Nuclear Physics and Radioactivity

1. The number of electrons in an atom of atomic number Z and mass number A is _____

   1) A 2) Z 3) A+Z 4) A-Z

2. The repulsive force between the positively charged protons does not throw them apart, because

   1) Nuclear force is stronger 2) neutrons exist between protons

   3) coulombian force does not act at small distances

   4) Due to other reasons other than mentioned above

2) Which of the following is not conserved in nuclear reactions ?

   1) Momentum 2) charge 3) mass 4) Nucleons

4. In the nucleus, the forces between nucleons are

   1) Gravitational 2) Nuclear 3) both (1) & (2)

   4) Some other forces

5. The B.E. per nucleon (S.B.E.) is almost constant for many nuclei. To what characteristic of the nuclear forces does it point?

   1) Attractive nature 2) Exchange force 3) Saturative nature 4) short range

6. The mean density of the nuclei is proportional to

   1) mass number 2) atomic number 3) mass of nucleon

   4) none of the above

7. The approximate ratio of nuclear densities of $_{26}Fe^{56}$ and $_{92}U^{238}$ is _____

   1) 0 2) ∞ 3) 1 4) none of these

8. The stability of a nucleus is determined by it's _____

   1) B.E. per nucleon 2) neutron to proton ratio

   3) by the consideration whether it contains an even or odd number of protons & neutrons 4) all these

9. The packing fraction for $_7N^{14}$ isotope whose mass is 14,003 a.m.u. is ____

   1) 2.1×10^{-4} 2) $3x10^{-3}$ 3) 1.0002 4) 0.9

10. In each fission of $_{92}U^{235}$ releases 200 Mev of energy. How many fissions must occur per second to produce a power of 1 KW ?

    1) $1.25x10^{18}$ 2) 1.25×10^{13} 3) $3.125x10^{13}$ 4) 3.2×10^{8}

11. In nuclear fission, 0.1% of mass is converted into energy. The energy released by the fission of 1kg mass will be _____ J

1) $9x10^{19}$ 2) $9x10^{17}$ 3) $9x10^{16}$ 4) $9x10^{13}$

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

1) Isotopes 2) Isobars 3) Isotones 4) none of these

13. What is the approximate energy equivalent to rest mass of proton?

1) zero 2) $9x10^{16}$J 3) 931 eV 4) 931 Mev

14. The total binding energies of $_1H^2$, $_2He^4$, $_{26}Fe^{56}$ and $_{92}U^{235}$ are 2.22, 28.3, 492 and 786 Mev respectively. Which of the following nucleus is most stable? 1) $_2He^4$ 2) $_1H^2$ 3) $_{92}U^{235}$ 4) $_{28}Fe^{56}$

15. When the number of nucleons in a nucleus increase, the B.E. per nucleon _____

1) remains the same

2) decreases continuously with increase in mass number.

3)increases continuously with increase in mass number.

4) Initially increases and then decreases with increase in mass number.

16. Which of the following isotopes is normally fissionable ?

1) $_{92}U^{235}$ 2) $_{92}U^{238}$ 3) $_2He^4$ 4) $_{93}NP^{239}$

17. Energy generation in stars is mainly due to _____

1) Chemical reactions 2) Fission of heavy nuclei

3) Fusion of heavy nuclei 4) Fusion of light nuclei.

18. In nuclear reactions, we have the conservation of

1) mass only 2) energy only 3) momentum only

4) mass, energy and momentum

19. Thermal neutrons are those which

1) are at very high temperature

2) move with high velocities

3) have kinetic energies similar to those of surrounding molecules

4) are at rest

20. A chain reaction is continues due to

1) Large mass defect 2) Large energy

3) Production of more neutrons in fission 4) None of these

21. The volume of atom in comparison to the volume of the nucleus is of the order of

$\left(\frac{R_A}{R_N}\right)^3 = \left(\frac{10^{-10}}{10^{-15}}\right)^3 = \left(10^5\right)^3 = 10^{15}$

