ATOMS AND NUCLEI

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 :**

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

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**

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

3. **In sun, the important source of energy is**

   1) proton-proton cycle 2) carbon-nitrogen cycle

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

4. **A free neutron decays spontaneously into:**

   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

5. **Particles and their anti-particles have:**

   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

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

   A: Nuclear density is same for all nuclei

   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

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)**

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

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

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.

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

1) 11.65 x 10^{-4} 2) 23.5 x 10^{-4} 3) 73.6 x10^{-4} 4) 47.15 x 10^{-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**

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

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:**

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

12. **The following particles are Baryons:**

1) Nucleons and hyperons 2) Nucleons and leptons

3) Hyperons and leptons 4) Hyperons and Bosons

13. **Electron belongs to the following class of elementary particles**

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

14. **Assertion (A): Nuclear forces arise from strong Columbic interactions between protons and neutrons.**

Reason (R): Nuclear forces are independent of the charge of the nucleons.

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

15 **The particle that possesses half integral spin is:**

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

16 Matching pairs in the two lists given below are

List-I	**List-II**
A) Gravitons	E) Hyperons
B) Baryons	F) Positrons
C) Pions	G) Particles with zero mass and with aspin of unity
D) Leptons	H) Decay to –mesons
	I) Mass less particles with 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

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

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

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

B: Beryllium is used as a moderator in nuclear reactors

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

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

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

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

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

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

1) $1.5x10^{17}$ 2) $3x10^{19}$ 3) $1.5x10^{25}$ 4) $3x10^{25}$

22. If M(A;Z), M_p and M_n denote the masses of the nucleus $^{A}_{Z}X$, proton and neutron respectively in units of U(1 u = 931.5 MeV/c^2) and BE represents its bonding energy in MeV, then

1) $M(A,Z) = ZM_p + (A-Z)M_n – BE$ 2) $M(A,Z) = ZM_p + (A-Z)M_n – BE/c^2$

3) $M(A,Z) = ZM_p + (A-Z)M_n – BE/c^2$ 4) $M(A,Z) = ZM_p + (A-Z)M_n + BE$

23. Two nuclei have mass numbers in the ratio of 1:3. The ratio of their nuclear densities would be

1) $(3)^{1/3}$:1 2) 1:1 3) 1:3 4) 3:1

24. **The ground state energy of hydrogen atom is -13.6 eV. When its electron is in the first excited state, its excitation energy is**

1) 10.2 eV 2) 0 3) 3.4 eV 4) 6.8 eV

25. **Two radioactive materials X_1 and X_2 have decay constants 5λ and λ respectively. If initially they have the same number of nuclei, then the ratio of the number of nuclei of X_1 to that X_2 will be 1/e after a time**

1) $1/4\lambda$ 2) e/λ 3) λ 4) $\frac{1}{2}\lambda$

26. **In the nuclear decay given below $^{A}_{Z}X \rightarrow ^{A}_{z+1}Y \rightarrow ^{A-4}_{Z-1}B^{*} \rightarrow ^{A-4}_{Z-1}B$ the particles emitted in the sequence are**

1) γ, β, α 2) β, γ, α 3) α, β, γ 4) β, α, γ

27. **The number of beta particles emitted by a radioactive substance is twice the number of alpha particles emitted by it. The resulting daughter is an**

1) Isomer of parent 2) isotone of parent 3) isotope of parent 4) isobar of parent

28. **In a Rutherford scattering experiment when a projectile of charge z_1 and mass M_1, approaches a target nucleus of charge z_2 and mass M_2, the distance of closes approach is r0. The energy of the projectile is**

1) directly proportional to z_1z_2 2) inversely proportional to z_1

3) directly proportional to mass M_1 4) directly proportional to $M_1 xM_2$

29. **Which of the following can be detected by a magnet?**

1) Gamma rays 2) beta rays 3) radio waves 4) ultra-violet rays

30. **The ratio of the radii of the nuclei of $_{13}Al^{27}$ and $_{52}Te^{125}$ is approximately**

