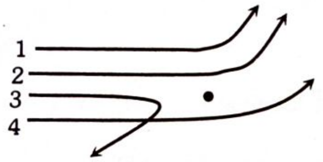
25. Atomic and Nuclear Physics – Multiple Choice Questions

1. Atomic Structure

1. According to classical theory, the circular path of an electron in Rutherford atom is

(a) Spiral (b) Circular
(c) Parabolic (d) Straight line

2. The diagram shows the path of four α-particles of the same energy being scattered by the nucleus of an atom simultaneously. Which of these are/is not physically possible



(a) 3 and 4 (b) 2 and 3
(c) 1 and 4 (d) 4 only

3. In Bohr's model of hydrogen atom, which of the following pairs of quantities are quantized

(a) Energy and linear momentum
(b) Linear and angular momentum
(c) Energy and angular momentum
(d) None of the above

4. The simple Bohr model cannot be directly applied to calculate the energy levels of an atom with many electrons. This is because

(a) Of the electrons not being subject to a central force
(b) Of the electrons colliding with each other
(c) Of screening effects
(d) The force between the nucleus and an electron will no longer be given by Coulomb's law

5. For the ground state, the electron in the H-atom has an angular momentum = h, according to the simple Bohr model. Angular momentum is a vector and hence there will be infinitely many orbits with the vector pointing in all possible directions. In actuality, this is not true,

(a) Because Bohr model gives incorrect values of angular momentum
(b) Because only one of these would have a minimum energy
(c) Angular momentum must be in the direction of spin of electron
(d) Because electrons go around only in horizontal orbits

6. If electron in a hydrogen atom has moved from $n=1$ to $n=10$ orbit, the potential energy of the system has

(a) Increased (b) Decreased
(c) Remained unchanged (d) Become zero

7. The ratio of the kinetic energy to the total energy of an electron in a Bohr orbit is

(a) – 1 (b) 2
(c) 1 : 2 (d) None of these

8. The Half life of a particle of mass $1.6\times10^{-26} kg$ is 6.9 s and a stream of such particles is travelling with the $K.E.$ of a particle being $0.05\, eV$. The fraction of particles which will decay when they travel a distance of $1\, m$ is

(a) 0.1 (b) 0.01
(c) 0.001 (d) 0.0001

9. The distance of the closest approach of an alpha particle fired at a nucleus with kinetic energy K is r_0. The distance of the closest approach when the α particle is fired at the same nucleus with kinetic energy $2K$ will be

(a) $\frac{r_0}{2}$ (b) $4r_0$
(c) $\frac{r_0}{4}$ (d) $2r_0$

10. The radius of electron's second stationary orbit in Bohr's atom is R. The radius of the third orbit will be

(a) 3 R (b) 2.25 R
(c) 9 R (d) $\frac{R}{3}$

11. The radius of the first (lowest) orbit of the hydrogen atom is a_0. The radius of the second (next higher) orbit will be

(a) $4a_0$ (b) $6a_0$
(c) $8a_0$ (d) $10a_0$

12. Taking the Bohr radius as $a_0 = 53\, pm$, the radius of Li^{++} ion its ground state, on the basis of Bohr's model, will be about

(a) 53 pm (b) 27 pm
(c) 18 pm (d) 13 pm

13. The ionisation energy of 10 times ionised sodium atom is

(a) 13.6 eV (b) $13.6\times11\, eV$
(c) $\frac{13.6}{11} eV$ (d) $13.6\times(11)^2 eV$

14. If the energy of a hydrogen atom in nth orbit is E_n, then energy in the nth orbit of a singly ionized helium atom will be

(a) $4E_n$ (b) $E_n/4$

(c) $2E_n$ (d) $E_n/2$

15. In a hypothetical Bohr hydrogen, the mass of the electron is doubled. The energy E_0 and the radius r_0 of the first orbit will be (a_0 is the Bohr radius)

(a) $E_0 = -27.2\ eV; r_0 = a_0/2$

(b) $E_0 = -27.2\ eV; r_0 = a_0$

(c) $E_0 = -13.6\ eV; r_0 = a_0/2$

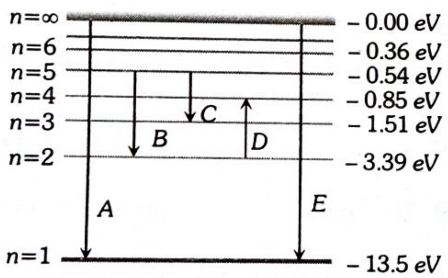
(d) $E_0 = -13.6\ eV; r_0 = a_0$

16. A singly ionized helium atom in an excited state ($n = 4$) emits a photon of energy $2.6\,eV$. Given that the ground state energy of hydrogen atom is $-13.6\,eV$, the energy (E_t) and quantum number (n) of the resulting state are respectively

(a) $E_t = -13.6\,eV, n = 1$ (b) $E_t = -6.0\,eV, n = 3$

(c) $E_t = 6.0\,eV, n = 2$ (d) $E_t = -13.6\,eV, n = 2$

17. The energy levels of the hydrogen spectrum are shown in figure. There are some transitions A, B, C, D and E. Transition A, B and C respectively represent



(a) First member of Lyman series, third spectral line of Balmer series and the second spectral line of Paschen series

(b) Ionization potential of hydrogen, second spectral line of Balmer series and third spectral line of Paschen series

(c) Series limit of Lyman series, third spectral line of Balmer series and second spectral line of Paschen series

(d) Series limit of Lyman series, second spectral line of Balmer series and third spectral line of Paschen series

18. An electron jumps from the 4th orbit to the 2nd orbit of hydrogen atom. Given the Rydberg's constant $R = 10^5\,cm^{-1}$. The frequency in Hz of the emitted radiation will be

(a) $\frac{3}{16}\times 10^5$ (b) $\frac{3}{16}\times 10^{15}$

(c) $\frac{9}{16}\times 10^{15}$ (d) $\frac{3}{4}\times 10^{15}$

19. If the wavelength of the first line of the Balmer series of hydrogen is $6561\,Å$, the wavelength of the second line of the series should be

(a) $13122\,Å$ (b) $3280\,Å$

(c) $4860\,Å$ (d) $2187\,Å$

20. The minimum energy required to excite a hydrogen atom from its ground state is

(a) 13.6 eV (b) −13.6 eV

(c) 3.4 eV (d) 10.2 eV

21. The ratio of the longest to shortest wavelengths in Lyman series of hydrogen spectra is

(a) $\frac{25}{9}$ (b) $\frac{17}{6}$

(c) $\frac{9}{5}$ (d) $\frac{4}{3}$

22. The ratio of the wavelengths for $2 \to 1$ transition in Li^{++}, He^{+} and H is

(a) 1 : 2 : 3 (b) 1 : 4 : 9

(c) 4 : 9 : 36 (d) 3 : 2 : 1

23. An electron changes its position from orbit $n = 4$ to the orbit $n = 2$ of an atom. The wavelength of the emitted radiation is (R = Rydberg's constant)

(a) $\frac{16}{R}$ (b) $\frac{16}{3R}$

(c) $\frac{16}{5R}$ (d) $\frac{16}{7R}$

24. In the hydrogen spectrum, the ratio of the wavelengths for Lyman $\alpha-$ radiation to Balmer $-\alpha$ radiation is

(a) $\frac{5}{27}$ (b) $\frac{5}{48}$

(c) $\frac{27}{5}$ (d) $\frac{1}{3}$

25. Due to transitions among its first three energy levels, hydrogenic atom emits radiation at three discrete. Wavelengths λ_1, λ_2 and $\lambda_3 (\lambda_1 < \lambda_2 < \lambda_3)$, then

(a) $\lambda_1 = \lambda_2 + \lambda_3$ (b) $\lambda_1 + \lambda_2 = \lambda_3$

(c) $1/\lambda_1 + 4/\lambda_2 = 1/\lambda_3$ (d) $1/\lambda_1 = 1/\lambda_2 + 1/\lambda_3$

26. Calculate the highest frequency of the emitted photon in the Paschen series of spectral lines of the Hydrogen atom

(a) $3.7\times 10^{14}\,Hz$ (b) $9.1\times 10^{15}\,Hz$

(c) $10.23\times 10^{14}\,Hz$ (d) $29.7\times 10^{15}\,Hz$

27. The wavelength of radiation emitted is λ_0 when an electron jumps from the third to the second orbit of hydrogen atom. For the electron jump from the fourth to the second orbit of the hydrogen atom, the wavelength of radiation emitted will be

(a) $\frac{16}{25}\lambda_0$ (b) $\frac{20}{27}\lambda_0$

(c) $\frac{27}{20}\lambda_0$ (d) $\frac{25}{16}\lambda_0$

28. The wavelength of the first Balmer line caused by a transition from the $n=3$ level to the $n=2$ level in hydrogen is λ_1. The wavelength of the line caused by an electronic transition from $n=5$ to $n=3$ is

(a) $\frac{375}{128}\lambda_1$ (b) $\frac{125}{64}\lambda_1$

(c) $\frac{64}{125}\lambda_1$ (d) $\frac{128}{375}\lambda_1$

29. An electron of an atom transits from n_1 to n_2. In which of the following maximum frequency of photon will be emitted

(a) $n_1=1$ to $n_2=2$ (b) $n_1=2$ to $n_2=1$

(c) $n_1=2$ to $n_2=6$ (d) $n_1=6$ to $n_2=2$

30. Which of the following transitions will have highest emission wavelength

(a) $n=2$ to $n=1$ (b) $n=1$ to $n=2$

(c) $n=2$ to $n=5$ (d) $n=5$ to $n=2$

31. Two energy levels of an electron in an atom are separated by 2.3 eV. The frequency of radiation emitted when the electrons goes from higher to the lower level is

(a) 6.95×10^{14} Hz (b) 3.68×10^{15} Hz

(c) 5.6×10^{14} Hz (d) 9.11×10^{15} Hz

32. A double charged lithium atom is equivalent to hydrogen whose atomic number is 3. The wavelength of required radiation for emitting electron from first to third Bohr orbit in Li^{++} will be (Ionisation energy of hydrogen atom is 13.6eV)

(a) 182.51 Å (b) 177.17 Å

(c) 142.25 Å (d) 113.74 Å

33. Which of the following statements are true regarding Bohr's model of hydrogen atom

(I) Orbiting speed of electron decreases as it shifts to discrete orbits away from the nucleus

(II) Radii of allowed orbits of electron are proportional to the principal quantum number

(III) Frequency with which electrons orbit around the nucleus in discrete orbits is inversely proportional to the cube of principal quantum number

(IV) Binding force with which the electron is bound to the nucleus increases as it shifts to outer orbits

Select correct answer using the options given below

Options :

(a) I and III (b) II and IV

(c) I, II and III (d) II, III and IVs

34. For electron moving in n^{th} orbit of H-atom the angular velocity is proportional to

(a) n (b) $1/n$

(c) n^3 (d) $1/n^3$

35. An electron in hydrogen atom makes a transition $n_1 \to n_2$ where n_1 and n_2 are principal quantum numbers of the two states. Assuming Bohr's model to be valid, the time period of the electron in the initial state is eight times that in the final state. The possible value of n_1 and n_2 are

(a) $n_1=6$ and $n_2=2$ (b) $n_1=8$ and $n_2=1$

(c) $n_1=8$ and $n_2=2$ (d) $n_1=4$ and $n_2=2$

36. A sodium atom is in one of the states labelled 'Lowest excited levels'. It remains in that state for an average time of 10^{-8} s, before it makes a transition back to a ground state. What is the uncertainty in energy of that excited state

