**DPP – 1 (Nuclear Physics)**

Q 1. The graph of $\log\left(\frac{R}{R_0}\right)$ versus log A (R = radius of a nucleus and A = mass number) is -
(a) a circle
(b) an ellipse
(c) a parabola
(d) a straight line

Q 2. The range of nuclear forces is about -
(a) $2 \times 10^{-10}$m
(b) $1.5 \times 10^{-20}$ m
(c) $7.2 \times 10^{-4}$ m
(d) $1.4 \times 10^{-15}$ m

Q 3. A star initially has $10^{40}$ deuterons. It produces energy via the processes $_1H^2 + _1H^2 \rightarrow _1H^3 + p$ and $_1H^2 + _1H^3 \rightarrow _2He^4 + n$. If the average power radiated by the star is $10^{16}$ W, the deuteron supply of the star is exhausted in a time of the order of: [The mass of the nuclei are as follows $M(H^2) = 2.014$amu ; $M(n) = 1.008$ amu;$M(p) = 1.008$ amu; $M(He^4) = 4.001$ amu.]
(a) $10^6$ s
(b) $10^8$s
(c) $10^{12}$ s
(d) $10^{16}$ s

Q 4. Let $m_p$ be the mass of proton, $m_n$ the mass of neutron. $M_1$ the mass of $_{10}^{20}$Ne nucleus and $M_2$ the mass of $_{20}^{40}$Ca nucleus. Then:
(a) $M_2 = 2 M_1$
(b) $M_2 > 2 M_1$
(c) $M_2 < 2 M_1$
(d) $M_1 < 10(m_n + m_p)$

Q 5. When an electron and positron with equal speeds in opposite direction annihilate each other, they cannot produce just one gamma ray, because that will violate law of–
(a) conservation of charge
(b) conservation of energy
(c) conservation of momentum
(d) conservation of nucleon number

Q 6. The heavier nuclie tend to have larger N/Z ratio because–
(a) a neutron is heavier than a proton
(b) a neutron is an unstable particle
(c) a neutron does not exert electric repulsion
(d) coulomb forces have longer range compared to the nuclear forces

Q 7. A proton moving with velocity $v_0$ moves towards a proton initially at rest and free to move. Find the distance of closest approach.

(a) $\dfrac{e^2}{2\pi\varepsilon_0 mv_0^2}$

(b) $\dfrac{e^2}{4\pi\varepsilon_0 mv_0^2}$

(c) $\dfrac{e^2}{\pi\varepsilon_0 mv_0^2}$

(d) None of these

Q 8. In the fusion reaction, $_1^2H + {_1^2H} \rightarrow {_2^3He} + {_0^1n}$ The masses of deutrons, helium and neutron expressed in amu are 2.015, 3.017 and 1.009 respectively. If 1 kg of deuterium undergoes complete fusion. Find the amount of total energy release, 1 amu = 931 MeV/$C^2$

(a) $6 \times 10^{13}$ J

(b) $5.6 \times 10^{13}$ J

(c) $9 \times 10^{13}$ J

(d) $0.9 \times 10^{13}$ J

Q 9. Nuclear radius of $_8O^{16}$ is 3 fermi. The nuclear radius of $_{82}Pb^{205}$ is

(a) 5.02 fermi    (b) 5.02 fermi

(c) 7.02 fermi    (d) 9.02 fermi

Q 10. In a star, three alpha particles join in succession to form $_6C^{12}$ nucleus. How much energy is evolved in this reaction? Take mass $_6C^{12} = 12$ amu and that of alpha particle = 4.002603 amu

(a) 15 MeV

(b) 18 MeV

(c) 7.27 MeV

(d) 2.917 MeV

Q 11. Mass defect of an atom refers to -
(a) packing fraction of the atom
(b) increase in mass over total mass of its constituents to bind the atoms
(c) mass annihilated to produce energy to bind the nucleons
(d) error in the measurement of atomic masses

Q 12. The binding energy of deuteron is 2.2 MeV and that of $_2^4He$ is 28 MeV. If two deuterons are fused to form one $_2^4He$ then the energy released is -
(a) 25.8 MeV
(b) 23.6 MeV
(c) 19.2 MeV
(d) 30.2 MeV

Q 13. For nuclei with A > 100, mark the incorrect statement -
(a) the binding energy per nucleon decreases on the average as A increases
(b) if the nucleus breaks into two roughly equal parts, energy is released
(c) if two nuclei fuse to form a bigger nucleus energy is released
(d) the nucleus with Z > 83 are generally unstable

## Answer Key

| Q.1 d | Q.2 d | Q.3 c | Q.4 c,d | Q.5 c |
|-------|-------|-------|---------|-------|
| Q.6 c,d | Q.7 c | Q.8 c | Q.9 c | Q.10 c |
| Q.11 c | Q.12 b | Q.13 c | | |