1) 10^5 2) 10^{15} 3) 10^{25} 4) 10^{30}

22. What is nuclear holocaust ?

1) Formation of nuclear bomb
2) Nuclear atmosphere
3) Making holes in metalic case by nuclear radiations
4) The aftermath of an atomic explosion

23. The phenomenon of pair production is ……..

1) Production of an election and a positron from γ-rays
2) Ionisation of neutral atom
3) Ejection of an electron from a nucleus
4) Ejection of an electron from metal surface when exposed to uv light

Pair production is a Process In which energy is converted in to matter $\gamma \rightarrow e^+ + e^-$

24. The B.E. per nuclear is almost constant many nuclei. To what characteristic of the nuclear forces does it point ?

1) Saturative nature 2) Short range
2) 3) attractive nature 4) Exchange force

25. Which of the following is most unstable ?

1) Proton 2) Neutron 3) Electron 4) alpha parti

(∴ The life time of free neutron is about 14 minutes)

26. In stable nucleic, the number of neutrons (N) is related to the number of protons Z in neural atom in general as

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

In Hydrogen number of neutrons is zero is an exception otherwise $N \geq Z$ in all case

27. The average binding energy of a nucleus is -------

1) 8 ev 2) 8 Kev 3) 8 Mev 4) 8 Bev

28. In the following reaction ${}_4Be^9 + {}_2He^4 \rightarrow {}_6 a^9 + {}_on^1$ The value of a is -------

1) 10 2) 12 3) 14 4) 16

29. When $_5B^{10}$ is bombarded by neutron, α - particles are emitted. The mass number of the resulting nucleus is ……

1) 15 2) 11 3) 7 4) 6

$_5B^{10} + _0n^1 \rightarrow x^n + _2He^4$

$10 + 1 = n + 4$

$N = 11 - 4 = 7$

30. The energy released in the fission of U^{235} is about ……..

1) 200ev 2) 200kev 3) 20ev 4) 200Mev

31. The main source of energy on the sun is ……..

1) Gravitational contraction
2) The burning of Hydrogen in the oxygen
3) Fission of uranium present in the sun
4) The energy liberated in the fission of protons during the synthesis of heavier nuclei

[Fusion of Hydrogen in to Helium is the major source of release of energy of on the sun]

32. The fusion occurs at high temperature because

1) Atoms are ionized at high temperature
2) Molecules breakup at high temperature
3) Nuclei break up at high temperature
4) Kinetic energy is high enough to over come the repulsion between nuclei

[High energy is required to merge nuclei]

33. The critical mass of uranium is …….

1) Minimum mass needed for chain reaction 2) 1 kg equivalent
2) 3) 75 kg 4) The rest mass is eqvivalent to 10^{20} joules.

[Ans :1 The size of fission able material need for steady or sustained NCR so that K = 1 Reproduction factor If K > 1, the stage is super critical leads in explosion If K < 1 , subcritical, the chain reaction gradually stops]

Neutron Multiplication factor $K = \frac{\text{rate of neutron production}}{\text{rate of neutron loss}}$

34. In β - decay …….. is holds good acc to Neutrino hypothesis

1) Principle of conservation of energy 2)Principle of conservation of angular momentum 3) Both (1) and (2) 4) None of these

35. Which of the following is not correct ?

1) A free proton is stable

2) Inside the nucleus, a proton can change in to a neutron and vice versa.

3) The life time of proton is greater than our universe

4) A free neutron cannot change into a proton

Note : A free neutron can change into a proton but a free proton can not change into a neutron

36. In decay daughter nucleus has the same mass number and atomic number as those of parent nucleus

α - decay 2) β - decay 3) γ - decay 4) none of these

(∴ γ - ray photon do not have rest mass or any change)

37. The neutrons produced after fission are called ……. Numbers

1) Thermal 2) secondary 3) both 1 & 2 4) none of these

38. 1 a.m.u is equal to ---------

1) $\frac{1}{25}$ mass of F_2 molecule

2) $\frac{1}{14}$ mass of N_2 molecule

3) $\frac{1}{12}$ mass of 1 atom of C^{12} so top

4) $\frac{1}{16}$ mass of O_2 molecule

39. The atoms of same element having different masses but same chemical properties are called

5) Isotopes 2) Isobars 3) Isotones 4) Isomers

40. In any fission process the ratio of mass of fission products to the mass of fission parent nucleus (fission reactants) is …….