(a) 6.56×10^{-8} eV (b) 2×10^{-8} eV

(c) 10^{-8} eV (d) 8×10^{-8} eV

37. Two H atoms in the ground state collide inelastically. The maximum amount by which their combined kinetic energy is reduced is

(a) 10.20 eV (b) 20.40 eV

(c) 13.6 eV (d) 27.2 eV

38. In hydrogen atom, the electron is moving round the nucleus with velocity $2.18\times10^6 m/s$ in an orbit of radius 0.528Å. The acceleration of the electron is

(a) $9\times10^{18} m/s^2$ (b) $9\times10^{22} m/s^2$

(c) $9\times10^{-22} m/s^2$ (d) $9\times10^{12} m/s^2$

39. In Bohr model of an atom, two electrons move round the nucleus in circular orbits of radii in the ratio 1 : 4. The ratio of their kinetic energies are

(a) 1 : 4 (b) 4 : 1

(c) 8 : 1 (d) 1 : 8

2. Nucleus, Nuclear Reaction

1. Outside a nucleus

(a) Neutron is stable

(b) Proton and neutron both are stable

(c) Neutron is unstable

(d) Neither neutron nor proton is stable

2. Following process is known as $h\nu \to e^+ + e^-$

(a) Pair production (b) Photoelectric effect

(c) Compton effect (d) Zeeman effect

3. When $_{92}U^{235}$ undergoes fission, 0.1% of its original mass is changed into energy. How much energy is released if 1*kg* of $_{92}U^{235}$ undergoes fission

(a) $9\times10^{10}J$
(b) $9\times10^{11}J$
(c) $9\times10^{12}J$
(d) $9\times10^{13}J$

4. In a nuclear reactor, the fuel is consumed at the rate of 1 *mg/s*. The power generated in kilowatt is

(a) 9×10^{4}
(b) 9×10^{7}
(c) 9×10^{8}
(d) 9×10^{12}

5. Using the following data

mass of hydrogen atom = 1.00783 u

mass of neutron = 1.00867 u

mass of nitrogen atom $({}_7N^{14})$ = 14.00307 u

the calculated value of the binding energy of the nucleus of the nitrogen atom $({}_7N^{14})$ is close to

(a) 56 *MeV*
(b) 98 *MeV*
(c) 104 *MeV*
(d) 112 *MeV*

6. Calculate the neutron separation energy from the following data $m({}^{40}_{20}Ca) = 39.962591u$; $m({}^{41}_{20}Ca) = 40.962278u$;

$m_n = 1.00865,\ 1u = 931.5\,MeV/C^2$

(a) 7.57 MeV
(b) 8.36 MeV
(c) 9.12 MeV
(d) 9.56 MeV

7. The following fusion reaction takes place

$${}^2_1H + {}^2_1H \longrightarrow {}^3_2He + n + 3.27\,MeV$$

If 2 *kg* of deuterium is subjected to above reaction, the energy released is used to light a 100 *W* lamp, how long will the lamp glow

(a) 2×10^{6} *years*
(b) 3×10^{5} *years*
(c) 5×10^{4} *years*
(d) 7×10^{3} *years*

8. The binding energy of a H-atom, considering an electron moving around a fixed nuclei (proton), is

$$B = -\frac{me^4}{8n^2\varepsilon_0^2h^2}\ (m = \text{electron mass})$$

If one decides to work in a frame of reference where the electron is at rest, the proton would be moving around it. By similar arguments, the binding energy would be

$$B = -\frac{Me^4}{8n^2\varepsilon_0^2h^2}\ (M = \text{proton mass})$$

This last expression is not correct, because

(a) n would not be integral
(b) Bohr-quantisation applies only two electron
(c) The frame in which the electron is at rest is not inertial
(d) The motion of the proton would not be in circular orbits, even approximately

9. The gravitational force between a *H*-atom and another particle of mass m will be given by Newton's law

$$F = G\frac{M.m}{r^2}$$, where r is in *km* and

(a) $M = m_{proton} + m_{electron}$

(b) $M = m_{proton} + m_{electron} - \frac{B}{c^2}\,(B = 13.6\,eV)$

(c) M is not relate to the mass of the hydrogen atom)

(d) $M = m_{proton} + m_{electron} - \frac{|V|}{c^2}$ ($|V|$= magnitude of the potential energy of electron in the H-atom)

10. In one model of the election, the electron of mass m_e is thought to be a uniformly charged shell of radius R and total charge e, whose electrostatic energy E is equivalent to its mass m_e via Einstein's mass energy relation $E = m_ec^2$. In this model, R is approximately,

$(m_e = 9.1\times10^{-31}kg), c = 3\times10^{8} m.s.^{-1}, \frac{1}{4\pi\varepsilon_0} 9\times10^{9}$ Farads m^{-1}, magnitude of the electron charge $= 1.6\times10^{-19}C$

(a) $1.4\times10^{-15}m$
(b) $2\times10^{-13}m$
(c) $5.3\times10^{-11}m$
(d) $2.8\times10^{-35}m$

11. The binding energy per nucleon of $_5B^{10}$ is 8.0 *MeV* and that $_5B^{11}$ is 7.5 *MeV*. The energy required to remove a neutron from $_5B^{11}$ is (mass of electron and proton are $9.11\times10^{-31}kg$ and $1.67\times10^{-27}kg$)

(a) 2.5 *MeV*
(b) 8.0 *MeV*
(c) 0.5 *MeV*
(d) 7.5 *MeV*

12. If one takes into account finite mass of the proton, the correction to the binding energy of the hydrogen atom is approximately. (Mass of proton $= 1.60\times10^{-27}kg$ mass of electron $= 9.10\times10^{-21}kg$)

(a) 0.06%
(b) 0.0006%
(c) 0.02%
(d) 0.00%

13. In a working nuclear reactor, cadmium rods (control rods) are used to

(a) Speed up neutrons
(b) Slow down neutrons
(c) Absorb some neutrons
(d) Absorb all neutrons

14. A reaction between a proton and $_8O^{18}$ that produces $_9F^{18}$ must also liberate

(a) $_0n^1$
(b) $_1e^0$
(c) $_1n^0$
(d) $_0e^1$

15. What is used as a moderator in a nuclear reactor

(a) Water (b) Graphite

(c) Cadmium (d) Steel

16. An atomic power nuclear reactor can deliver 300 MW. The energy released due to fission of each nucleus of uranium atom U^{238} is 170 MeV. The number of uranium atoms fissioned per hour will be

(a) 30×10^{25} (b) 4×10^{22}

(c) 10×10^{20} (d) 5×10^{15}

17. In a nuclear reactor, moderators slow down the neutrons which come out in a fission process. The moderator used have light nuclei. Heavy nuclei will not serve the purpose, because

(a) They will break up

(b) Elastic collision of neutrons with heavy nuclei will not slow them down

(c) The net weight of the reactor would be unbearably high

(d) Substances with heavy nuclei do not occur in liquid or gaseous state at room temperature

18. If 200 MeV energy is released in the fission of a single U^{235} nucleus, the number of fissions required per second to produce 1 *kilowatt* power shall be (Given $1\,eV = 1.6\times10^{-19} J$)

(a) 3.125×10^{13} (b) 3.125×10^{14}

(c) 3.125×10^{15} (d) 3.125×10^{16}

19. Nuclear fusion is common to the pair

(a) Thermonuclear reactor, uranium based nuclear reactor

(b) Energy production in sun, uranium based nuclear reactor

(c) Energy production in sun, hydrogen bomb

(d) Disintegration of heavy nuclei, hydrogen bomb

20. Heavy stable nuclei have more neutrons than protons. This is because of the fact that

(a) Neutrons are heavier than protons

(b) Electrostatic force between protons are repulsive

(c) Neutrons decay into protons through beta decay

(d) Nuclear forces between neutrons are weaker than that between protons

21. If M is the atomic mass and A is the mass number, packing fraction is given by

(a) $\dfrac{A}{M-A}$ (b) $\dfrac{A-M}{A}$

(c) $\dfrac{M}{M-A}$ (d) $\dfrac{M-A}{A}$

22. Nuclear forces are

(a) Short ranged attractive and charge independent

(b) Short ranged attractive and charge dependent

(c) Long ranged repulsive and charge independent

(d) Long ranged repulsive and charge dependent

23. Two nucleons are at a separation of $1\times10^{-15} m$. The net force between them is F_1 if both are neutrons, F_2 if both are protons and F_3 if one is a proton and other is a neutron. In such a case

(a) $F_2 > F_1 > F_3$ (b) $F_1 = F_2 = F_3$

(c) $F_1 = F_2 > F_3$ (d) $F_1 = F_3 > F_2$

24. Consider the following statements

S1 : The nuclear force is independent of the charge of nucleons.

S2 : The number of nucleons in the nucleus of an atom is equal to the number of electrons in the atom.

S3 : All nuclei have masses that are less than the sum of the masses of constituent nucleons.

S4 : Nucleons belong to the family of leptons while electrons are members of the family of hadrons.

Choose the correct statement(s) from these

(a) S1 only (b) S1 and S4

(c) S2, S3 and S4 (d) S1 and S3

25. O_2 molecule consists of two oxygen atoms. In the molecule, nuclear force between the nuclei of the two atoms

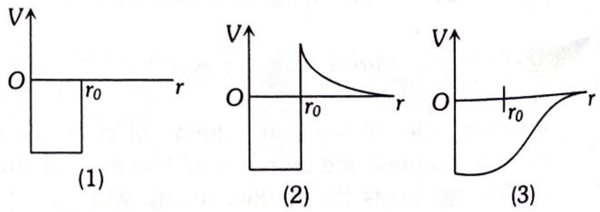
(a) Is not important because nuclear forces are short – ranged

(b) Is as important as electrostatic force for binding the two atoms

(c) Cancels the repulsive electrostatic force between the nuclei

(d) Is not important because oxygen nucleus have equal number of neutrons and protons

26. Given below are three schematic graphs of potential energy $V(r)$ versus distance r for three atomic articles : electron (e), proton (P^+) and neutron (n), in the presence of a nucleus at the origin O. The radius of the nucleus is r_0. The scale on the $V-$ axis may not be the same for all figures. The correct pairing of each graph with the corresponding atomic particle is



(a) $(1,n),(2,p^+),(3,e)$ (b) $(1,p^+),(2,e),(3,n)$

(c) $(1,e),(2,p^+),(3,n)$ (d) $(1,p^+),(2,n),(3,e)$

27. The radius of a nucleus of a mass number A is directly proportional to

(a) A^3 (b) A

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

28. The radius of ${}_{29}Cu^{64}$ nucleus in Fermi is (given $R_0 = 1.2\times10^{-15}\,m$)

(a) 4.8 (b) 1.2

(c) 7.7 (d) 9.6

29. The nuclear radius of a certain nucleus is 7.2 *fm* and it has a charge of $1.28\times10^{-17}\,C$. The number of neutrons inside the nucleus is

(a) 136 (b) 142

(c) 140 (d) 132

(e) 126

3. Radioactivity

1. The rate of disintegration of fixed quantity of a radioactive element can be increased by

(a) Increasing the temperature

(b) Increasing the pressure

(c) Chemical reaction

(d) It is not possible

2. The phenomenon of radioactivity is

(a) Exothermic change which increases or decreases with temperature

(b) Increases on applied pressure

(c) Nuclear process does not depend on external factors

(d) None of the above

3. Half life of radioactive element depends upon

(a) Amount of element present

(b) Temperature

(c) Pressure

(d) Nature of element

4. A radio-isotope has a half- life of 5 *years*. The fraction of the atoms of this material that would decay in 15 *years* will be

