NUCLEAR PHYSICS

PREVIOUS EAMCET BITS

ENGINEERING

1. The radioactivity of a sample is 'X' at a time 't_1' and 'Y' at a time 't_2'. If the mean life time of the specimen is τ, the number of atoms that have disintegrated in the time interval ($t_1 - t_2$) is : **(2009 E)**

1) $Xt_1 - Yt_2$ 2) X-Y 3) $\frac{X-Y}{\tau}$ 4) $(X-Y)\tau$

Ans : 4

Sol: The relation between $t_{1/2}$ *and* λ is $t_{1/2} = \frac{0.693}{\lambda}$

$\lambda t_1 = X$ .....(1)

$\lambda t_2 = Y$ .....(2)

from (1) and (2)

$\lambda(t_1 - t_2) = X - Y \Rightarrow t_1 - t_2 = \frac{X-Y}{\lambda}$

but $\tau = \frac{1}{\lambda}$

$\therefore t_1 - t_2 = (X - Y)\tau$

2. Let F_{pp},F_{pn} and F_{nn} denote the magnitudes of the nuclear force by a proton on a proton ,by a proton on a neutron and by a neutron on a neutron respectively when the separation is less than one fermi, then **(2008 E)**

1) $F_{pp} > F_{pn} = F_{nn}$ 2) $F_{pp} = F_{pn} = F_{nn}$ 3) $F_{pp} > F_{pn} > F_{nn}$ 4) $F_{pp} < F_{pn} = F_{nn}$

Ans: 2

Sol. Nuclear forces are charge independent

3. In sun, the important source of energy is **(E-2007)**

1) proton-proton cycle 2) carbon-nirtogen cycle

3) carbon-caron cycle 4) nitrogen-nitrogen cycle

Ans: 1

Sol. Because of nuclear fusion proton – proton cycle takes place

4. A free neutron decays spontaneously into: **[2006E]**

1) a proton, an electron and an anti-neutrino

2) a proton, an electron and a neutrino

3) a proton and electron

4) a proton, an electron, a neutrino and an anti-neutrino

Ans: 1

Sol. ${}_0n^1 \longrightarrow {}_{-1}e^0 + {}_1H^1 + \upsilon$

5. Particles and their anti-particles have: **[2005E]**

1) the same masses but opposite spins

2) the same masses but opposite magnetic moments.

3) the same masses and same magnetic moments

4) opposite spins and same magnetic moments

Ans: 2

Sol. Same masses but opposite electromagnetic properties like charge, magnetic moment etc.

6. Consider the following two statements A and B and identify the correct answer given below:

A: Nuclear density is same for all nuclei **[2004 E]**

B: Radius of the nucleus (R) and its mass number (A) are related as $\sqrt{A} \propto R^{1/6}$

1) Both A and B are true 2) Both A and B are false

3) A is true and B is false 4) A is false B is true

Ans : 3

Sol: Density remains constant

$(A): \rho$ = constant

(B) : (B) $R \propto A^{1/3}$ $\left[\sin ce \;\; R = R_0 A^{1/3}\right]$

$\Rightarrow R^3 \propto A$

$\Rightarrow R^{3/2} \propto \sqrt{A}$

7. The mass defect in a particular nuclear reaction is 0.3grams. The amount of energy liberated in kilowatt hours is : (C=3x10^{8}m/s) **[2003E]**

1) $7.5\times10^5 KWH$ 2) $7.5\times10^4 KWH$ 3) $7.5\times10^3 KWH$ 4) $7.5\times10^6 KWH$

Ans: 4

Sol: From Einstein mass – energy equivalence

$\Delta E = \Delta MC^2$

$= 0.3\times10^{-3}\times\left(3\times10^8\right)^2$

$= 2.7\times10^{13} J = \dfrac{2.7\times10^3}{3600\times10^3}$

= 0.75 $\times$ 10^7 KWH

= $7.5\times10^6 KWH$

8. Consider the following statements A and B.

Identify the correct choice in the given answer.

(A) p-p, p-n, n-n forces between nucleons are not equal and charge dependent

(B) In nuclear reactor the fission reaction will be in accelerating state if the value of neutron reproduction factor k >1 **(2002 E)**

1) Both A and B are correct 2) Both A an d B are wrong

3) A is wrong and B is correct 4) A is correct and B is wrong.

Ans :3

A: The p-n, p-p and n-n nuclear forces are equal and charge independent.

B : $K = \dfrac{Neutrons\ in\ one\ generation}{Neutrons\ in\ the\ previous\ \ generation}$

Where k is called neutron multiplication factor

If K > 1, the neutron population keeps on increasing after the completion of each neutron cycle which takes time of the order of a millisecond. Which is called as super critical state

9. True masses of neutron, proton and deutron in a.m.u are1.00893,1.00813 and 2.01473 respectively. The packing fraction of the deutron in a.m.u is **(2002 E)**

1) 11.65 x 10^{-4} 2) 23.5 x 10^{-4}

3) 73.6 x10^{-4} 4) 47.15 x 10^{-4}

Ans :3

Sol: Packing fraction = $\frac{M-A}{A}$, where M is the atomic mass and A is the mass number.

$$P=\frac{M-A}{A}=\frac{2.01473-2}{2}=73.6\times10^{-4}$$

10. A heavy nucleus at rest breaks into two fragments which fly off with velocities 8:1. The ratio of radii of fragments is **(2001 E)**