1) 6:10 2) 13:52 3) 40:177 4) 14:73

31. **The number of neutrons in an atom X of atomic number Z and mass number A is**

1) Z–A 2) Z 3) A–Z 4) A

32. **The radius of a nucleus changes with the mass number A of the nucleus as**

1) $r \propto A^{2/3}$ 2) $r \propto A^{1/3}$ 3) $r \propto A^{0}$ 4) $r \propto A$

33. **The density of a nuclear matter varies with mass number A as**

1) $d \propto A^{3}$ 2) $d \propto A^{2}$ 3) $d \propto A$ 4) $d \propto A^{0}$

34. **The average binding energy of nucleus is**

1) 8 eV 2) 8 keV 3) 8 MeV 4) 8 BeV

35. **In a fusion process, a proton and a neutron combine to form a deuterium nucleus. If m_p and m_n denote the mass of a proton and the mass of a neutron respectively, the mass of the deuterium nucleus is**

1) Equal to (m_p+m_n) 2) greater than (m_p+m_n)

3) less than (m_p+m_n) 4) it has no relation with the given masses

36. The nuclei $_6C^{13}$ and $_7N^{14}$ can be described as

1) Isotones 2) isobars 3) isomers 4) isotopes

37. Slow neutrons are sometimes referred to as thermal neutrons because

1) they are a sort heat radiations

2) they are in thermal equilibrium

3) they are capable of generating heat

4) their energies are of the same order as that of molecular energies at ambient temperatures

38. In a stable nuclei, the number of neutrons (N) is related to the number of protons Z in neutral atom as

1) N<Z 2) N+Z 3) N>Z 4) $N \geq Z$

39. In the reaction represented by $_ZX^A \rightarrow {}_{Z-2}Y^{A-4} \rightarrow {}_{Z-2}Y^{A-4} \rightarrow {}_{Z-1}K^{A-4}$ the decays in the sequence are

1) α, β, γ 2) β, γ, α 3) γ, α, β 4) α, γ, β

40. The number of neutrons in a chain reaction increases in

1) arithmetic progression 2) geometric progression

3) Harmonic progression 4) none of these

41. Hydrogen bomb is based on the principle of

1) fission 2) fusion 3) electrolysis 4) ionization

42. A good moderator should

1) be a gas 2) have appetite for neutrons

3) be light in mass number 4) all of these

43. The main source of energy in the sun is due to

1) the burning of hydrogen in oxygen

2) fusion of uranium present in the sun

3) the energy liberated in the fusion protons during the synthesis of heavier nuclei

4) gravitational contraction

44. In the nuclear decay, $_7N^{13} \rightarrow {}_6C^{13}$+( )+( ) the particles represented by the two parentheses are

1) neutron and γ- ray 2) positron and neutrino

3) positron and antineutrino 4) positron and electron

45. During a nuclear fusion reaction

1) a heavy nucleus breaks into two fragments by itself

2) a light nucleus bombarded by thermal neutrons brakes up

3) a heavy nucleus bombarded by thermal neutrons breaks up

4) two light nuclei combine to give a heavier nucleus and possibly other products

46. Fusion reactions take place at high temperature because

1) atoms are ionised at high temperature

2) molecules break up at high temperature

3) nuclei break up at high temperature

4) kinetic energy is high enough to overcome repulsion between nuclei

47. If the nuclear force between two protons, two neutrons and between proton and neutron is denoted by F_{pp}, F_{nn} and F_{pn} respectively, then

1) $F_{pp}= F_{nn}= F_{pn}$ 2) $F_{pp} \neq F_{nn}$ but $F_{pp}= F_{pn}$ 3) $F_6 = F_6 = F_6$ 4) $F_{pp} \neq F_{nn} \neq F_{pn}$