(a) 1/8 (b) 2/3

(c) s7/8 (d) 5/8

5. 99% of a radioactive element will decay between

(a) 6 and 7 half lives (b) 7 and 8 half lives

(c) 8 and 9 half lives (d) 9 half lives

6. A set of atoms in an excited state decays

(a) In general to any of the states with lower energy

(b) Into a lower state only when excited by an external electric field

(c) All together simultaneously into a lower state

(d) To emit photons only when they collide

7. 1 Suppose we consider a large number of containers each containing initially 10000 atoms of a radioactive material with a half life of 1 yr. After 1 yr,

(a) All the containers will have 5000 atoms of the material

(b) All the containers will contain the same number of atoms of the material but that number will only by approximately 5000

(c) The containers will in general have different number of the atoms of the material but their average will be close to 5000

(d) None of the containers can have more than 5000 atoms

8. A sample contains 16 *g* of a radioactive material, the half life of which is two days. After 32 days, the amount of radioactive material left in the sample is

(a) Less than 1 *mg* (b) $\frac{1}{4}g$

(c) $\frac{1}{2}g$ (d) 1 *g*

9. What is the disintegration constant of radon, if the number of its atoms diminishes by 18% in 24 *h*

(a) $2.1\times10^{-3}s^{-1}$ (b) $2.1\times10^{-4}s^{-1}$

(c) $2.1\times10^{-5}s^{-1}$ (d) $2.1\times10^{-6}s^{-1}$

10. *A* and *B* are two radioactive substances whose half lives are 1 and 2 *years* respectively. Initially 10 *g* of *A* and 1 *g* of *B* is taken. The time (approximate) after which they will have same quantity remaining is

(a) 6.62 *years* (b) 5 *years*

(c) 3.2 *years* (d) 7 *years*

11. At time $t = 0$, a container has No radioactive atoms with a decay constant λ. In addition, c numbers of atoms of the same type are being added to the container per unit time. How many atoms of this type are there at $t = T$

(a) $\frac{c}{\lambda}\exp(\lambda T)N_0\ \exp(\lambda T)$

(b) $\frac{c}{\lambda}\exp(\lambda T)+N_0\ \exp(\lambda T)$

(c) $\frac{c}{\lambda}\{1\ \exp(\lambda T)\}+N_0\ \exp(\lambda T)$

(d) $\frac{c}{\lambda}\{1+\exp(\lambda T)\}+N_0\ \exp(\lambda T)$

12. 1 curie is equal to

(a) 3×10^{10} disintegrations/s

(b) 3.7×10^{7} disintegrations/s

(c) 5×10^{7} disintegrations/s

(d) 3.7×10^{10} disintegrations/s

13. A nucleus has a half – life of 30 minutes. At 3 PM its decay rate was measured as 120,000 counts/sec. what will be the decay rate at 5 PM

(a) 120,000 counts/sec (b) 60,000 counts/sec

(c) 30,000 counts/sec (d) 75,00 counts/sec

14. The half-life of a radioactive substance against α-decay is $1.2\times10^7 s$. What is the decay rate for 4×10^{15} atoms of the substance

(a) $4.6\times10^{12} atoms/s$ (b) $2.3\times10^{11} atoms/s$

(c) $4.6\times10^{10} atoms/s$ (d) $2.3\times10^{8} atoms/s$

15. A radioactive substance emits n beta particles in the first 2 seconds and $0.5n$ beta particles in the next 2 seconds. The mean life of the sample is

(a) $4\ s$ (b) $2s$

(c) $\frac{2}{(\ln 2)}s$ (d) $2(\ln 2)s$

16. A radioactive nucleus A has a single decay mode with half life τ_A. Another radioactive nucleus B has two decay modes 1 and 2. If decay mode 2 were absent, the half life of B would have been $\tau_A/2$. If decay mode 1 were absent the half life of B would have been $3\tau_A$. If the actual half life of B is τ_B, then the ratio $\frac{\tau_B}{\tau_A}$ is

(a) $\frac{3}{7}$ (b) $\frac{7}{2}$

(c) $\frac{7}{3}$ (d) 1

17. Two species of radioactive atoms are mixed in equal number. The disintegration of the first species is λ and of the second is $\lambda/3$. After a long time the mixture will behave as a species with mean life of approximately

(a) $\frac{0.70}{\lambda}$ (b) $\frac{2.10}{\lambda}$

(c) $\frac{1.00}{\lambda}$ (d) $\frac{0.52}{\lambda}$

18. A nucleus of mass number 220, initially at rest, emits an $\alpha-$ particle. If the Q value of the reaction is $5.5\,MeV$, the energy of the emitted $\alpha-$ particle will be

(a) $4.8\,MeV$ (b) $5.4\,MeV$

(c) $5.5\,MeV$ (d) $6.8\,MeV$

19. M_x and M_y denote the atomic masses of the parent and the daughter nuclei respectively in radioactive decay. The Q-value for a β^- decay is Q_1 and that for a β^+ decay is Q_2. If m_e denotes the mass of an electron, then which of the following statement is correct

(a) $Q_1=(M_x-M_y)c^2$ and $Q_2=(M_x-M_y-2m_e)c^2$

(b) $Q_1=(M_x-M_y)c^2$ and $Q_2=(M_x-M_y)c^2$

(c) $Q_1=(M_x-M_y-2m_e)c^2$ and $Q_2=(M_x-M_y+2c_e)c^2$

(d) $Q_1=(M_x-M_y+2m_e)c^2$ and $Q_2=(M_x-m_y+2m_e)c^2$

20. Tritium is an isotope of hydrogen whose nucleus triton contains 2 neutrons and 1 proton. Free neutrons decay into $p+\bar{e}+\bar{n}$. If one of the neutrons in Triton decays, it would transform into He^3 nucleus. This does not happen. This is because

(a) Triton energy is less than that of a He^3 nucleus

(b) The electron created in the beta decay process cannot remain in the nucleus

(c) Both the neutrons in triton have to decay simultaneously resulting in a nucleus with 3 protons, which is not a He^3 nucleus

(d) Free neutrons decay due to external perturbations which absent in triton nucleus

21. A nuclear decay is possible if the mass of the parent nucleus exceeds the total mass of the decay particles. If $M(A,Z)$ denotes the mass of a single neutral atom of an element with mass number A and atomic number Z, then the minimal condition that the $\beta-$decay $X_Z^A \rightarrow Y_{Z+1}^A+\beta^-+\bar{V}e$ will occur is (m_e denotes the mass of the $\beta-$ particle and the neutrino mass mv can be neglected)

(a) $M(A,Z)>M(A,Z+1)+m_e$

(b) $M(A,Z)>M(A,Z+1)$

(c) $M(A,Z)>M(A,Z+1)+Zm_e$

(d) $M(A,Z)>M(A,Z+1)-m_e$

22. Carbon –11 decays to boron (e^+) produced in the decay combine with free electrons in the atmosphere and annihilate each other almost immediately. Also assume that the neutrinos (V_e) are massless and do not intersect with the environment.. at $t=0$ we have $1\mu\,g$ of ${}_6^{12}C$. If the half – life of the decay process is t_0, the net energy produced between time $t=0$ and $t=2t_0$ will be nearly

(a) $8\times10^{18}\ MeV$ (b) $8\times10^{16}\ MeV$

(c) $4\times10^{18}\ MeV$ (d) $4\times10^{16}\ MeV$

23. A nucleus of mass 214 amu in free state decays to emit an α-particle. Kinetic energy of the α-particle emitted is 6.7 MeV. The recoil energy (in MeV) of the daughter nucleus is

(a) 1.0 (b) 0.5

(c) 0.25 (d) 0.125

24. A radioactive nucleus undergoes a series of decay according to the scheme

$$A\xrightarrow{\alpha}A_1\xrightarrow{\beta}A_2\xrightarrow{\alpha}A_3\xrightarrow{\gamma}A_4$$

If the mass number and atomic number of A are 180 and 72 respectively, then what are these numbers for A_4

(a) 172 and 69 (b) 174 and 70

(c) 176 and 69 (d) 176 and 70

25. Consider the following two statements

A. Energy spectrum of α-particles emitted in radioactive decay is discrete

B. Energy spectrum of β-particles emitted in radioactive decay is continuous

(a) Only A is correct
(b) Only B is correct
(c) A is correct but B is wrong
(d) Both A and B are correct

26. A radioactive nucleus with Z protons and N neutrons emits an α-particle, 2β-particles and 2 gamma rays. The number of protons and neutrons in the nucleus left after the decay respectively, are

(a) $Z-3, N-1$ (b) $Z-2, N-2$
(c) $Z-1, N-3$ (d) $Z, N-4$

27. A radioactive decay chain starts from ${}_{93}Np^{237}$ and produces ${}_{90}Th^{229}$ by successive emissions. The emitted particles can be

(a) Two α-particles and one β-particle
(b) Three β^+ particles
(c) One α particle and two β^+ particles
(d) One α particle and two β^- particles

28. What is the respective number of α and β particles emitted in the following radioactive decay ${}_{90}X^{200} \rightarrow {}_{80}Y^{168}$

(a) 6 and 8 (b) 8 and 8
(c) 6 and 6 (d) 8 and 6

29. A radioactive element ${}_{90}X^{238}$ decays into ${}_{83}Y^{222}$. The number of β – particles emitted are

(a) 4 (b) 6
(c) 2 (d) 1

30. When a nucleus in an atom undergoes a radioactive decay, the electronic energy levels of the atom

(a) Do not change for any type of radioactivity
(b) Change for α and β - radioactivity but not for γ - radioactivity
(c) Change for α - radioactivity but not for others
(d) Change for β - radioactivity but not for others

4. IIT-JEE/AIEEE

1. If in nature there may not be an element for which the principal quantum number $n>4$, then the total possible number of elements will be **[1983]**

(a) 60 (b) 32
(c) 4 (d) 64

2. A Hydrogen atom and a Li^{++} ion are both in the second excited state. If l_H and l_{Li} are their respective electronic angular momenta, and E_H and E_{Li} their respective energies, then **[2002]**

(a) $l_H > l_{Li}$ and $|E_H| > |E_{Li}|$ (b) $l_H = l_{Li}$ and $|E_H| < |E_{Li}|$
(c) $l_H = l_{Li}$ and $|E_H| > |E_{Li}|$ (d) $l_H < l_{Li}$ and $|E_H| < |E_{Li}|$

3. The electric potential between a proton and an electron is given by $V = V_0 \ln\frac{r}{r_0}$, where r_0 is a constant. Assuming Bohr's model to be applicable, write variation of r_n with n, n being the principal quantum number **[2003]**

(a) $r_n \propto n$ (b) $r_n \propto 1/n$
(c) $r_n \propto n^2$ (d) $r_n \propto 1/n^2$

4. The electron in a hydrogen atom makes a transition from an excited state to the ground state. Which of the following statements is true **[2000]**

(a) Its kinetic energy increases and its potential and total energies decrease
(b) Its kinetic energy decreases, potential energy increases and its total energy remain the same
(c) Its kinetic and total energies decrease and its potential energy increases
(d) Its kinetic, potential and total energies decrease

5. Suppose an electron is attracted towards the origin by a force $\frac{k}{r}$ where 'k' is a constant and 'r' is the distance of the electron from the origin. By applying Bohr model to this system, the radius of the n^{th} orbital of the electron is found to be 'r_n' and the kinetic energy of the electron to be 'T_n'. Then which of the following is true **[2008]**

(a) T_n independent of n, $r_n \propto n$
(b) $T_n \propto \frac{1}{n}$, $r_n \propto n$
(c) $T_n \propto \frac{1}{n}$, $r_n \propto n^2$
(d) $T_n \propto \frac{1}{n^2}$, $r_n \propto n^2$