1) = 0 2) > 1 3)< 1 4) none of these

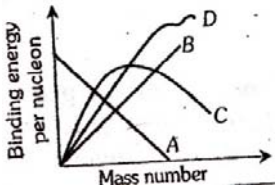
41. If r_1 and r_2 are the radii of atomic nucleli of mass number 64 and 125 respectively, then the ratio r_1 / r_2 is ……

1) $\frac{5}{4}$ 2) $\frac{4}{5}$ 3) $\frac{64}{125}$ 4) $\sqrt{\frac{64}{125}}$

[$R_1/R_2 = (A_1/A_2)^{1/3}=(\frac{64}{125})= \frac{4}{5}$]

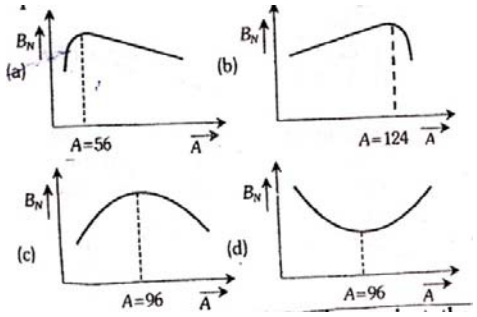
42. B.E. per nucleon plot against the mass number for stable nucleii is shown in the figure. Which curve is correct ?

1) A 2) B 3) C 4) D



43. The dependence of B.E. per nucleon (B_N) on the mass number A is represented by

44. by 1) 2)



3) 4)

45. The size of an atom is of the order of .....

1) $1A^0$ 2) 1F 3) 1 nm 4) 1μ

46. The mass of neutron is the same as that of --------

1) A proton 2) an electron 3) a meson 4) none of the these

46. Which one of these is non – divisible ?

1) Nucleus 2) proton 3) atom 4) photon

47. 1 amu cannot be expressed in ……..

1) Joule 2) Newton 3) eV 4) KWh

[Options 1, 3, & 4 are units of energy]

48. A is the mass number of an element. The volume of the nucleus of an atom this element is proportional to ……

1) A^2 2) A^3 3) $A^{1/3}$ 4)A

[$R \alpha A^{1/3}$ But $V \alpha A \ \alpha \frac{4}{3} \pi R^3$]

49. A radioactive substance of life 2 days contains 2828 atoms. How many atoms will be lift intact in the sample after 1 days

1) 2000 2) 1000 3) 1414 4) 707

[In 2 days no of atoms remaining 2828 – 1414 = 1414

$\therefore$ In 1 day no of atoms intact must be in between 1414 and 2828 (i.e. option 1 which is 2000) [$N = 1/2^n$ No $=2828/2^{1/2}$] = 2000]

50. In a nuclear reactor

1) The fuel used is mostly U^{235}
2) ordinary water moderates the activity of the reactor.
3) The think concrete shield is used to slow down the speed of neutrons
4) The chain reaction is kept under control by the rods of cadmium whose going in reduces the reaction rate.

51. In the reaction, ${}_1H^2 + {}_1H^2 \rightarrow {}_2He^4 + x$, x is ----------

1) Proton 2) photon 3) Electron 4) neutron

52. When an electron and a position collide -------

1) They repel each other 2) part of mass is converted into energy
3)the total mass is converted in to energy 4) the mass in not converted in to energy.

