Review Packet #3 - Random Topics

Electron Configuration and the Periodic Table

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) Account for each of the following in terms of principles of atomic structure, including the number, properties, and arrangements of subatomic particles.
(a) The second ionization energy of sodium is about three time greater than the second ionization energy of magnesium.
(b) The difference between the atomic radii of Na and K is relatively large compared to the difference between the atomic radii of Rb and Cs.
(c) A sample of solid nickel chloride is attracted into a magnetic field, whereas a sample of solid zinc chloride is not.
(d) Phosphorus forms the fluorides PF_3 and PF_5, whereas nitrogen forms only NF_3.

3) 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 wavelengths rather than a continuum of wavelengths?
(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.

Qualitative Chemistry

1) Account for the difference in solubility described in each of the following experimental observations:
(a) $BaCO_3$, $BaSO_3$, and $BaSO_4$ are only slightly soluble in water, but the first two dissolve in HCl solution whereas $BaSO_4$ does not.
(b) CuS cannot be dissolved by warm, dilute HCl but it does dissolve in warm, dilute HNO_3
(c) AgCl, Hg_2Cl_2, and $PbCl_2$ are only slightly soluble in water, but AgCl does dissolve in ammonia solution whereas the other two do not.
(d) $Fe(OH)_3$ and $Al(OH)_3$ are only slightly soluble in water, but $Al(OH)_3$ dissolves in concentrated NaOH whereas $Fe(OH)_3$ does not.

2) Describe a laboratory procedure needed to carry out each of the following.
(a) Separate a mixture of powdered solid $CaCl_2$ and $CaCO_3$.
(b) Determine the concentration of solute in an aqueous sodium chloride solution and give the concentration units that your method provides.
(c) Separate a mixture of two volatile liquids.

3) Describe a separate laboratory procedure for preparing each of the following.
(a) Pure barium sulfate from an aqueous solution of barium chloride.
(b) A pure aqueous solution of copper(II) nitrate from solid copper(II) carbonate.
(c) A pure aqueous solution of calcium chloride from an aqueous solution of calcium bromide.