48. Nuclear force is a

1) short range repulsive force 2) long range repulsive force

3) short range attractive force 4) long range attractive force

49. The age of pottery is determined by archeologists using a radio isotope of

1) carbon 2) cobalt 3) iodine 4) phosphorus

50. The equation, $4\,{}_1H^1 \rightarrow {}_2He^4 + 2\,{}_{+1}e^0 + 26$ MeV represents

1) β-decay 2) γ–decay 3) fusion 4) fission

51. Of the following atoms ${}_6C^{14}$, ${}_7N^{13}$, ${}_{88}Ra^{236}$, ${}_7N^{14}$, ${}_8O^{16}$ and Rn a pair of isobars is

1) ${}_6C^{14}$, ${}_7N^{13}$ 2) ${}_7N^{13}$, ${}_7N^{14}$ 3) ${}_6C^{14}$, ${}_7N^{14}$ 4) ${}_6C^{14}$, ${}_8O^{16}$

52. In the above question a pair of isodiapheres is

1) ${}_{88}Ra^{236}$, ${}_{88}Ra^{232}$ 2) ${}_7N^{13}$, ${}_7N^{14}$ 3) ${}_6C^{14}$, ${}_7N^{14}$ 4) ${}_7N^{14}$, ${}_8O^{16}$

53. Mass defect of an atom refers to

1) inaccurate measurement of mass of neutrons

2) mass annihilated to produce energy to bind the nucleus

3) packing fraction

4) difference in the number of neutrons and protons in the nucleus

54. For the fission of heavy nucleus, neutron is more effective than proton or alpha particle because

1) neutron is heavier than alpha particle

2) neutron is lighter than alpha particle

3) neutron is uncharged 4) neutron moves with a small velocity

55. A deuterium nucleus ^2_1H combines with a tritium nucleus ^3_1H to form a heavier helium nucleus ^4_2He with the release of a neutron (^1_0n). The fusion reaction is represented by the equation $^2_1H+^3_1H \rightarrow ^4_2He+^1_0n$. In this reaction, the mass of ^4_2He + mass of ^1_0n is

1) less than the mass of ^2_1H+mass of ^3_1H

2) greater than the mass of ^2_1H+mass of ^3_1H

3) the same as the mass of ^2_1H+mass of ^3_1H

4) twice the mass of ^2_1H+mass of ^3_1H

56. Which of the following are conserved in nuclear reactions?

1) mass number and energy
2) mass number and charge number
3) charge number and mass
4) mass number, charge number and energy

57. In carbon-nitrogen nuclear 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

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

58. Nuclear forces are

a) charge dependent
b) spin dependent
c) short ranged
d) neutral

1) only a and b are true
2) only a and c are true
3) only b and d are true
4) only b and c are true

59. In the fission of U^{235}

a) slow neutron is absorbed by U^{235}

b) the products in the process are not same always, their atomic number varies from 34 to 58

c) about 200 MeV energy is released per fission

d) the product are always Ba and Kr

1) only a, b & c are true
2) only b and d are true
3) only a and c are true
4) only b and c are true

60. Which of the following is true regarding nuclear fusion

a) the probable reaction in high temperature stars is carbon nitrogen cycle

b) it is generally observed on the earth

c) the probable reaction in low-temperature stars is proton-proton cycle

d) it takes place at a temperature of about 10^4 K

1) only a and b are true
2) only b and d are true
3) only a and c are true
4) only c and d are true

61. Identify the correct order of increasing order of B.E per nucleon of the following nuclei

a) Helium b) Carbon c) Oxygen e) Iron

1) a-b-c-d 2) d-c-b-a 3) c-b-d-a 4) c-b-a-b

62. Match the following

List I	**List II**
a) Artificial Radioactivity	**e) Bethe**
b) Carbon-Nitrogen cycle	**f) Fermi**
c) Carbon dating	**g) Rutherford**
d) Transmutation of atomic nuclei by α-particles	h) Libby