53. 1 gram of a radioactive element is reduced to 200 mg in 10 days. Then the mass of the sample at the end of another 10 days (in mg) is -------

1) 100 2)50 3) 40 4) 20

$M_0 = 1_g$, $M_1 = 200mg = 0.2g$ in 10mg

$M_o/M_1 = \frac{1}{0.2} = \frac{10}{2} = 5$ in to days

$M_1/M_2 = 5 \rightarrow M_2 = M_1/1 = \frac{0.2}{5}$

$M_2 = 0.04$ g or 40 mg

54. When a triton captures a tons, it becomes ----------

1) Deuteron 2) α particle 3) Neutron 4) meson

${}_1H^3 + {}_1H^1 \rightarrow {}_2He^4$ (α particle)

55. Percentage of original number of atoms in a radioactive sample remaining at the end of one mean life is

1) 50 2) 60 3) 63 4) 37

56. C^{14} decays with a half life of about 5800 years. In a sample of bone, the ratio of C^{14} to C^{12} is found to be $\frac{1}{4}$ of what it is in free air . This bone may belongs to a period about x centuries ago, where x is nearest to ------

1) 2 x 58 2) 58 3) $\frac{58}{2}$ 4) 3 x 58

57. T_1 and T_2 are the half lives of two radioactive elements of decay constants λ_1 and λ_2 respectively Then the value of T_1/T_2 is -----

1) $\lambda_2 = \lambda_1$ 2) $\lambda_1 - \lambda_2$ 3) λ_1/λ_2 4) λ_2/λ_1

58. A radioactive element has a half life of 1 day. Then 1000 atoms of the element reduce to 125 atoms in days

1) 3 2) 4 3) 8 4) 125

59. A nuclear reactor using U^{235} has a power of 1W. Number of uranium atoms undergoing fission per second is

1) 3×10^9 2) 10^6 3) $3x10^{10}$ 4) $3x10^8$

60. Range of S.B.E for stable nuclides is ------ Mev

1) 9 – 10 2) 8 – 9 3) 7 – 8 4) 6-7

61. Rate of radioactive decay can be accelerated by

1) A magnetic field 2) an electric field
3) using a catalyst 4) none of these

62. A radioactive sample contains 2000 atoms and has half life of 10 days. The number of atoms decaying in 5 days is -------

1) 1500 2) 1414 3) 586 4) 500

63. An atom has mass number 14 has a packing fraction of 0.0002. The mass of the atom is 1) 14.028 2) 14.0028 3) 13.72 4) 18.42

64. Rate of decay of a radioactive substance changes with time

1) Linearly 2) logarith mically 3) exponentially 4) none of these

65. The ratio of mean life to half of a radioactive element is -------

1) 250 2) 2000 3) 4000 4) 1600

66. One common property of radioactive radiations is ----------

1) All are e-m radiations 2) all move with velocity of light

3) all affect photographic plate 4) None of these

67. When an α - particle is accelerated by a p.d of 1V, the energy gained by it is _ ev

1) 4 2) 1 3) 2 4) 0.5

68. A nuclear reactor producing radio isotopes is called -------

1) Breeder reactor 2) power reactor 3) both 1 & 2 4) research reactor

69. Energy released due to annihilation of 1 mg of matter is ----------

1) 9×10^{10} 2) 9×10^{16} 3) 3×10^{16} 4) 9×10^{8} J

70. Nuclear density of the order of ---- kg m^{-3}

10^{10} 2) 10^{7} 3) 10^{16} 4) 10^{17}

71. Neutrons are more effective than protons s projective to induce nuclear reaction because

1) Protons are less stable 2) neutrons are more penetrating

3) Neutrons have no charge 4) none of the above

72. If T is half is the half life of a radioactive element, time taken for N atoms in a sample to decay is ---------

1) 1000 2) ∞ 3) NT 4) $\frac{T}{N}$

73. The packing fraction of Hydrogen atom of mass number 1 is 0.0078. Then mass of H – atoms is

1) 1.0022 2) 1 3) 0.9022 3) 1.0078

74. The number of α and β particles emitted in the reaction $_{92}U^{238} \rightarrow {}_{82}pb^{206}$ respectively is -------- 1) 8,6 2) 6,8 3) 8, 10 4) 8, 8

75. A triton contains ------ proton and ------ neutrons

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

76. After certain lapse of time, the fraction of radioactive polonium is found to be 12.5% of initial quantity. If the half life of polonium is 138 days, then duration of time lapse is --------days.