1) 1:2 2) 1:4 3) 4:1 4) 2:1

Ans:1

Sol Momentum conservation gives

$$m_1v_1=m_2v_2$$

$$\Rightarrow\frac{v_1}{v_2}=\frac{8}{1}=\frac{m_2}{m_1}$$

$$\Rightarrow\frac{m_2}{m_1}=\frac{1}{8}\approx\frac{A_1}{A_2}$$

$$\frac{R_1}{R_2}=\left(\frac{A_1}{A_2}\right)^{1/3}=\left(\frac{1}{8}\right)^{1/3}=\frac{1}{2}$$

MEDICAL

11. Atomic mass of $^{13}_{6}C$ is 13.00335 amu and its mass number is 13.0. If 1amu=931 MeV, binding energy of the neutrons present in the nucleus is: **(2009 M)**

1) 0.24 MeV 2) 1.44 MeV 3) 1.68 MeV 4) 3.12 MeV

Ans: 3

Sol: Mass defect = 0.00335 amu

$\therefore$ binding energy of neutrons

$$=\left[\frac{(0.00335)(931)}{13}\right]7$$

$$=1.679=1.68\,MeV$$

12. The following particles are Baryons: **(2008 M)**

1) Nucleons and hyperons 2) Nucleons and leptons

3) Hyperons and leptons 4) Hyperons and Bosons

Ans: 1

Sol. Nucleons and hyperons are called Baryons

13. Electron belongs to the following class of elementary particles **[2007M]**

1) Hardon 2) Lepton 3) Boson 4) Baryon

Ans: 2

Sol. As electrons have lighter mass. Therefore they belong to leptons

14. Assertion(A): Nuclear forces arise from strong Coulombic interactions between protons and neutrons.
Reason (R): Nuclear forces are independent of the charge of the nucleons. **[2006M]**

1) Both A and R are true and R is the correct explanation of A

2) Both A and R are true but R is the not correct explanation of A

3) A is true, but R is false 4) A is false, but R is true

Ans: 4

15 The particle that possesses half integral spin is: **[2005M]**

1) Photon 2) Pion 3) Proton 4) K-meson

Ans: 3

Sol. Proton Possesses half integral spin.

16 Matching pairs in the two lists given below are **[2004M]**

List-I	**List-II**
A) Gravitions	E) Hyperons
B) Baryons	F) Positrons
C) Pions	G) Particles with zero mass and with a spin of unity
D) Leptons	H) Decay to -mesons
	I) Massless particles with a probable spin of two units.

1) A-E,B-H,C-G,D-I 2) A-I,B-E,C-H,D-F 3) A-H,B-F,C-I,D-E 4) A-F,B-G,C-E,D-H

Ans: 2

17. A nucleus splits into two nuclear parts having radii in the ratio 1:2. Their velocities are in the ratio **[2003M]**

1) 8:1 2) 6:1 3) 4:1 4) 2:1

Ans: 1

Sol: $R = R_0 A^{1/3}$

$\frac{A_1}{A_2} = \frac{M_1}{M_2} = \frac{R_1^3}{R_2^3} = \frac{1^3}{2^3} = \frac{1}{8}$ [since mass = volume x density]

$M_1 V_1 = M_2 V_2$ [from law of conservation of momentum]

$\Rightarrow \frac{V_1}{V_2} = \frac{M_2}{M_1} = 8$

18. A: Density of nucleus is independent of its mass number

B: Beryllium is used as a moderator in nuclear reactors **(2002 M)**

1) Both A and B are correct

2) Both A and B are wrong

3) A is correct,B is wrong

4) A is wrong,B is correct

Ans : 3

Sol: A : $\rho = \frac{mass\ of\ nucleus}{volume} = \frac{A \times M_p}{4\pi R^3 / 3}$

$= \frac{3M_p}{4\pi} \frac{A}{\left(r_0 A^{1/3}\right)^3} = \frac{3M_p}{4\pi r_0^3}$ = constant [since m_p and r_0 are constant]

B: A good moderator must be light (low atomic weight) must be capable of scattering neutrons with a high probability, but should not absorb neutrons. Therefore Beryllium is not suitable for moderator

19. In Carbon-Nitrogen fusion cycle , protons are fused to form a helium nucleus, positrons and release some energy. The number of protons fused and the number of positrons released in this process respectively are **(2002 M)**

1) 4,4 2) 4,2 3) 2,4 4) 4,6

Ans :2

Sol: $4_1H^1 \rightarrow_2 He^4 + 2_1e^0 + 2\gamma$

4 protons fuses and 2 positron are released

20. The ratio of radii of nuclei $_{13}Al^{27}$ and $_{52}Te^{125}$ is **(2001 M)**

1) 1 : 5 2) 2: 5 3) 4 : 5 4) 3 : 5

Ans:4

Sol: $R = r_0 A^{1/3}$

$$\frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{1/3} = \left(\frac{27}{125}\right)^{1/3} = \frac{3}{5}$$

21. In a nuclear reactor using U^{235} as a fuel , the power output is 4.8MW. The number of fissions per second is __ **(2000 M)**

(Energy released per fission =200MeV, 1ev = 1.6×10^{-19}J)

1) 1.5×10^{17} 2) 3×10^{19} 3) 1.5×10^{25} 4) 3×10^{25}

Ans :1

Sol: Power of reactor P = $\frac{nE}{t}$

Where 'n' is number of fissions, 't' is time and 'E' is energy released per fission

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