

D) Pre - Lab Solution

a) The binding energy E_n for an electron in the n^{th} shell of an atom with atomic number Z in terms of ionization energy of Hydrogen atom E_0 is given by -

$$E_n = -\frac{Z^2}{n^2} E_0$$

Accounting for screening effect :-

$$E_n = \frac{E_0}{n^2} - (Z_{\text{eff}})^2$$

$$\text{where } Z_{\text{eff}} = Z - S(n, Z)$$

$$\text{where } E_0 = 13.6 \text{ eV}$$

b) Yes $S(n, Z)$ is dependent on n for a constant Z because the force of attraction that the nucleus exerts on the outermost electrons due to presence of the electrons on the inner shell increases with n .

$$\begin{aligned} \text{c) } E_{n \rightarrow m} &= E_n - E_m \\ &= \frac{-13.6}{n^2} (Z - S(Z))^2 + \frac{13.6}{m^2} (Z - S(Z))^2 \\ &= 13.6 \left[\frac{(Z - S(Z))^2}{m^2} - \frac{(Z - S(Z))^2}{n^2} \right] \end{aligned}$$