1) 34.5 2) 276 3) 414 4) 125

77. Mean life of a radioactive clement is 1 year. Then it's half life (in years) is -----

1) 0.8 2) 1 3) 0.693 4) 0.5

SCATTERING OF LIGHT

78. Scattered light is ----------

1) Unpolarised 2) plane polarized 3) partially 4) both 2 & 3

79. Scattering of light by smoke is an example of ---------

1) Tyndall scattering 2) Incoherent scattering

3) Raman effect 4) none

80. According to Rayleigh the intensity of scattered light is inversely proportional to ---------- 1) λ^2 2) λ^3 3) λ^4 4) λ

81. During Rayleigh scattering, the most scattered colour is --------

1) Blue 2) red 3) violet 4) yellow

82. The example for incoherent scattering is ---- scattering

1) Raman 2) Rayleigh 3) Tyndall 4) none of these

83. In Raman spectrum spectral lines of more intensity are called ---------- lines

1) Stokes 2) Antistokes 3) Raman 4) none of these

84. The sky appear ------- in the absence of earth's atmosphere

1) Violet 2) black 3) red 4) blue

85. -------- Supports quantum theory of radiation,

1) Tyndall effect 2) Rayleish effect

3) Raman effect 4) none of these

86. A composite beam of light containing wavelengths 440 nm and 550 nm is passed through a gas. In a given direction, the ratio of intensity of scattered light of those wavelengths will be

1) 125 : 256 2) 256 :125 3) 256 : 625 4) 625 : 256

LASERS

87. Laser beam of power 10^{10} W is focused upon an object o area 10^{-2} cm^2. The intensity of the beam in W m^{-2} is ------

1) 10^6 2) 10^{12} 3) 10^{16} 4) 10^{18}

88. The incorrect statement of the following if --------

1) Laser is coherent 2) laser light do not consist of several wavelengths

3)Laser beam is highly collimated 4) laser stands for light amplification by by spontaneous emission of radiation

89. An example of pulsed laser is ------ laser

1) $He - N_e$ 2) Co_2 3) Ruby 4) semiconductor

90. If atom* represents atom in the excited state, then stimulated emission is

Atom $* \rightarrow$ atom + photon 2) atom + photon $\rightarrow$ atom + photon

3) atom * + photon $\rightarrow$ atom + 2 photon

4) atom* + photon $\rightarrow$ atom + photon

91. The atom remains for longer period of about 10^{-3}s in ---------

1) Ground 2) meta stable state 3) excited state 4) non

92. A laser device used to measure large distances on pulse echo method is called

1) Sonar 2) Radar 3) Lidar 4) none of these

93. The function of xenon flash rube in a ruby laser is ---------

1) Optical pumping 2) spontaneous emission

3) to absorb photons 4) slow down photons

94. Laser beam is highly coherent because photons

1) Same energy 2) same direction 3) same energy 4) all these

Elementary particles

95. Elementary particles that are weakly interacting are called --------

1) Leptons 2) neutron 3) position 4) meson

96. There are --------- types of leptons exist

1) 3 2) 4 3) 5 4) 6

97. The spins of protons, neutrons and electrons are all ---------

1) 0 2) 1 3) 2 4) 1/2

98. Elementary particles that have strong interaction and have half integral spins are called ----------

1) Leptons 2) Hadrons 3) Baryons 4) mesons

99. The Various types of quarks are called _____

1) Leptons 2) Hadrons 3) strange particles 4) flavors

100. Baryons consist of _____ quarks.

1) Two 2) three 3) four 4) five

101. Particles that have fractional multiples of electron charge are called _____

1) Quarks 2) leptons 3) banyans 4) mesons

102 The required condition to achieve laser action in a system is :

1) state of population inversion
2) existence of a metastable state
3) confinement of emitted photon for amplification
4) all of the above