1) a-e, b-f, c-g, d-h 2) a-f, b-e, c-h, d-g 3) a-h, b-g, c-f, d-e 4) a-g, b-h, c-e, d-f

63. Match the following

List I	**List II**
a) Liquid Sodium	**e) Moderation**
b) Pu-239	**f) Control rod**
c) Graphite	**g) Fuel**
d) Cadmium steel	**h) Coolant**

1) a-f, b-g, c-e, d-h 2) a-h, b-g, c-e, d-f 3) a-e, b-g, c-f, d-h 4) a-h, b-g, c-f, d-e

Assertion & Reason: In each of the following questions, a statement is given and a corresponding statement or reason is given just below it. In the statements, marks the correct answer as

1) If both Assertion and Reason are true and Reason is correct explanation of Assertion.

2) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

3) If Assertion is true but Reason is false.

4) If both Assertion and Reason are false.

64. [A]: At least one thermal neutron should be available to initiate the fission reaction.

[R]: The state of the chain reaction depends on the neutrons multiplication factor.

65. [A]: Neutron flux in the interior of a nuclear reactor can be increased using neutron reflector.

[R]: Fast neutrons can be changed into slow neutrons or thermal neutrons.

66 [A]: Cadmium or Boron rods are generally used as control rods.

[R]: Cadmium or Boron rods slow down fast moving neutrons.

67 [A]: In the fission of uranium nuclei on an average 2.5 neutrons are emitted per fission.

[R]: In the fission of uranium, the number of prompt neutrons will change with the products.

68. [A]: The penetrating power of neutron is high.

[R]: Neutron is charge less.

69 [A]: The velocity of de-Broglie's wave associated with a moving particle is greater than the velocity of light.

[R]:de-Broglie waves are not electromagnetic waves.

70 [A]: Density of the nucleus is almost same for all nuclei.

[R] : Nuclear density is independent of atomic number

71 A] : Nuclear density is same for all nuclei.

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

72 [A] : A fusion reaction is a powerful source of energy.

[R] :Fusion reaction takes place at a very high temperature (10^6 K).

73 [A] : Electrons are not expected to be found inside the nucleus.

[R] : Electrons are much lighter than protons or neutrons.

KEY :

1)	**4**	2)	**2**	3)	**1**	4)	**1**	5)	**2**	6)	**3**	7)	**4**	8)	**3**	9)	**3**	10)	**1**
11)	**3**	12)	**1**	13)	**2**	14)	**4**	15)	**3**	16)	**2**	17)	**1**	18)	**3**	19)	**2**	20)	**2**
21)	**1**	22)	**3**	23)	**2**	24)	**1**	25)	**1**	26)	**4**	27)	**3**	28)	**3**	29)	**2**	30)	**1**
31)	**3**	32)	**3**	33)	**4**	34)	**3**	35)	**3**	36)	**1**	37)	**4**	38)	**4**	39)	**4**	40)	**2**
41)	**2**	42)	**3**	43)	**3**	44)	**2**	45)	**4**	46)	**4**	47)	**1**	48)	**3**	49)	**1**	50)	**3**
51)	**3**	52)	**4**	53)	**2**	54)	**3**	55)	**1**	56)	**4**	57)	**2**	58)	**4**	59)	**1**	60)	**3**
61)	**1**	62)	**2**	63)	**2**	64)	**3**	65)	**1**	66)	**2**	67)	**3**	68)	**2**	69)	**1**	70)	**3**
71)	**2**	72)	**3**	73)	**3**														

Solutions

1.

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.

Ans: 2

Sol. Nuclear forces are charge independent

3. Ans: 1

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

4.

Ans: 1

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

5. Ans: 2

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

6.

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.

