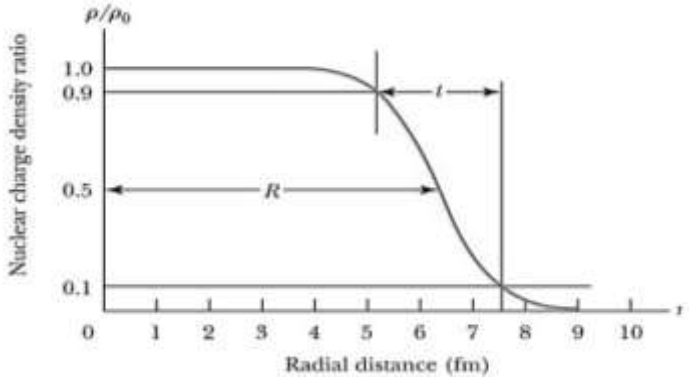
Q.1: Determine the mass and the radius of a ^{208}Pb nuclide (assumes that $R_0 = 1.4F$) and then draw the density distribution of nuclear matter in a nucleus?

Q.2: From the figure below, show that the skin thickness is $4.4a$



Q.3: An 0.2 MeV proton makes a head-on collision with an alpha particle at rest. What is distance of closest approach in Fermi?

Q.4: An alpha particle of kinetic energy T_α makes a head-on collision with a nucleus of atomic number Z and mass number A. Calculate the distance of closest approach, taking into account the recoil of the nucleus.?

Q.5: Calculate, from the semiempirical mass formula, the binding energies of the last neutron in ^{207}Pb and ^{208}Pb. Use any set of consistent energy parameter?

Q.6: All separation energies can be expressed in terms of the total binding energies of the nuclei involved by substituting the expression for the mass, how can write it for each of neutron, proton and alpha particle?

Q. 7: Show That $V_{Coulomb} = \frac{3}{5}\frac{Z(Z-1)e^2}{R}$

Q.8: Draw the Coulomb energy of a uniformly charged sphere. (a) Actual charge distribution; a layer of thickness dr is added to a sphere of radius r. (b) Equivalent charge distribution for purpose of potential energy calculation. The density of the charge is called ρ ?

Q.9: Determine the ground state total angular momentum and the parity of the following elements $^{15}_{8}O$?

Q.10: The gamma-ray photon collides with an electron at rest. It is scattered through 90^0, what is it frequency after collision, if it's initial frequency is $(3 \times 10^{19}\ Hz)$?

Q.11: Show that $\tau = \frac{1}{\lambda}$

Q.12: Draw the graph of activity of a radionuclide decreases exponentially with time. The mean life of a radionuclide is 1.44 times its half-life ?

Q.13: Draw the internal conversion spectrum of ^{113}Sn. Then explain the two peaks correspond to K electrons (363 keV) and L electrons (387 keV)?

Q.14: How much time is required for 5 mg of ^{22}Na $(t_{1/2} = 2.6\ year)$ to reduce to 1 mg?

Q.15: Effect of the parity operation on the electric field $\boldsymbol{E}$ radiated according to classical theory by (a) an electric dipole, (b) a magnetic dipole, (c) an electric quadrupole?

Q.16: Determine the predominant decay mode of the transition $2^+ \rightarrow 0^+$?

Q.17: Draw the Coulomb barrier for $Z = 90$ or 92. Classically one cannot understand how alpha particles of 4.2 MeV can be emitted by $^{238}_{92}U$ since the coulomb barrier has been shown to exceed 8.6 MeV?

Q.18: Show that $Q = T_n\left(\frac{A+4}{A+3}\right) - T_\alpha\left(\frac{A-1}{A+3}\right) - \frac{4}{A+3}\ (T_\alpha T_n)^{\frac{1}{2}} cos\theta$?

Q.19 summarizes the energetics of the three beta-decay processes graphically. All three types of beta decay can also lead to excited states?

Q.20 is the $^{40}_{19}K$ possible to decay by $\alpha - decay$?

Q.21 Determine the Q-value and the threshold energy of the following reaction?

$$^1_0n + \ ^{235}_{92}U \rightarrow {}^{236}_{92}U^* \rightarrow \ ^1_0n + \ ^{94}_{36}Kr + \ ^{141}_{56}Ba + Q$$

Constants

$M(^1_0n) = 1.00866452\ u$
$M(^{235}_{92}U) = 235.0439302\ u$
$M(^{94}_{36}Kr) = 93.93413849\ u$
$M(^{141}_{56}Ba) = 140.9144037\ u$
Mp $\approx M_H = 1.007825032$ u , Mn = 1.008665 u , Z of Pb = 82

Good Luck **Dr. Mohammed I. Hussein**