

Question 3. The ground state energy of the hydrogen atom is  $-13.6$  eV. Consider an electronic state  $\psi$  of  $\text{He}^+$  whose energy, azimuthal quantum number and magnetic quantum number are  $-3.4$  eV, 2 and 0, respectively. Which of the following statement(s) is(are) true for the state  $\psi$ ?

A. It is a 4d state

B. The nuclear charge experienced by the electron in this state is less than  $2e$ , where  $e$  is the magnitude of the electronic charge

C. It has 2 angular nodes

D. It has 3 radial nodes

**Solution:** (A, C)

$$E_{\text{He}^+} = -13.6 \times (2)^2 / n^2 = -3.4 = -13.6 / 4$$

$$n^2 = 16 \text{ so } n = 4$$

Quantum number is

$$n = 4, \ell = 2, m = 0$$

So, subshell is = d

$$\text{Angular node} = \ell = 2$$

$$\text{Radial node} = [n - \ell - 1] = 4 - 2 - 1 = 1$$