6. In the nuclear fusion reaction ${}_1^2H + {}_1^3H \rightarrow {}_2^4He + n$, given that the repulsive potential energy between the two nuclei is $-7.7\times10^{-14}J$, the temperature at which the gases must be heated to initiate the reaction is nearly

[Boltzmann's constant $k = 1.38\times10^{-23} J/K$] **[2003]**

(a) $10^9 K$ (b) $10^7 K$
(c) $10^5 K$ (d) $10^3 K$

7. An alpha nucleus of energy $\frac{1}{2}mv^2$ bombards a heavy nuclear target of charge Ze. Then the distance of closest approach for the alpha nucleus will be proportional to **[2006]**

(a) $1/m$ (b) $1/v^4$

(c) $1/Ze$ (d) v^2

8. An α-particle of 5 MeV energy strikes with a nucleus of uranium at stationary at an scattering angle of 180°. The nearest distance upto which α-particle reaches the nucleus will be of the order of **[1981]**

(a) 1 Å (b) $10^{-10} cm$

(c) $10^{-12} cm$ (d) $10^{-15} cm$

9. If the atom ${}_{100}Fm^{257}$ follows the Bohr model and the radius of ${}_{100}Fm^{257}$ is n times the Bohr radius, then find n **[2003]**

(a) 100 (b) 200

(c) 4 (d) 1/4

10. As per Bohr model, the minimum energy (in eV) required to remove an electron from the ground state of doubly ionized Li atom ($Z = 3$) is **[1997]**

(a) 1.51 (b) 13.6

(c) 40.8 (d) 122.4

11. In hydrogen atom, when electron jumps from second to first orbit, then energy emitted is **[2002]**

(a) – 13.6 eV (b) – 27.2 eV

(c) – 6.8 eV (d) None of these

12. If the binding energy of the electron in a hydrogen atom is 13.6 eV, the energy required to remove the electron from the first excited state of Li^{++} is **[2003]**

(a) 122.4 eV (b) 30.6 eV

(c) 13.6 eV (d) 3.4 eV

13. Which of the following atoms has the lowest ionization potential **[2003]**

(a) ${}^{16}_{8}O$ (b) ${}^{14}_{7}N$

(c) ${}^{133}_{55}Cs$ (d) ${}^{40}_{18}Ar$

14. Energy required for the electron excitation in Li^{++} from the first to the third Bohr orbit is **[2011]**

(a) 12.1 eV (b) 36.3 eV

(c) 108.8 eV (d) 122.4 eV

15. An energy of 24.6 eV is required to remove one of the electrons from a neutral helium atom. The energy (in eV) required to remove both the electrons from a neutral helium atom is **[1995]**

(a) 79.0 (b) 51.8

(c) 49.2 (d) 38.2

16. A hydrogen like atom of atomic number Z is in an excited state of quantum number $2n$. It can emit a maximum energy photon of 204 eV. If it makes a transition to quantum state n, a photon of energy 40.8 eV is emitted. The value of n will be **[2000]**

(a) 1 (b) 2

(c) 3 (d) 4

17. Hydrogen atom is excited from ground state to another state with principal quantum number equal to 4. Then the number of spectral lines in the emission spectra will be **[2012]**

(a) 2 (b) 3

(c) 5 (d) 6

18. In the following atoms and molecules for the transition from $n = 2$ to $n = 1$, the spectral line of minimum wavelength will be produced by **[1983]**

(a) Hydrogen atom (b) Deuterium atom

(c) Uni-ionized helium (d) Di-ionized lithium

19. The largest wavelength in the ultraviolet region of the hydrogen spectrum is 122 nm. The smallest wavelength in the infrared region of the hydrogen spectrum (to the nearest integer is) **[2007]**

(a) 802 nm (b) 823 nm

(c) 1882 nm (d) 1648 mn

20. The wavelength of the first spectral line in the Balmer series of hydrogen atom is 6561 Å. The wavelength of the second spectral line in the Balmer series of singly ionized helium atom is **[2011]**

(a) 1215 Å (b) 1640 Å

(c) 2430 Å (d) 4687 Å

21. Hydrogen $({}_1H^1)$, Deuterium $({}_1H^2)$, singly ionised Helium $({}_2He^4)^+$ and doubly ionised lithium $({}_3Li^6)^{++}$ all have one electron around the nucleus. Consider an electron transition from $n=2$ to $n=1$. If the wave lengths of emitted radiation are λ_1, λ_2, λ_3 and λ_4 respectively then approximately which one of the following is correct **[2014]**

(a) $4\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$ (b) $\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$

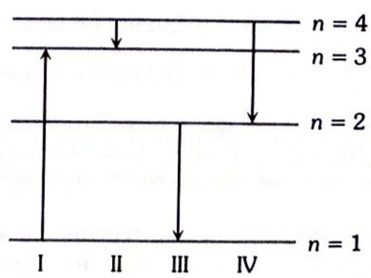
(c) $\lambda_1 = \lambda_2 = 4\lambda_3 = 9\lambda_4$ (d) $\lambda_1 = 2\lambda_2 = 3\lambda_3 = 4\lambda_4$

22. Imagine an atom made up of a proton and a hypothetical particle of double the mass of the electron but having the same charge as the electron. Apply the Bohr's atom model and consider all possible transitions of this hypothetical particle to the first excited level. The longest wavelength photon that will be emitted has wavelength λ (given in terms of the Rydberg constant R for the hydrogen atom) is equal to **[2000]**

(a) 9/(5R) (b) 36/(5R)

(c) 18/(5R) (d) 4/R

23. The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of a photon with the most energy **[2005]**



(a) I (b) II

(c) III (d) IV

24. The transition from the state $n=4$ to $n=3$ in a hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition from **[2009]**

(a) $2 \to 1$ (b) $3 \to 2$

(c) $4 \to 2$ (d) $5 \to 4$

25. In a hydrogen like atom electron make transition from an energy level with quantum number n to another with quantum number $(n-1)$. If $n>>1$, the frequency of radiation emitted is proportional to **[2013]**

(a) $\frac{1}{n}$ (b) $\frac{1}{n^2}$

(c) $\frac{1}{n^3/2}$ (d) $\frac{1}{n^3}$

26. Which of the transitions in hydrogen atom emits a photon of lowest frequency (n = quantum number) **[2007]**

(a) $n = 2$ to $n = 1$ (b) $n = 4$ to $n = 3$

(c) $n = 3$ to $n = 1$ (d) $n = 4$ to $n = 2$

27. The wavelengths involved in the spectrum of deuterium $({}_1^2D)$ are slightly different from that of hydrogen spectrum, because **[2003]**

(a) The attraction between the electron and the nucleus is different in the two cases

(b) The size of the two nuclei is different

(c) The nuclear forces are different in the two cases

(d) The masses of the two nuclei are different

28. If λ_{cu} is the wavelength of K_α X-ray line of copper (atomic number 29) and λ_{Mo} is the wavelength of the K_α X-ray line of molybdenum (atomic number 42), then the ratio $\lambda_{Cu}/\lambda_{Mo}$ is close to **[2014]**

(a) 1.99 (b) 2.14

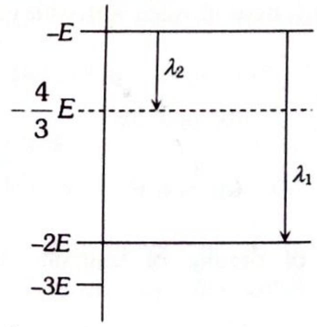
(c) 0.50 (d) 0.48

29. A diatomic molecule is made of two masses m_1 and m_2 which are separated by a distance r. If we calculate its rotational energy by applying Bohr's rule of angular momentum quantization, its energy will be given by (n is an integer) **[2012]**

(a) $\frac{(m_1+m_2)^2 n^2 \hbar^2}{2m_1^2 m_2^2 r^2}$ (b) $\frac{n^2\hbar^2}{2(m_1+m_2)r^2}$

(c) $\frac{2n^2\hbar^2}{(m_1+m_2)r^2}$ (d) $\frac{(m_1+m_2)n^2\hbar^2}{2m_1 m_2 r^2}$

30. Some energy levels of a molecule are shown in the figure. The ratio of the wavelengths $r = \lambda_1/\lambda_2$, is given by **[2017]**



(a) $r = \frac{1}{3}$ (b) $r = \frac{4}{3}$

(c) $r = \frac{2}{3}$ (d) $r = \frac{3}{4}$ s

31. If the series limit frequency of the Lyman series is υ_L, then the series limit frequency of the Pfund series is **[2018]**

(a) $\upsilon_L/16$ (b) $\upsilon_L/25$

(c) $25\upsilon_L$ (d) $16\upsilon_L$

32. If the binding energy per nucleon in Li^7 and He^4 nuclei are respectively 5.60 *MeV* and 7.06 *MeV*, then energy of reaction $Li^7 + p \to 2\ {}_2He^4$ is **[2006]**

(a) 19.6 *MeV* (b) 2.4 *MeV*

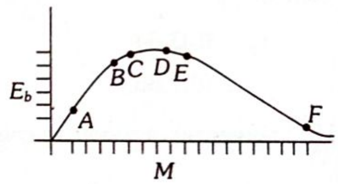
(c) 8.4 *MeV* (d) 17.3 *MeV*

33. The binding energy per nucleon of deuterium and helium atom is 1.1 *MeV* and 7.0 *MeV*. If two deuterium nuclei fuse to form helium atom, the energy released is **[1976]**

(a) 19.2 *MeV* (b) 23.6 *MeV*

(c) 26.9 *MeV* (d) 13.9 *MeV*

34.



The above is a plot of binding energy per nucleon E_b, against the nuclear mass M; A, B, C, D, E, F correspond to different nuclei. Consider four reactions

(a) A + B → C + ε (ii) C → A + B + ε

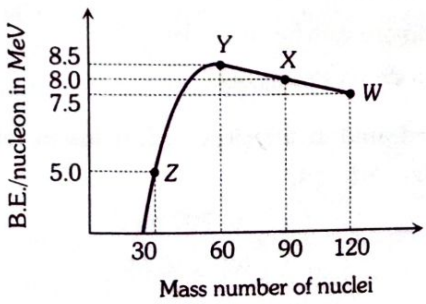
(iii) D + E → F + ε (iv) F → D + E + ε

where ε is the energy released ? In which reactions is ε positive **[2009]**

(a) (i) and (iv) (b) (i) and (iii)

(c) (ii) and (iv) (d) (ii) and (iii)

35. Binding energy per nucleon verses mass number curve for nuclei is shown in the figure. W, X, Y and Z are four nuclei indicated on the curve. The process that would release energy is **[1999]**



(a) $Y \to 2Z$ (b) $W \to X + Z$

(c) $W \to 2Y$ (d) $X \to Y + Z$

36. In the options given below, let E denote the rest mass energy of a nucleus and n a neutron. The correct option is **[2007]**

(a) $E\left({}^{236}_{92}U\right) > E\left({}^{137}_{53}I\right) + E\left({}^{97}_{39}Y\right) + 2E(n)$

(b) $E\left({}^{236}_{92}U\right) < E\left({}^{137}_{53}I\right) + E\left({}^{97}_{39}Y\right) + 2E(n)$

(c) $E\left({}^{236}_{92}U\right) < E\left({}^{140}_{56}Ba\right) + E\left({}^{94}_{36}Kr\right) + 2E(n)$

(d) $E\left({}^{236}_{92}U\right) = E\left({}^{140}_{56}Ba\right) + E\left({}^{94}_{36}Kr\right) + 2E(n)$

