# PERIODICITY & MOLECULAR BONDING THEORY
## (Chemistry 11 IB)

1) Arrange the following groups of atoms in order of increasing size:
   (a) Be, Mg, Ca
   (b) Te, I, Xe
   (c) Ga, Ge, In

2) Arrange the atoms in question (1) in order of increasing first ionization energy.

3) The first ionization energy of Ge, As, and Se are 0.7622, 0944, and 0.9409 MJ/mol, respectively. Explain why these values are such in terms of electronic configuration.

4) For each of the following pairs of elements: **Li & K** **S & Sc**
   Pick the atom with: (a) More favorable electron affinity.
   (b) Higher Ionization energy
   (c) Larger size

5) The electron affinity of Na is -52.9kJ/mol. Is it possible to add one electron to sodium to make an $Na^{-1}$ ion? Why or why not?

6) Using the element P as an example, write the equation for the process in which the energy change will correspond to the ionization energy. (ie. Write a chemical equation where the P atom will undergo a loss of electrons).

7) Predict the atomic number (A), of the next alkali metal after francium, and give its ground-state electron configuration.

8) An electron is excited from the n=1 ground state to n=3 for a hydrogen atom. Which of the following statements are true? Give corrected statements for those that are deemed false.
   (a) It takes more E to ionize the electron from n=3 than from the ground state.
   (b) The electron is further away from the nucleus on average in the n=3 state than in the n=1 state.
   (c) The wavelength of light emitted if the electron drops from n=3 to n=2 will be shorter than the wavelength of light emitted if the electron drops from n=3 to n=1.
   (d) The wavelength of light emitted when the electron returns to the ground state from n=3 is the same as the wavelength of light absorbed to go from n=1 to n=3.
   (e) For n=3, the electron is in the first excited state.

9) Without using your Data Booklet, predict the order of increasing electronegativity for each of the following groups of atoms:
   (a) C, N, O
   (b) S, Se, Cl
   (c) Si, Ge, Sn
   (d) Tl, S, Ge

10) Without using your Data Booklet, predict which bonds in each of the following groups will be most polar:
   (a) C-F, Si-F, Ge-F
   (b) P-Cl, S-Cl
   (c) S-F, S-Cl, S-Br
   (d) Ti-Cl, Si-Cl, Ge-Cl

11) For each of the following groups, place the atoms/ions in order of decreasing size:

(a) $Cu$, $Cu^{+1}$, $Cu^{+2}$

(b) $Ni^{+2}$, $Pd^{+2}$, $Pt^{+2}$

(c) $O^{2-}$, $S^{2-}$, $Se^{2-}$

(d) $La^{3+}$, $Eu^{3+}$, $Gd^{3+}$, $Yb^{3+}$

(e) $Te^{2+}$, $I^{1-}$, Xe, $Cs^{1+}$, $Ba^{2+}$, $La^{3+}$

**Answers:**

1) (a) Be<Mg<Ca

(b) Xe<I<Te

(c) Ge<Ga<In

2) (a) Ca<Mg<Be

(b) Te<I<Xe

(c) In<Ga<Ge

3) Se has lower IE b/c it has 2 $e^-$ in the same 4p orbital.

4) (a) Li, S (b) Li, S (c) K, Sc

5) Yes, would have to be an exothermic reaction

6) $P + \text{energy} \longrightarrow P^+ + e^-$

7) A= 119 $[Rn]\ 7s^2\ 5f^4\ 6d^{10}\ 7p^6\ 8s^1$

8) (a) False – n=3 state has $e^-$ further from nucleus, therefore easier to ionize.

(b) True

(c) False – Short wavelength implies higher frequency. $\Delta E$ from n=3 to n=2 is smaller than that of n=3 to n=1, therefore wavelength should be longer.

(d) True

(e) False – n=3 is the 2nd excited state.

9) (a) C<N<O

(b) Se<S<Cl

(c) Sn<Ge<Si

(d) Tl<Ge<S

10) (a) Ge-F

(b) P-Cl

© S-F

(d) Ti-Cl

11) (a) $Cu > Cu^{1+} > Cu^{2+}$

(b) $Pt^{2+} > Pd^{2+} > Ni^{2+}$

(c) $Se^{2-} > S^{2-} > O^{2-}$

(d) $La^{3+} > Eu^{3+} > Gd^{3+} > Yb^{3+}$

(e) $Te^{2-} > I^{1-} > Xe > Cs^{1+} > Ba^{2+} > La^{3+}$