AP Chemistry Atomic Structure Review

#1

(a) Write the ground state electron configuration for an arsenic atom, showing the number of electrons in each subshell

(b) Give one permissible set of four quantum numbers for each of the outermost electrons in a single As atom when it is in its ground state.

(c) Is an isolated arsenic atom in the ground state paramagnetic or diamagnetic? Explain briefly.

(d) Explain how the electron configuration of the arsenic atom in the ground state is consistent with the existence of the following known compounds: Na_3As, $AsCl_3$, and AsF_5.

#2

The emission spectrum of hydrogen consists of several series of sharp emission lines in the ultraviolet (Lyman series) in the visible (Balmer series) and in the infrared (Paschen series, Brackett series, etc.) regions of the spectrum.

(a) What feature of the electronic energies of the hydrogen atom explains why the emission spectrum consists of discrete wavelength rather than a continuum wavelength?

(b) Account for the existence of several series of lines in the spectrum. What quantity distinguishes one series of lines from another?

(c) Draw an electronic energy level diagram for the hydrogen atom and indicate on it the transition corresponding to the line of lowest frequency in the Balmer series.

(d) What is the difference between an emission spectrum and an absorption spectrum? Explain why the absorption spectrum of atomic hydrogen at room temperature has only the lines of the Lyman series.

#3

Give the designated electron notations for the following

a. core electron configuration of vanadium (IV)
b. orbital notation of Cr
c. electron configuration of Mg^{+2}
d. core electron configuration of Tungsten
e. electron dot notations for Ca, Al, N, Cl, Rb^{+1}, S^{-2}
f. core electron configuration of Zn^{+2}

#4

a. What is the maximum wavelength of light capable of removing an electron from principal level n=3 in a hydrogen atom?

B. Which of the following sets of quantum numbers are not allowed in the hydrogen atom? For the sets of quantum numbers that are incorrect, state what is wrong in each set.

a. $n = 2, \ell = 1, m_\ell = -1$
b. $n = 1, \ell = 1, m_\ell = 0$
c. $n = 8, \ell = 7, m_\ell = -6$
d. $n = 1, \ell = 0, m_\ell = 2$
e. $n = 3, \ell = 2, m_\ell = 2$
f. $n = 4, \ell = 3, m_\ell = 4$
g. $n = 0, \ell = 0, m_\ell = 0$
h. $n = 2, \ell = -1, m_\ell = 1$

C. What is the maximum number of electrons in an atom that can have these quantum numbers:

a. $n = 4$
b. $n = 5, m_\ell = +1$
c. $n = 5, m_s = +\frac{1}{2}$
d. $n = 3, \ell = 2$
e. $n = 2, \ell = 1$
f. $n = 0, \ell = 0, m_\ell = 0$
g. $n = 2, \ell = 1, m_\ell = -1, m_s = -\frac{1}{2}$
h. $n = 3$
i. $n = 2, \ell = 2$
j. $n = 1, \ell = 0, m_\ell = 0$