Periodic Table (DPP-4)

Solutions
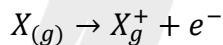
1. More the positive charge on species more IE will increase

2. The first five ionization energies of an element are 9.1,16.2,24.5,35 and 205.7eV
    respectively then, the number of valence electrons in the atom is 4.
    Since IE_4 and IE_5 have a significant IE difference, the value of IE_5 is quite high in
    comparison. Getting an atom's 5th electron out is challenging. Because of this, it
    had to be in the last shell. It consequently has 4 valence electrons in the
    outermost shell. The element achieves noble gas structure following the
    elimination of 4 electrons.
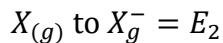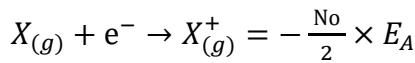
3. The electron affinity rises when travelling from left to right over time (becomes
    more negative). This results from the nuclear charge increasing and the size
    decreasing.
    Due to nitrogen's increased stability provided by its half-filled p orbitals, its
    electron affinities are lower than those of carbon.
    The correct order is Halogen > oxygen > carbon > nitrogen.

4. $\frac{2E_1}{No}, \frac{2(E_2-E_1)}{No}$

    $X_{(g)} \rightarrow X_g^+ + e^-$

    Energy required to ionise $\frac{No}{2}$ atoms of $X_g = \frac{No}{2} \times 1. E = E_1$ (given)

 $\therefore | E = \frac{2E_1}{No}$ (or) $E_1 = \frac{No \times I.E}{2}$

    $X_{(g)} + e^- \rightarrow X_{(g)}^+ = -\frac{No}{2} \times E_A$

    $X_{(g)}$ to $X_g^- = E_2$

    $E_2 = -\frac{N_0}{2} \times E_A$

    $\frac{No}{2} \times 1. E - \frac{No}{2} \times E_A = E_2$

$$X_{(g)} + e^- \rightarrow X^+_{(g)} = -\frac{No}{2} \times$$
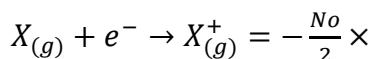
E_A(energy released to add electrons to $\frac{No}{2}$ atoms of X_g)

substituting the value of I.E

$$\frac{No}{2} \times \frac{2E_1}{No} - \frac{No}{2} \times E_A = E_2$$
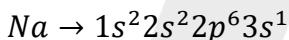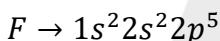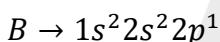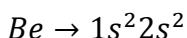
$$-\frac{No}{2} \times E_A = E_2 - E_1$$

$$-E_A = \frac{2(E_2 - E_1)}{No}$$

$$\therefore I.E = \frac{2E_1}{No} \text{ and } -E_A = \frac{2(E_2 - E_1)}{No}$$

5.   This solution is in the data and electronic configurations of Be, B, F and Na.

Let's start with electronic configurations.

$Be \rightarrow 1s^2 2s^2$

$B \rightarrow 1s^2 2s^2 2p^1$

$F \rightarrow 1s^2 2s^2 2p^5$

$Na \rightarrow 1s^2 2s^2 2p^6 3s^1$

$IP_1 = 100eV \quad IP_2 = 150eV \quad IP_3 = 1500eV$

Now, you can see after IP_2, very large potential was needed to remove an electron.

So, we are looking for an atom which will attain very high stability or noble gas configuration after losing two electrons.

By looking at electronic configurations, we can very easily say that it is very much possible in case of Be.

After giving away two electrons, it will achieve noble gas configuration (He). So most oblivious answer is Be.

6. $Li^-/Li = 4/3 = 1.33$

Size ratio for Hydrogen,

$H^-/H = 2/1 = 2$
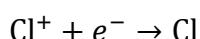
Size ratio for Sodium,

$Na^-/Na = 12/11 = 1.09$

7. The reaction is.

    $Cl^+ + e^- \rightarrow Cl$

    This reaction is exothermic reaction in which involves the release of energy in the form. So the reaction in option C is associated with best possibility of the energy release.

8. When compared to N, which has an extra electron it is easier to release, F is more stable and half-filled. However, it takes more energy to lose an electron.
    Half-full p subshells in nitrogen are more stable than partially filled ones. On the other hand, oxygen is able to quickly lose one electron and achieve a more stable half-filled e configuration.

9. (a) EA of M+ ion that is amount of energy released on adding the electron to the neutral species and I.E. of M is amount of energy required to remove electron from the normal species. Both of these energies will be equal.
    (b) EA of sulphur will be more due to large size electron addition will be easy and more stability will be acquired.
    (c) Due to poor screening of 4f electrons.

10. (a) Due to high nuclear charge in Na+ than Ne. First I. E will be high for Na+.
    (b) I.E2 of Oxygen is more greater than the Nitrogen as second electron is removed from the half filled configuration of oxygen.
    (c) Lithium will have higher IE2 as second electron will removed from stable configuration.