37. Assume that a neutron breaks into a proton and an electron. The energy released during this process is (mass of neutron $= 1.6725 \times 10^{-27} kg$, Mass of proton $= 1.6725 \times 10^{-27} kg$, mass of electron $= 9 \times 10^{-31} kg$) **[2012]**

(a) 0.73 MeV (b) 7.10 MeV

(c) 6.30 MeV (d) 5.4 MeV

38. The binding energy per nucleon of O^{16} is 7.97 MeV and that of O^{17} is 7.75 MeV. The energy (in MeV) required to remove a neutron from O^{17} is **[1995]**

(a) 3.52 (b)3.64

(c) 4.23 (d)7.86

39. A star initially has 10^{40} deuterons. It produces energy via the processes

${}_1H^2 + {}_1H^2 \rightarrow {}_1H^3 + p$

${}_1H^2 + {}_1H^3 \rightarrow {}_2He^4 + n$

The masses of the nuclei are as follows :

$M(H^2) = 2.014\ amu$; $M(p) = 1.007\ amu$;

$M(n) = 1.008\ amu$; $M(He^4) = 4.001\ amu$

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 **[1993]**

(a) $10^6 s$ (b) $10^8 s$

(c) $10^{12} s$ (d) $10^{16} s$

40. Fast neutrons can easily be slowed down by **[1994]**

(a) The use of lead shielding

(b) Passing them through water

(c) Elastic collisions with heavy nuclei

(d) Applying a strong electric field

41. The energy released in a typical nuclear fusion reaction is approximately **[1992]**

(a) 25 MeV (b) 200 MeV

(c) 800 MeV (d) 1050 MeV

42. In the nuclear reaction: $X(n,\alpha)\,{}_3Li^7$ the term X will be **[2005]**

(a) ${}_5B^{10}$ (b) ${}_5B^9$

(c) ${}_5B^{11}$ (d) ${}_2He^4$

43. During the nuclear fusion reaction **[1987]**

(a) A heavy nucleus breaks into two fragments by itself

(b) A light nucleus bombarded by thermal neutrons breaks up

(c) A heavy nucleus bombarded by thermal neutrons breaks up

(d) Two light nuclei combine to give a heavier nucleus and possibly other products

44. A fission reaction is given by ${}^{236}_{92}U \rightarrow {}^{140}_{54}Xe + {}^{94}_{39}Sr + x + y$, where x and y are two particles. Considering ${}^{236}_{92}U$ to be at rest, the kinetic energies of the products are denoted by $K_{Xe}, K_{Sr}, K_x(2MeV)$ and $K_y(2MeV)$, respectively. Let the binding energies per nucleon of ${}^{236}_{92}U$, ${}^{140}_{54}Xe$ and ${}^{94}_{38}Sr$ be 7.5 MeV, 8.5 MeV and 8.5 MeV, respectively. Considering different conservation laws, the correct option(s) is (are) **[2015]**

(a) $x = n, y = n, K_{Sr} = 129 MeV, K_{Xe} = 86 MeV$

(b) $x = p, y = e^-, K_{Sr} = 129 MeV, K_{Xe} = 86 MeV$

(c) $x = p, y = n, K_{Sr} = 129 MeV, K_{Xe} = 86 MeV$

(d) $x = n, y = n, K_{Sr} = 86 MeV, K_{Xe} = 129 MeV$

45. The mass number of a nucleus is **[1986]**

(a) Always less than its atomic number

(b) Always more than its atomic number

(c) Always equal to its atomic number

(d) Sometimes more than and sometimes equal to its atomic number

46. If radius of the ${}^{27}_{13}Al$ nucleus is estimated to be 3.6 *fermi* then the radius of ${}^{125}_{52}Te$ nucleus be nearly **[2005]**

(a) 4 *Fermi* (b) 5 *Fermi*

(c) 6 *Fermi* (d) 8 *Fermi*

47. For uranium nucleus how does its mass vary with volume **[2003]**

(a) $m \propto V$ (b) $m \propto 1/V$

(c) $m \propto \sqrt{V}$ (d) $m \propto V^2$

48. Order of magnitude of density of uranium nucleus is $(m_p = 1.67 \times 10^{-27} kg)$ **[1999]**

(a) $10^{20} kg/m^3$ (b) $10^{17} kg/m^3$

(c) $10^{14} kg/m^3$ (d) $10^{11} kg/m^3$

49. The electrostatic energy of Z protons uniformly distributed throughout a spherical nucleus of radius R is given by

$$E = \frac{3}{5}\frac{Z(Z-1)e^2}{4\pi\varepsilon_0 R}$$

The measured masses of the neutron, ${}_1^1H, {}_7^{15}N$ and ${}_8^{15}O$ are 1.008665 u, 1.007825 u, 15.000109 u and 15.003065 u, respectively. Given that the radii of both the ${}_7^{15}N$ and ${}_8^{15}O$ nuclei are same, $1u = 931.5\,MeV/c^2$ (c is the speed of light) and $e^2/(4\pi\varepsilon_0) = 1.44\,MeV\,fm$. Assuming that the difference between the binding energies of ${}_7^{15}N$ and ${}_8^{15}O$ is purely due to the electrostatic energy, the radius of either of the nuclei is ($1\,fm = 10^{-15}m$) **[2016]**

(a) 2.85 fm (b) 3.03 fm
(c) 3.42 fm (d) 3.80 fm

50. Radioactive substances do not emit **[2003]**

(a) Electron (b) Helium nucleus
(c) Positron (d) Proton

51. The 'rad' is the correct unit used to report the measurement of **[2006]**

(a) The energy delivered by radiation to a target
(b) The biological effect of radiation
(c) The rate of decay of a radioactive source
(d) The ability of a beam of gamma ray photons to produce ions in a target

52. The half life of ${}^{131}I$ is 8 days. Given a sample of ${}^{131}I$ at time $t = 0$, we can assert that **[1998]**

(a) No nucleus will decay before t = 4 days
(b) No nucleus will decay before t = 8 days
(c) All nuclei will decay before t = 16 days
(d) A given nucleus may decay at any time after t = 0

53. The half life of a radioactive substance is 20 minutes. The approximate time interval $(t_2 - t_1)$ between the time t_2 when $\frac{2}{3}$ of it has decayed and time t_1 when $\frac{1}{3}$ of it had decayed is **[2011]**

(a) 7 min (b) 14 min
(c) 20 min (d) 28 min

54. Half-life of a substance is 10 *years*. In what time, it becomes $\frac{1}{4}$*th* part of the initial amount **[2002]**

(a) 5 *years* (b) 10 *years*
(c) 20 *years* (d) None of these

55. If N_0 is the original mass of the substance of half life period $T_{1/2} = 5$ *years*, then the amount of substance left after 15 *years* is **[2002]**

(a) $N_0/8$ (b) $N_0/16$
(c) $N_0/2$ (d) $N_0/4$

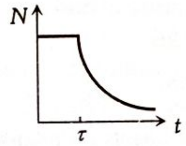
56. The half-life of ${}^{215}At$ is $100\mu s$. The time taken for the radioactivity of a sample of ${}^{215}At$ to decay to 1/16th of its initial value is **[2002]**

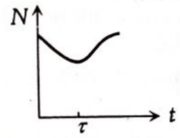
(a) 400 μs (b) 6.3 μs
(c) 40 μs (d) 300 μs

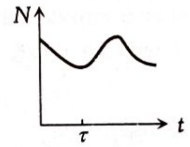
57. After 280 days, the activity of a radioactive sample is 6000 *dps*. The activity reduces to 3000 *dps* after another 140 days. The initial activity of the sample in *dps* is **[2004]**

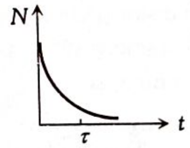
(a) 6000 (b) 9000
(c) 3000 (d) 24000

58. A radioactive sample consists of two distinct species having equal number of atoms initially. The mean life time of one species is τ and that of the other is 5τ. The decay products in both cases are stable. A plot is made of the total number of radioactive nuclei as a function of time. Which of the following figures best represents the form of this plot **[2001]**

(a) 

(b) 

(c) 

(d) 

59. Given a sample of *Radium*-226 having half- life of 4 days. Find the probability, a nucleus disintegrates after 2 half lives **[2006]**

(a) 1 (b) 1/2
(c) 1.5 (d) 3/4

60. Starting with a sample of pure ${}^{66}Cu$, $\frac{7}{8}$ of it decays into Zn in 15 *min*. The corresponding half-life is **[2005]**

(a) 5 *min* (b) $7\frac{1}{2}$ *min*
(c) 10 *min* (d) 15 *min*

61. Half-lives of two radioactive elements A and B are 20 minutes and 40 minutes, respectively, initially, the samples have equal number of nuclei. After 80 minutes, the ratio of decayed numbers of A and B nuclei will be **[2016]**

(a) 4 : 1 (b) 1 : 4
(c) 5 : 4 (d) 1 : 16

62. The half life of radioactive Radon is 3.8 *days*. The time at the end of which $1/20^{th}$ of the Radon sample will remain undecayed is (Given $\log_{10} e = 0.4343$) **[1981]**

(a) 3.8 *days* (b) 16.5 *days*
(c) 33 *days* (d) 76 *days*

63. A radioactive material decays by simultaneous emission of two particles with respective half lives 1620 and 810 *years*. The time (in *years*) after which one- fourth of the material remains is **[1995]**

(a) 1080 (b) 2430
(c) 3240 (d) 4860

64. Two radioactive materials X_1 and X_2 have decay constants 10λ 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 of X_2 will be $1/e$ after a time **[2000]**

(a) $1/(10\lambda)$ (b) $1/(11\lambda)$
(c) $11/(10\lambda)$ (d) $1/(9\lambda)$

65. A radioactive sample of U^{238} decays to *Pb* through a process for which half life is 4.5×10^9 *years*. The ratio of number of nuclei of *Pb* to U^{238} after a time of 1.5×10^9 *years* (given $2^{1/3}=1.26$) **[2004]**

(a) 0.12 (b) 0.26
(c) 1.2 (d) 0.37

66. A radioactive sample at any instant has its disintegration rate 5000 disintegrations per minute. After 5 *minutes*, the rate is 1250 disintegrations per minute. Then, the decay constant (per minute) is **[2003]**

(a) 0.8 ln 2 (b) 0.4 ln 2
(c) 0.2 ln 2 (d) 0.1 ln 2

67. An accident in a nuclear laboratory resulted in deposition of a certain amount of radioactive material of half-life 18 days inside the laboratory. Tests revealed that the radiation was 64 times more than the permissible level required for safe operation of the laboratory. What is the minimum number of days after which the laboratory can be considered safe for use **[2016]**

(a) 64 (b) 90
(c) 108 (d) 120

68. A radioactive sample S1 having an activity of $5\mu Ci$ has twice the number of nuclei as another sample S2 which has an activity of $10\mu Ci$. The half lives of S1 and S2 can be **[2008]**

(a) 20 years and 5 years, respectively
(b) 20 years and 10 years, respectively
(c) 10 years each
(d) 5 years each

69. From a newly formed radioactive substance (Half life 2 *hours*), the intensity of radiation is 64 times the permissible safe level. The minimum time after which work can be done safely from this source is **[1983]**

(a) 6 *hours* (b) 12 *hours*
(c) 24 *hours* (d) 128 *hours*

70. If the decay or disintegration constant of a radioactive substance is λ, then its half life and mean life are respectively **[1989]**

(a) $\frac{1}{\lambda}$ and $\frac{\log_e 2}{\lambda}$ (b) $\frac{\log_e 2}{\lambda}$ and $\frac{1}{\lambda}$
(c) $\lambda \log_e 2$ and $\frac{1}{\lambda}$ (d) $\frac{\lambda}{\log_e 2}$ and $\frac{1}{\lambda}$

