**Practice Set (Nuclear Properties)**

**MCQ (Multiple Choice Questions)**

Q1. The distance of closest approach $b$ of an $\alpha$ - particle of kinetic energy $E$ to a gold is proportional to

(a) $E$ (b) $E^{-1}$ (c) $E^{2}$ (d) $E^{-2}$

Q2. The distance of closest approach of an $\alpha$ - particle of kinetic energy $1.0\,MeV$ to a gold nucleus of atomic number $79$. Given that charge of an electron is $1.6\times10^{-19}$ coulomb.

(a) $2.275\times10^{-13}\,m$ (b) $2.275\times10^{-14}\,m$ (c) $2.275\times10^{-15}\,m$ (d) $2.275\times10^{-16}\,m$

Q3. $1$ order of nucleus radius is given by

(a) $10^{-6}\,m$ (b) $10^{-10}\,m$ (c) $10^{-12}\,m$ (d) $10^{-15}\,m$

Q4. If $A$ is mass number of any nucleus then radius is proportional to

(a) $A^{1/3}$ (b) $A^{2/3}$ (c) $A^{2}$ (d) $A^{3}$

Q5. A nucleus has a size of $10^{-15}\,m$. Consider an electron bound within a nucleus. The estimated momentum of this electron is of the order of

(a) $6.6\times10^{-18}\,kgm/\sec$ (b) $6.6\times10^{-19}\,kgm/\sec$

(c) $6.6\times10^{-20}\,kgm/\sec$ (d) $6.6\times10^{-22}\,kgm/\sec$

Q6. According to fermi model of nucleus fermi momentum of proton is proportional to atomic mass $A$ as

(a) $A^{1/3}$ (b) $A^{-1/3}$ (c) $A^{2/3}$ (d) $A^{-2/3}$

Q7. According to fermi model of nucleus fermi energy of proton is proportional to atomic mass $A$ as

(a) $A^{1/3}$ (b) $A^{-1/3}$ (c) $A^{2/3}$ (d) $A^{-2/3}$

Q8. According to fermi model of nucleus total energy of nucleus is proportional to atomic mass $A$ as

(a) $E_{total}=\left(\frac{9\pi}{4}\right)^{2/3}\frac{\hbar^2c^2}{mc^2R_0^2}\left[\frac{3}{10}A^2+\frac{1}{6}\left(\frac{N-Z}{A}\right)^2\right]$

(b) $E_{total}=\left(\frac{9\pi}{4}\right)^{2/3}\frac{\hbar^2c^2}{mc^2R_0^2}\left[\frac{3}{10}A+\frac{1}{6}\left(\frac{N-Z}{A}\right)\right]$

(c) $E_{total}=\left(\frac{9\pi}{4}\right)^{2/3}\frac{\hbar^2c^2}{mc^2R_0^2}\left[\frac{3}{10}A^2+\frac{1}{6}\left(\frac{N-Z}{A}\right)^2\right]$

(d) $E_{total}=\left(\frac{9\pi}{4}\right)^{2/3}\frac{\hbar^2c^2}{mc^2R_0^2}\left[\frac{3}{10}A+\frac{1}{6}\left(\frac{N-Z}{A}\right)^2\right]$

Q9. According to fermi model of nucleus average energy of nucleus is proportional to atomic mass $A$ as

(a) $A^{1/3}$ (b) $A^{-1/3}$ (c) $A^{2/3}$ (d) $A^{-2/3}$

**NAT (Numerical Answer Type)**

Q10. Given the mass of iron nucleus as $55.85u$ and $A=56$, then nuclear density is given by $\alpha\times10^{17}kg/m^3$, then the value of $\alpha$ is _____

Q11. The radius of carbon atom $C_6^{12}$ is $\alpha$ Fermi, then the value of $\alpha$ is_____

Q12. The volume of nucleus of atom $C_6^{12}$ is given by $\alpha(fermi)^3$, then the value of $\alpha$ is _____

Q13. The density of nucleus of atom $C_6^{12}$ is given by $\alpha\times10^{17}kg/m^3$, then the value of $\alpha$ is _____

Q14. What will be the ratio of the sizes of $Pb_{82}^{208}$ and $Mg_{12}^{26}$ nuclei?

Q15. The radius of a ${}_{29}Cu^{64}$ nucleus is measured to be $4.8\times10^{-15}m$. And the radius of a ${}_{12}Mg^{27}$ nucleus is $\alpha\times10^{-15}m$. Then what will be value of $\alpha$?

Q16. The mean momentum $\vec{p}$ of a nucleon in a nucleus of mass number $A$ and atomic number $Z$ depends on $A$ and $Z$. If $p_c$ is momentum of carbon nucleus and $p_I$ is momentum of iron nucleus then ratio of $\frac{p_c}{p_I}$ is _____

Q17. For the carbon atom $C_6^{12}$, the average value of momentum is given by $\alpha\times10^{-19}$. Then what will be value of $\alpha$?

Q18. According to fermi model of nucleus, Fermi momentum of proton is proportional to atomic number as $Z^{\alpha}$. Then the value of $\alpha$ is _____

Q19. According to fermi model of nucleus, Fermi energy of proton is proportional to atomic number as $Z^{\alpha}$, Then the value of $\alpha$ is _____

Q20. Let $m_p$ and $m_n$ be the mass of proton and neutron. $M_1$ is the mass of ${}_{10}^{20}Ne$ nucleus and $M_2$ is the mass of a ${}_{20}^{40}$Ca nucleus. Then find the correct relation:

(a) $M_1=10(m_p+m_n), M_2=20(m_p+m_n)$ and $M_2=2M_1$

(b) $M_1<10(m_p+m_n), M_2<20(m_p+m_n)$ and $M_2=2M_1$

(c) $M_1<10(m_p+m_n), M_2<20(m_p+m_n)$ and $M_2>2M_1$

(d) $M_1<10(m_p+m_n), M_2<20(m_p+m_n)$ and $M_2<2M_1$

**Answer**

Ans. 1: (b) Ans. 2: (a) Ans. 3: (d) Ans. 4: (a) Ans. 5: (b) Ans. 6: (b)

Ans. 7: (d) Ans. 8: (d) Ans. 9: (d)

**NAT (Numerical Answer Type)**

Ans. 10: 2.29 Ans. 11: 2.7 Ans. 12: 86.86 Ans. 13: 2.4 Ans. 14: 2 Ans. 15: 3.6

Ans. 16: 1.66 Ans. 17: 2.5 Ans. 18: 0.33 Ans. 19: 0.66 Ans. 20: (d)