Ans: 4

Sol: From Einstein mass – energy equivalence

$$\Delta E = \Delta MC^2$$

$$= 0.3 \times 10^{-3} \times \left(3 \times 10^8\right)^2$$

$$= 2.7 \times 10^{13} J = \frac{2.7 \times 10^3}{3600 \times 10^3}$$

= 0.75 × 10^7 KWH

$$= 7.5 \times 10^6 KWH$$

8.

Ans :3

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

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

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.

Ans :3

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

$$P = \frac{M - A}{A} = \frac{2.01473 - 2}{2} = 73.6 \times 10^{-4}$$

10.

Ans:1

Sol Momentum conservation gives

$$m_1 v_1 = m_2 v_2$$

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

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

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

11.

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.

Ans: 1

Sol. Nucleons and hyperons are called Baryons

13.

Ans: 2

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

14.

Ans: 4

15

Ans: 3

Sol. Proton possesses half integral spin.

16

Ans: 2

17.

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.

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.

Ans :2

Sol: $4\,_1H^1 \rightarrow {}_2He^4 + 2\,_1e^0 + 2\gamma$

4 protons fuses and 2 positrons are released

20.

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.

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

22. (3):

$ZM_p+(A-Z)M_n - M(A,Z)$

= mass effect = $\frac{B.E.}{c^2}$

$$\Rightarrow M(A,Z) = ZM_p + (A-Z)M_n - \frac{B.E.}{c^2}$$

23. (2) : $A_1 : A_2 = 1:3$

Their radii will be in the ratio

$$R_0 A_1^{1/3} : R_0 A_2^{1/3} = 1 : 3^{1/3}$$

Density = $\dfrac{A}{\frac{4}{3}\pi R^3}$

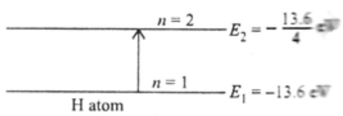
$$\therefore\ \rho_{A_1} : \rho_{A_2} = \frac{1}{\frac{4}{3}\pi R_0^3 . 1^3} = \frac{3}{\frac{4}{3}\pi R_0^3 . \left(3^{1/3}\right)^3}$$

Their nuclear densities will be the same.

24. (1) Energy of electron in n^th orbit = $\dfrac{-13.6}{n^2} eV$

When n = 1 $E_{n_1} = -13.6\, eV$

When n = 2 $E_{n_2} = -3.4\, eV$



1^st excitation energy $E_{n_2} - E_{n_1} = (-3.4 + 13.6)$ = 10.2 eV

25 (1) $X_1 = N_0 e^{-\lambda_1 t}; X_2 = N_0 e^{-\lambda_2 t}$

$$\frac{X_1}{X_2} = e^{-1} = e^{(-\lambda_1 + \lambda_2)t}; e^{-1} = e^{-(\lambda_1 - \lambda_2)t}$$

$$\therefore t = \left|\frac{1}{\lambda_1 - \lambda_2}\right| = \frac{1}{(5\lambda - \lambda)} = \frac{1}{4\lambda}$$

26 (4)

Because of β emission atomic number increases by 1 unit, α- particle atomic number increases by 2 units & mass number by 4 units.

$$^{A}_{Z}X \xrightarrow{\beta^-} {}^{A}_{Z+1}Y \xrightarrow{\alpha} {}^{A-4}_{Z-1}B^* \xrightarrow{\gamma} {}^{A-4}_{Z-1}B$$

First X decays by β^- emission emitting $\overline{\upsilon}$, antineutrino simultaneously. Y emits α resulting in the excited level of B which in turn emits a γ ray.

27 (3) $^{A}_{Z}X \xrightarrow{2\beta^-} {}^{A}_{Z+2}Y_1 \xrightarrow{\alpha} {}^{A-4}_{Z}Y_2$

The result daughter is an isotope of the original parent nucleus.

28. (1) : Energy of the projectile is the potential energy at closest approach, $\dfrac{1}{4\pi\varepsilon_0}\dfrac{z_1 z_2}{r}$

Therefore energy $\propto z_1 z_2$