Tutorial 1:

- Basic nuclear properties-size,
  - binding energy, angular momentum, parity, magnetic moment
- Semi-empirical mass formula and applications, mass parabolas;

Q1:

(i) How does one explain the approximate constancy of average binding energy per nucleon (BE/A) of nuclei in the region $30 \leq A \leq 170$ in the plot of BE/A versus mass number A ?

(ii) Write the semi-empirical mass formula pointing out the role of volume term, surface energy term, coulomb and symmetry energy correction terms. 5+10=15

2017

Q2:

Estimate the order of nuclear radius of lead (Z = 82) using the large angle (back) scattering of alpha particles of energy 10 MeV incident on a target (lead).
[Given : $(4\pi\epsilon_0)^{-1} = 9\times10^9$ Nm^{2}C^{-2}] 10

2017

Q3:

Write the semi-empirical mass formula for nuclei and on its basis draw mass parabolas for odd and even isobars. What would be the most stable isobar in each case? 15

2018

Q4:

Write down the Weizsäcker mass formula for the nuclear binding energy. Give short justification for each term of the formula. 20

2020

Q5:

Write down the Weizsäcker semi-emperical mass formula and explain each term. Explain why $^{238}_{92}$U nuclide is an α-emitter and not a β^--emitter ? 10+10

2022

Q6:

Establish the Rutherford's scattering cross section formula for α-particle by considering the standard assumptions and symbols. 20

2023

Q7:

By assuming the nucleus as a cubical box of length equal to the nuclear diameter 10^{-12} cm, calculate the kinetic energy of the highest level occupied nucleon of iron-56 nucleus. 15

2023

Q8.

Compare nuclear density of hydrogen ($_1H^1$) with its atomic density. (Assume the atom to have the radius of its first Bohr orbit). What inference can one get from the above comparison ? *8+2=10*

2024

Q9.

Does the nucleus possess magnetic moment ? Justify your answer. Define nuclear magneton (μ_N) and Bohr magneton (μ_B). Calculate their values. *7+8=15*

2024

Q10.

(i) Write semi-empirical mass formula. Calculate the atomic number (Z) of most stable nucleus for given mass number (A) using the above formula. (Use the value of fitted coefficients for Coulomb energy $a_3 = 0{\cdot}711$ MeV and that for asymmetry energy $a_4 = 23{\cdot}702$ MeV). 15

2024

Q11.

What is the minimum energy required to break a $_2He^4$ nucleus into free protons and neutrons?

[Given, $m_H = 1{\cdot}007825$ amu, $m_n = 1{\cdot}008665$ amu, $m_e = 0{\cdot}00055$ amu and $m_{He} = 4{\cdot}002603$ amu] 15

2025