($\log_e 2$ can be written as *ln* 2)

71. The half life period of a radioactive element *X* is same as the mean life time of another radioactive element *Y*. Initially both of them have the same number of atoms. Then **[1999]**

(a) *X* and *Y* have the same decay rate initially
(b) *X* and *Y* decay at the same rate always
(c) *Y* will decay at a faster rate than *X*
(d) *X* will decay at a faster rate than *Y*

72. The half-life period of a radio-active element *X* is same as the life time of another radio-active element *Y*. Initially they have the same number of atoms. Then **[2007]**

(a) *X* will decay faster than *Y*
(b) *Y* will decay faster than *X*
(c) *X* and *Y* have same decay rate initially
(d) *X* and *Y* decay at same rate always

73. ^{22}Ne nucleus after absorbing energy decays into two α– particles and an unknown nucleus. The unknown nucleus is **[1999]**

(a) Nitrogen (b) Carbon
(c) Boron (d) Oxygen

74. A nucleus with mass number 220 initially at rest emits an α-particle. If the *Q* value of the reaction is 5.5 *MeV*, calculate the kinetic energy of the α-particle **[2003]**

(a) 4.4 *MeV* (b) 5.4 *MeV*
(c) 5.6 *MeV* (d) 6.5 *MeV*

75. During a negative beta decay **[1990]**

(a) An atomic electron is ejected
(b) An electron which is already present within the nucleus is ejected
(c) A neutron in the nucleus decays emitting an electron
(d) A part of the binding energy is converted into electron

76. Beta rays emitted by a radioactive material are **[1983]**

(a) Electromagnetic radiation
(b) The electrons orbiting around the nucleus
(c) Charged particles emitted by nucleus
(d) Neutral particles

77. The electron emitted in beta radiation originates from **[2001]**

(a) Inner orbits of atoms

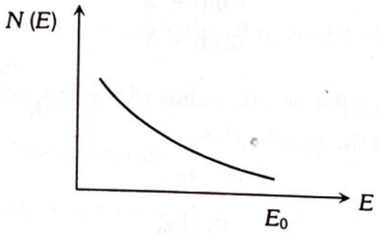
(b) Free electrons existing in nuclei

(c) Decay of a neutron in a nucleus

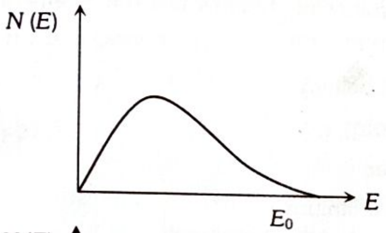
(d) Photon escaping from the nucleus

78. The energy spectrum of β-particles [number N(E) as a function of β-energy E] emitted from a radioactive source is **[2006]**

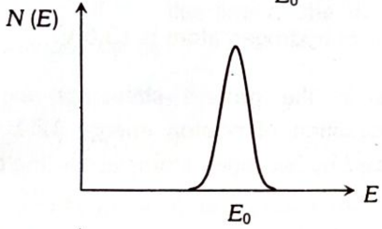
(a)



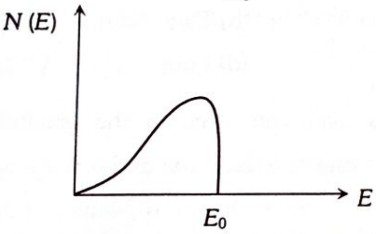
(b)



(c)



(d)



79. When $_3Li^7$ nuclei are bombarded by protons, and the resultant nuclei are $_4Be^8$, the emitted particles will be **[2006]**

(a) Beta particles (b) Gamma photons

(c) Neutrons (d) Alpha particles

80. Which of the following processes represent a gamma-decay **[2002]**

(a) $^AX_Z + \gamma \rightarrow {}^AX_{Z-1} + a + b$

(b) $^AX_Z + {}^1n_0 \rightarrow {}^{A-3}X_{Z-2} + c$

(c) $^AX_Z \rightarrow {}^AX_Z + f$

(d) $^AX_Z + e_{-1} \rightarrow {}^AX_{Z-1} + g$

81. Some radioactive nucleus may emit **[1986]**

(a) Only one α, β or γ at a time

(b) All the three α, β and γ one after another

(c) All the three α, β and γ simultaneously

(d) Only α and β simultaneously

82. Which of the following is in the increasing order for penetrating power **[1994]**

(a) α, β, γ (b) β, α, γ

(c) γ, α, β (d) γ, β, α

83. Which of the following is a correct statement **[1999]**

(a) Beta rays are same as cathode rays

(b) Gamma rays are high energy neutrons

(c) Alpha particles are singly ionized helium atoms

(d) Protons and neutrons have exactly the same mass

84. A radioactive nucleus (initial mass number A and atomic number Z) emits 3α-particles and 2 positrons. The ratio of number of neutrons to that of protons in the final nucleus will be **[2010]**

(a) $\frac{A-Z-4}{Z-2}$ (b) $\frac{A-Z-8}{Z-4}$

(c) $\frac{A-Z-4}{Z-8}$ (d) $\frac{A-Z-12}{Z-4}$

85. A nucleus with $Z = 92$ emits the following in a sequence: $\alpha, \beta^-, \beta^-, \alpha, \alpha, \alpha, \alpha, \alpha, \beta^-, \beta^-, \alpha, \beta^+, \beta^+, \alpha$. The Z of the resulting nucleus is **[2003]**

(a) 74 (b) 76

(c) 78 (d) 82

86. Which of the following radiations has the least wavelength **[2003]**

(a) X-rays (b) γ-rays

(c) β-rays (d) α-rays

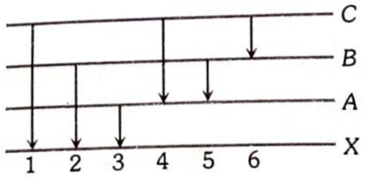
87. A radioactive nucleus A with a half life T, decays into a nucleus B. At $t = 0$, there is no nucleus B. At sometime t, the ratio of the number of B to that of A is 0.3. Then, t is given by **[2017]**

(a) $t = \frac{T}{\log(1.3)}$ (b) $t = \frac{T}{2}\frac{\log 2}{\log 1.3}$

(c) $t = T\frac{\log 1.3}{\log 2}$ (d) $t = T\log(1.3)$ s

5. NEET/AIPMT

1. The figure indicates the energy level diagram of an atom and the origin of six spectral lines in emission (*e.g.* line no. 5 arises from the transition from level *B* to *A*). Which of the following spectral lines will also occur in the absorption spectra **[1995]**



(a) 1, 4, 6 (b) 4, 5, 6
(c) 1, 2, 3 (d) 1, 2, 3, 4, 5, 6

2. The Bohr model of atom **[2004]**

(a) Assumes that the angular momentum of electrons is quantized
(b) Uses Einstein's photo-electric equation
(c) Predicts continuous emission spectra for atoms
(d) Predicts the same emission spectra for all types of atoms

3. When a hydrogen atom is raised from the ground state to an excited state **[1995]**

(a) P.E. increases and K.E. decreases
(b) P.E. decreases and K.E. increases
(c) Both kinetic energy and potential energy increase
(d) Both K.E. and P.E. decrease

4. The energy of electron in first excited state of H-atom is $-3.4\ eV$ its kinetic energy is **[2005]**

(a) – 3.4 *eV* (b) + 3.4 *eV*
(c) – 6.8 *eV* (d) 6.8 *eV*

5. 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 closest approach is r_0. The energy of the projectile is **[2009]**

(a) Directly proportional to $M_1 \times M_2$
(b) Directly proportional to $z_1 z_2$
(c) Inversely proportional to z_1
(d) Directly proportional to mass M_1

6. In the Bohr model of a hydrogen atom, the centripetal force is furnished by the coulomb attraction between the proton and the electron. If a_0 is the radius of the ground state orbit, *m* is the mass, *e* is the charge on the electron and ε_0 is the vacuum permittivity, the speed of the electron is **[1998]**

(a) 0 (b) $\frac{e}{\sqrt{\varepsilon_0 a_0 m}}$

(c) $\frac{e}{\sqrt{4\pi\varepsilon_0 a_0 m}}$ (d) $\frac{\sqrt{4\pi\varepsilon_0 a_0 m}}{e}$

7. In the Bohr's hydrogen atom model, the radius of the stationary orbit is directly proportional to (*n* = principal quantum number) **[1996]**

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

8. The radius of hydrogen atom in its ground state is $5.3 \times 10^{-11} m$. After collision with an electron it is found to have a radius of $21.2 \times 10^{-11} m$. What is the principal quantum number *n* of the final state of the atom **[1994]**

(a) $n = 4$ (b) $n = 2$
(c) $n = 16$ (d) $n = 3$

9. In Bohr's model, if the atomic radius of the first orbit is r_0, then the radius of the fourth orbit is **[2000]**

(a) r_0 (b) $4r_0$
(c) $r_0/16$ (d) $16r_0$

10. In which of the following systems will the radius of the first orbit $(n = 1)$ be minimum **[2003]**

(a) Single ionized helium
(b) Deuterium atom
(c) Hydrogen atom
(d) Doubly ionized lithium

11. Ionization potential of hydrogen atom is 13.6 *V*.

Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1 *eV*. The spectral lines emitted by hydrogen atoms according to Bohr's theory will be **[1996, 2006]**

(a) One (b) Two
(c) Three (d) Four

12. The energy of a hydrogen atom in the ground state is $-13.6\,eV$. The energy of a He^+ ion in the first excited state will be **[2010]**

(a) −6.8 eV (b) −13.6 eV
(c) −27.2 eV (d) −54.4 eV

13. The ionisation energy of hydrogen atom is 13.6 *eV*. Following Bohr's theory, the energy corresponding to a transition between the 3rd and the 4th orbit is **[1992]**

(a) 3.40 *eV* (b) 1.51 *eV*
(c) 0.85 *eV* (d) 0.66 *eV*

14. Energy *E* of a hydrogen atom with principal quantum number *n* is given by $E = \frac{-13.6}{n^2} eV$. The energy of a photon ejected when the electron jumps from $n = 3$ state to $n = 2$ state of hydrogen is approximately **[2004]**

(a) 1.5 *eV* (b) 0.85 *eV*
(c) 3.4 *eV* (d) 1.9 *eV*

15. The electron in the hydrogen atom jumps from excited state $(n=3)$ to its ground state $(n=1)$ and the photons thus emitted irradiate a photosensitive material. If the work function of the material is 5.1 eV, the stopping potential is estimated to be (the energy of the electron in n^{th} state $E_n = -\frac{13.6}{n^2} eV$) **[2010]**

(a) 5.1 V (b) 12.1 V

(c) 17.2 V (d) 7 V

16. Which one of the series of hydrogen spectrum is in the visible region **[1990]**

(a) Lyman series (b) Balmer series

(c) Paschen series (d) Bracket series

17. Electron in hydrogen atom first jumps from third excited state to second excited state and then from second excited to the first excited state. The ratio of the wavelengths $\lambda_1 : \lambda_2$ emitted in the two cases is **[2012]**

(a) 7/5 (b) 27/20

(c) 27/5 (d) 20/7

18. Given the value of Rydberg constant is $10^7 m^{-1}$, the wave number of the last line of the Balmer series in hydrogen spectrum will be **[2016]**

(a) $0.025\times10^4 m^{-1}$ (b) $0.5\times10^7 m^{-1}$

(c) $0.25\times10^7 m^{-1}$ (d) $2.5\times10^7 m^{-1}$

19. The ratio of the frequencies of the long wavelength limits of Lyman and Balmer series of hydrogen spectrum is **[2013]**

