

INDIAN INSTITUTE OF TECHNOLOGY, DELHI  
Nuclear Science and Engineering : EPL302

Minor Test II  
Time : 1 hour

Date : 26-3-218  
Max. Marks. 20

1. Wavefunction of a particle is

$$\psi(\vec{r}) = A \cdot \left(\frac{r}{a}\right) \cdot e^{\left(-\frac{r}{2a}\right)} \cdot \sin(\theta) \cdot e^{-i\phi}$$

where A and a are constants. Find the parity of the particle.

2. Masses of  ${}_{11}\text{Na}^{23}$  and  ${}_{12}\text{Mg}^{23}$  are 22.98977 u and 22.985044 u respectively. Using this data, determine the Coulomb coefficient ( $a_c$  or  $a_3$ ) of the semi-empirical mass formula. (5)
3. Write the shell configurations of the  ${}_8\text{O}^{17}$  nucleus in the ground state. Find the nuclear spin, parity, magnetic moment and electric quadrupole moment of the  ${}_8\text{O}^{17}$  nucleus. (5)
4. Calculate the energy of  $\gamma$ -rays emitted in the  $\beta$ -decay of  ${}^{28}\text{Al}_{13}$ . (Given  $E_{\max} = 2.86$  MeV) (5)

**Given :**

$$M_p = 1.6726 \times 10^{-27} \text{ Kg};$$

$$M_N = 1.6750 \times 10^{-27} \text{ Kg}$$

$$M_e = 9.1095 \times 10^{-31} \text{ Kg};$$

$$\text{Mass of alpha particle} = 4.026 \text{ u}$$

$$e = 1.6 \times 10^{-19} \text{ C};$$

$$1 \hbar = 6.652 \times 10^{-16} \text{ eV}\cdot\text{sec}$$

$$1 \text{ u} = 1.660566 \times 10^{-27} \text{ Kg} = 931.5 \text{ MeV}$$

$$\text{Mass of } {}^{28}\text{Al}_{13} = 27.981908 \text{ amu};$$

$$\text{Mass of } {}^{28}\text{Si}_{14} = 27.976927 \text{ amu};$$