_l = -2; c) n = 3, l = 2, m_l = -1; d) n = 5, l = 1, m_l = 1

9. Why can't an electron have the following quantum numbers?
a) n = 2, l = 2, m_l = 1; b) n = 3, l = 0, m_l = 3; c) n = 5, l = -2, m_l = 1

Answer Set for Chem 1104-2018 Summer Problem Set #7

1. $\lambda = 5.5\times10^{-8}$ m

2.a) $\nu = 5.99\times10^{14}$ Hz, λ = 500 nm; b) yes

3.a) $\lambda = 1.06\times10^{-34}$ m; b) mosquito weighs 1.55 mg.

4.a) λ = 93.75 nm; b) n = 5.

5.a) 5.28×10^{-21} m/s; b) 31.6 nm

6. Full notation:
a) Ba: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2$
b) Pb: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^2$
c) Nb^{2+}: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^1$
d) Xe: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6$
e) Lu^+: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^{14}$

Shorthand Notation:
a) Ba: $[Xe]6s^2$
b) Pb: $[Xe]6s^2\ 4f^{14}\ 5d^{10}\ 6p^2$
c) Nb^{2+}: $[Kr]\ 5s^2\ 4d^1$
d) Xe: $[Kr]\ 5s^2\ 4d^{10}\ 5p^6$
e) Lu^+: $[Xe]\ 6s^2\ 4f^{14}$

7.
a) Ba: 0(diamagnetic)
b) Pb: 2(paramagnetic)
c) Nb^{2+}: 1(paramagnetic)
d) Xe: 0(diamagnetic)
e) Lu^+: 0(diamagnetic)

8. a) 2p; b) 4f; c)3d; d) 5p

9. a) l can not exceed n-1. For n = 2, l = 0, 1.
b) For l = 0, m_l must be 0.
c) The orbital quantum number(l) must be positive integers or zero.