(a) 27 : 5 (b) 5 : 27

(c) 4 : 1 (d) 1 : 4

20. The wavelength of the first line of Lyman series for hydrogen atom is equal to that of the second line of Balmer series for a hydrogen like ion. The atomic number Z of hydrogen like ion is **[2011]**

(a) 2 (b) 3

(c) 4 (d) 1

21. An electron of a stationary hydrogen atom passes from the fifth energy level to the ground level. The velocity that the atom acquired as a result of photon emission will be **[2012]**

(a) $24hR/25m$ (b) $25hR/24m$

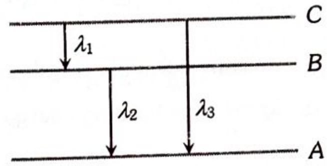
(c) $25m/24hR$ (d) $24m/25hR$

22. Out of the following which one is not a possible energy for a photon to be emitted by hydrogen atom according to Bohr's atomic model **[2011]**

(a) 13.6 eV (b) 0.65 eV

(c) 1.9 eV (d) 11.1 eV

23. Energy levels A, B, C of a certain atom corresponding to increasing values of energy, *i.e.*, $E_A < E_B < E_C$. If $\lambda_1, \lambda_2, \lambda_3$ are the wavelengths of radiations corresponding to the transitions C to B, B to A and C to A respectively, which of the following statements is correct **[1990, 2005]**



(a) $\lambda_3 = \lambda_1 + \lambda_2$ (b) $\lambda_3 = \frac{\lambda_1\lambda_2}{\lambda_1+\lambda_2}$

(c) $\lambda_1 + \lambda_2 + \lambda_3 = 0$ (d) $\lambda_3^2 = \lambda_1^2 + \lambda_2^2$

24. The ionization energy of the electron in the hydrogen atom in its ground state is 13.6 *eV*. The atoms are excited to higher energy levels to emit radiations of 6 wavelengths. Maximum wavelength of emitted radiation corresponds to the transition between **[2009]**

(a) $n=3$ to $n=2$ states (b) $n=3$ to $n=1$ states

(c) $n=2$ to $n=1$ states (d) $n=4$ to $n=3$ states

25. In Rutherford scattering experiment, what will be the correct angle for α scattering for an impact parameter $b = 0$ **[1994]**

(a) 90° (b) 270°

(c) 0° (d) 180°

26. When an α – particle of mass 'm' moving with velocity 'v' bombards on a heavy nucleus of charge 'Ze', its distance of closest approach from the nucleus depends on m as **[2016]**

(a) $\frac{1}{m}$ (b) $\frac{1}{\sqrt{m}}$

(c) $\frac{1}{m^2}$ (d) m

27. If an electron in a hydrogen atom jumps from the 3rd orbit to the 2nd orbit, it emits a photon of wavelength λ. When it jumps from the 4th orbit to the 3rd orbit, the corresponding wavelength of the photon will be **[2016]**

(a) $\frac{20}{7}\lambda$ (b) $\frac{20}{13}\lambda$

(c) $\frac{16}{25}\lambda$ (d) $\frac{9}{16}\lambda$

28. The ratio of wavelengths of the last line of Balmer series and the last line of Lyman series is **[2017]**

(a) 2 (b) 1

(c) 4 (d) 0.5

29. The ratio of kinetic energy to the total energy of an electron in a Bohr orbit of the hydrogen atom, is **[2018]**

(a) 1 : 1 (b) 1 : –1

(c) 2 : –1 (d) 1 : –2

30. The nuclei of which of the following pairs of nuclei are isotones **[2005]**

(a) ${}_{34}Se^{74}$, ${}_{31}Ca^{71}$ (b) ${}_{42}Mo^{92}$, ${}_{40}Zr^{92}$

(c) ${}_{38}Sr^{81}$, ${}_{38}Sr^{86}$ (d) ${}_{20}Ca^{40}$, ${}_{16}S^{32}$

31. The mass of a ${}^{7}_{3}Li$ nucleus is 0.042u less than the sum of the masses of all its nucleons. The binding energy per nucleon of ${}^{7}_{3}Li$ nucleus is nearly **[2010]**

(a) 23 MeV (b) 46 MeV

(c) 5.6 MeV (d) 3.9MeV

32. M_n and M_p represent mass of neutron and proton respectively. If an element having atomic mass M has N-neutrons and Z-protons, then the correct relation will be **[2001]**

(a) $M < [NM_n + ZM_P]$ (b) $M > [NM_n + ZM_P]$

(c) $M = [NM_n + ZM_P]$ (d) $M = N[M_n + M_P]$

33. The binding energies per nucleon for a deuteron and an α–particle are x_1 and x_2 respectively. What will be the energy Q released in the reaction ${}_1H^2 +_1 H^2 \to_2 He^4 + Q$ **[1995]**

(a) $4(x_1 + x_2)$ (b) $4(x_2 - x_1)$

(c) $2(x_1 + x_2)$ (d) $2(x_2 - x_1)$

34. A certain mass of Hydrogen is changed to Helium by the process of fusion. The mass defect in fusion reaction is 0.02866 u. The energy liberated per u is (given $1u$ = 931 MeV) **[2013]**

(a) 13.35 MeV (b) 2.67 MeV

(c) 26.7 MeV (d) 6.675 MeV

35. A nucleus ${}^{A}_{Z}X$ has mass represented by $M(A,Z)$. If M_P and M_n denote the mass of proton and neutron respectively and $B.E$ the binding energy in MeV, then **[2004,07, 08]**

(a) $B.E = [M(A,Z) - ZM_P - (A-Z)M_n]C^2$

(b) $B.E = [ZM_P + (A-Z)M_n - M(A,Z)]C^2$

(c) $B.E = [ZM_P + AM_n - M(A,Z)]C^2$

(d) $B.E = M(A,Z) - ZM_P - (A-Z)M_n$

36. Fission of nuclei is possible because the binding energy per nucleon in them **[2005]**

(a) Increases with mass number at high mass numbers

(b) Decreases with mass number at high mass numbers

(c) Increases with mass number at low mass numbers

(d) Decreases with mass number at low mass numbers

37. The power obtained in a reactor using U^{235} disintegration is 1000 kW. The mass decay of U^{235} per hour is **[2011]**

(a) 1 microgram (b) 10 microgram

(c) 20 microgram (d) 40 microgram

38. The masses of neutron and proton are 1.0087 $a.m.u.$ and 1.0073 $a.m.u.$ respectively. If the neutrons and protons combine to form a helium nucleus (alpha particles) of mass 4.0015 $a.m.u.$ the binding energy of the helium nucleus will be (1 $a.m.u.$ = 931 MeV) **[2003]**

(a) 28.4 MeV (b) 20.8 MeV

(c) 27.3 MeV (d) 14.2 MeV

39. In a fission reaction ${}^{236}_{92}U \to {}^{117}X + {}^{117}Y + n + n$, the binding energy per nucleon of X and Y is 8.5 MeV whereas of ${}^{236}U$ is 7.6 MeV. The total energy liberated will be about **[1997]**

(a) 200 KeV (b) 2 MeV

(c) 200 MeV (d) 2000 MeV

40. Heavy water is used as moderator in a nuclear reactor. The function of the moderator is **[1994]**

(a) To control the energy released in the reactor

(b) To absorb neutrons and stop chain reaction

(c) To cool the reactor faster

(d) To slow down the neutrons to thermal energies

41. A deutron is bombarded on ${}_8O^{16}$ nucleus and α-particle is emitted. The product nucleus is **[2002]**

(a) ${}_7N^{13}$ (b) ${}_5B^{10}$

(c) ${}_4Bc^9$ (d) ${}_7N^{14}$

42. In the reaction ${}^2_1H + {}^3_1H \to {}^4_2He + {}^1_0n$ if the binding energies of ${}^2_1H$, ${}^3_1H$ and ${}^4_2He$ are respectively a, b and c (in MeV), then the energy (in MeV) released in this reaction is **[2005]**

(a) $c + a - b$ (b) $c - a - b$

(c) $a + b + c$ (d) $a + b - c$

43. Complete the equation for the following fission process ${}_{92}U^{235} +_0 n^1 \to_{38} Sr^{90} + ...$ **[1998]**

(a) ${}_{54}Xe^{143} + 3\ {}_0n^1$ (b) ${}_{54}Xe^{145}$

(c) ${}_{57}Xe^{142}$ (d) ${}_{54}Xe^{142} + {}_0n^1$

44. Why high temperature is required for fusion reaction **[2011]**

(a) At high temperature, kinetic energy is sufficient to overcome repulsive force

(b) Atoms are ionised at high temperature

(c) Molecules break up at high temperature

(d) Nuclei break up at high temperature

45. Which of the following is suitable for the fusion process [2002]

(a) Heavy nuclei (b) Light nuclei

(c) Atom bomb (d) Radioactive decay

46. Solar energy is mainly caused due to [2003]

(a) Fission of uranium present in the sun

(b) Fusion of protons during synthesis of heavier elements

(c) Gravitational contraction

(d) Burning of hydrogen in the oxygen

47. If in a nuclear fusion process the masses of the fusing nuclei be m_1 and m_2 and the mass of the resultant nucleus be m_3, then [2004]

(a) $m_3 = m_1 + m_2$ (b) $m_3 = |m_1 + m_2|$

(c) $m_3 < (m_1 + m_2)$ (d) $m_3 > (m_1 + m_2)$

48. Nuclear fission experiments show that the neutrons split the uranium nuclei into two fragments of about same size. This process is accompanied by the emission of several [1994]

(a) Protons and positrons (b) α-particles

(c) Neutrons (d) Protons and α-particles

49. In any fission process the ratio $\frac{\text{mass of fission products}}{\text{mass of parent nucleus}}$ is [2005]

(a) Less than 1

(b) Greater than 1

(c) Equal to 1

(d) Depends on the mass of the parent nucleus

50. Atomic weight of boron is 10.81 and it has two isotopes $_5B^{10}$ and $_5B^{11}$. Then ratio of $_5B^{10} :_5 B^{11}$ in nature would be [1998]

(a) 19 : 81 (b) 10 : 11

(c) 15 : 16 (d) 81 : 19

51. The mass number of *He* is 4 and that for sulphur is 32. The radius of sulphur nucleus is larger than that of helium, by times [1994]

(a) $\sqrt{8}$ (b) 4

(c) 2 (d) 8

52. If the nuclear radius of ^{27}Al is 3.6 Fermi, the approximate nuclear radius of ^{64}Cu in Fermi is [2012]

(a) 2.4 (b) 1.2

(c) 4.8 (d) 3.6

53. If radius of the $^{27}_{12}Al$ nucleus is taken to be R_{Al}, then the radius of $^{125}_{53}Te$ nucleus is nearly [2015]

(a) $\frac{5}{3}R_{Al}$ (b) $\frac{3}{5}R_{Al}$

(c) $\left(\frac{13}{53}\right)^{1/3} R_{Al}$ (d) $\left(\frac{53}{13}\right)^{1/3} R_{Al}$

54. Two nuclei have their mass numbers in the ratio of 1 : 3. The ratio of their nuclear densities would be [2008]

(a) $(3)^{1/3}$:1 (b) 1 : 1

(c) 1 : 3 (d) 3 : 1

55. A nucleus ruptures into two nuclear parts which have their velocity ratio equal to 2 : 1. What will be the ratio of their nuclear size (nuclear radius) [1996]

(a) $2^{1/3}$: 1 (b) 1 : $2^{1/3}$

(c) $3^{1/2}$: 1 (d) 1 : $3^{1/2}$

56. The decay constant λ of the radioactive sample is the probability of decay of an atom in unit time, then [1990]

(a) λ decreases as atoms become older

(b) λ increases as the age of atoms increases

(c) λ is independent of the age

(d) Behaviour of λ with time depends on the nature of the activity

57. The half life period of radium is 1600 *years*. The fraction of a sample of radium that would remain after 6400 *years* is [1994]

(a) 1/4 (b) 1/2

(c) 1/8 (d) 1/16

58. Half lives of two radioactive substances *A* and *B* are respectively 20 *minutes* and 40 *minutes*. Initially the sample of *A* and *B* have equal number of nuclei. After 80 minutes, the ratio of remaining number of *A* and *B* nuclei is [1998]

(a) 1 : 16 (b) 4 : 1

(c) 1 : 4 (d) 1 : 1

59. The half life of a radioactive isotope *X* is 50 years. It decays to another element *Y* which is stable. The two elements *X* and *Y* were found to be in the ratio of 1 : 16 in a sample of a given rock. The age of the rock was estimated to be [2011]

(a) 100 years (b) 150 years

(c) 200 years (d) 250 years

60. Two radioactive substances *A* and *B* have decay constants 5λ and λ respectively. At $t = 0$ they have the same number of nuclei. The ratio of number of nuclei of *A* to those of *B* will be $\left(\frac{1}{e}\right)^2$ after a time interval [2008]

(a) $\frac{1}{4\lambda}$ (b) 4λ

(c) 2λ (d) $\frac{1}{2\lambda}$

61. A sample of radioactive element has a mass of 10 *g* at an instant $t = 0$.The approximate mass of this element in the sample after two mean lives is [2003]

(a) 2.50 *g* (b) 3.70 *g*

(c) 6.30 *g* (d) 1.35 *g*

62. The half life of a radioactive isotope 'X' is 20 years. It decays to another element 'Y' which is stable. The two elements 'X' and 'Y' were found to be in the ratio 1 : 7 in a sample of a given rock. The age of the rock is estimated to be **[2013]**

(a) 100 years (b) 40 years
(c) 60 years (d) 80 years

63. A mixture consists of two radioactive materials A_1 and A_2 with half lives of 20 *s* and 10 *s* respectively. Initially the mixture has 40 *g* of A_1 and 160 *g* of A_2. The amount of the two in the mixture will become equal after **[2012]**

(a) 60 *s* (b) 80 *s*
(c) 20 *s* (d) 40 *s*

64. A radio isotope *X* with a half life 1.4×10^9 years decays of *Y* which is stable. A sample of the rock from a cave was found to contain *X* and *Y* in the ratio 1 : 7. The age of the rock is **[2014]**

(a) 4.20×10^9 *years* (b) 8.40×10^9 *years*
(c) 1.96×10^9 *years* (d) 3.92×10^9 *years*

65. Two radioactive nuclei *P* and *Q*, in a given sample decay into a stable nucleus *R*. At time *t*=0, number of *P* species are 4 N_0 and that of *Q* are N_0. Half-life of *P* (for conversion to *R*) is 1 minute where as that of *Q* is 2 minutes. Initially there are no nuclei of *R* present in the sample. When number of nuclei of *P* and *Q* are equal, the number of nuclei of *R* present in the sample would be **[2011]**

(a) $\frac{5N_0}{2}$ (b) $2N_0$
(c) $3N_0$ (d) $\frac{9N_0}{2}$

66. The activity of a radioactive sample is measured as N_0 counts per minute at $t=0$ and N_0/e counts per minute at $t=5$ minutes. The time (in minutes) at which the activity reduces to half its value is **[2010]**

(a) $5\log_e 2$ (b) $\log_e 2/5$
(c) $\frac{5}{\log_e 2}$ (d) $5\log_{10} 2$

67. The count rate of a Geiger- Muller counter for the radiation of a radioactive material of half life of 30 *minutes* decreases to 5 s^{-1} after 2 hours. The initial count rate was **[1995]**

(a) 25 s^{-1} (b) 80 s^{-1}
(c) 625 s^{-1} (d) 20 s^{-1}

68. The decay constant of a radio isotope is λ. If A_1 and A_2 are its activities at times t_1 and t_2 respectively, the number of nuclei which have decayed during the time (t_1-t_2) **[2010]**

(a) $A_1t_1 - A_2t_2$ (b) $A_1 - A_2$
(c) $(A_1 - A_2)/\lambda$ (d) $\lambda(A_1 - A_2)$

69. A radioactive sample with a half life of 1 month has the label : "Activity=2 *micro curies* on 1.8.1991." What will be its activity two months later **[1992]**

(a) 1.0 micro curies (b) 0.5 micro curies
(c) 4 micro curies (d) 8 micro curies

70. The activity of a radioactive sample is measured as 9750 counts *per minute* at *t* = 0 and as 975 counts *per minute* at *t* = 5 *minutes*. The decay constant is approximately **[1997]**

(a) 0.230 *per minute* (b) 0.461 *per minute*
(c) 0.691 *per minute* (d) 0.922 *per minute*

71. The half-life of radium is about 1600 years. Of 100 *g* of radium existing now, 25 *g* will remain unchanged after **[2004]**

(a) 2400 years (b) 3200 years
(c) 4800 years (d) 6400 years

72. The activity of a sample of a radioactive material is *A* at time t_1 and A_2 at time t_2 $(t_2 > t_1)$. If its mean life is *T*, then **[2006]**

(a) $A_1t_1 = A_2t_2$ (b) $A_1 - A_2 = t_2 - t_1$
(c) $A_2 = A_1e^{(t_1-t_2)/T}$ (d) $A_2 = A_1e^{(t_1/t_2)T}$

73. A nucleus of uranium decays at rest into nuclei of thorium and helium. Then **[2015]**

(a) The helium nucleus has less momentum than the thorium nucleus
(b) The helium nucleus has more momentum than the thorium nucleus
(c) The helium nucleus has less kinetic energy than the thorium nucleus
(d) The helium nucleus has more kinetic energy than the thorium nucleus

74. A free neutron decays into a proton, an electron and **[1997]**

(a) A neutrino (b) An antineutrino
(c) An alpha particle (d) A beta particle

75. A nuclear reaction given by ${}_ZX^A \to {}_{Z+1}Y^A + {}_{-1}e^0 + \overline{p}$ represents **[2003]**

(a) γ-decay (b) Fusion
(c) Fission (d) β-decay

76. In the given reaction ${}_zX^A \to {}_{z+1}Y^A \to {}_{z-1}K^{A-4} \to {}_{z-1}K^{A-4}$ radioactive radiations are emitted in the sequence **[1993, 2009]**

(a) α, β, γ (b) β, α, γ
(c) γ, α, β (d) β, γ, α

77. A nucleus ${}_nX^m$ emits one α and one β particles. The resulting nucleus is **[1998, 99]**

(a) ${}_nX^{m-4}$ (b) ${}_{n-2}Y^{m-4}$

(c) ${}_{n-4}Z^{m-4}$ (d) ${}_{n-1}Z^{m-4}$

78. If ${}_{92}U^{238}$ undergoes successively 8 α-decays and 6 β-decays, then resulting nucleus is **[2002]**

(a) ${}_{82}U^{206}$ (b) ${}_{82}Pb^{206}$

(c) ${}_{82}U^{210}$ (d) ${}_{82}U^{214}$

79. 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 **[2009]**

(a) Isobar of parent (b) Isomer of parent

(c) Isotone of parent (d) Isotope of parent

80. A certain radioactive material ${}_ZX^A$ starts emitting α and β particles successively such that the end product is ${}_{Z-3}Y^{A-8}$. The number of α and β particles emitted are **[2011]**

(a) 4 and 3 respectively (b) 2 and 1 respectively

(c) 3 and 4 respectively (d) 3 and 8 respectively

81. The correct order of ionizing capacity of α, β and γ – rays is **[2000]**

(a) $\alpha > \gamma > \beta$ (b) $\alpha > \beta > \gamma$

(c) $\alpha < \beta < \gamma$ (d) $\gamma > \alpha > \beta$

82. A radioactive nucleus of mass M emits a photon of frequency ν and the nucleus recoils. The recoil energy will be **[2011]**

(a) $h\nu$ (b) $Mc^2 - h\nu$

(c) $\dfrac{h^2\nu^2}{2Mc^2}$ (d) Zero

83. Which of the following rays are not electromagnetic waves **[2003]**

(a) γ-rays (b) β-rays

(c) Heat rays (d) X-rays

84. Radioactive material 'A' has decay constant '8λ' and material 'B' has decay constant 'λ'. Initially they have same number of nuclei. After what time, the ratio of number of nuclei of material 'B' to that 'A' will be $\dfrac{1}{e}$ **[2017]**

(a) $\dfrac{1}{\lambda}$ (b) $\dfrac{1}{7\lambda}$

(c) $\dfrac{1}{8\lambda}$ (d) $\dfrac{1}{9\lambda}$

85. For a radioactive material, half-life is 10 minutes. If initially there are 600 number of nuclei, the time taken (in minutes) for the disintegration of 450 nuclei is **[2018]**

(a) 20 (b) 10

(c) 30 (d) 15

86. The half-life of a radioactive substance is 30 minutes. The time (in minutes) taken between 40% decay and 85% decay of the same radioactive substance is **[2016]**

(a) 45 (b) 60

(c) 15 (d) 30

6. AIIMS

1. The magnetic moment (μ) of a revolving electron around the nucleus varies with principal quantum number n as **[2005]**

(a) $\mu \propto n$ (b) $\mu \propto 1/n$

(c) $\mu \propto n^2$ (d) $\mu \propto 1/n^2$

2. The ground state energy of hydrogen atom is – 13.6 eV. What is the potential energy of the electron in this state **[2005]**

(a) 0 eV (b) – 27.2 eV

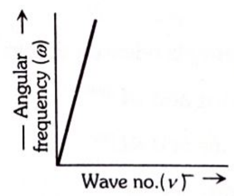
(c) 1 eV (d) 2 eV

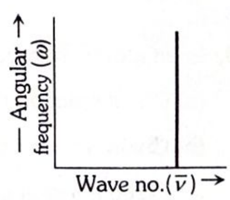
3. The wavelength of the energy emitted when electron comes from fourth orbit to second orbit in hydrogen is 20.397 cm. The wavelength of energy for the same transition in He^+ is **[1997]**

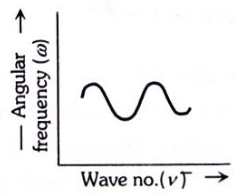
(a) 5.099 cm (b) 20.497 cm

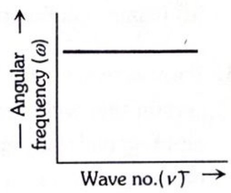
(c) 40.994 cm (d) 81.988 cm

4. The graph between wave number ($\bar{\nu}$) and angular frequency (ω) is **[2002]**

(a) 

(b) 

(c) 

(d) 

5. If an electron and a positron annihilate, then the energy released is **[2004]**

(a) $3.2 \times 10^{-13} J$ (b) $1.6 \times 10^{-13} J$

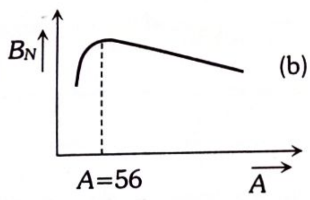
(c) $4.8 \times 10^{-13} J$ (d) $6.4 \times 10^{-13} J$

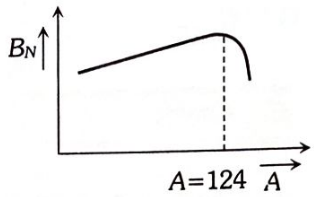
6. In a material medium, when a positron meets an electron both the particles annihilate leading to the emission of two gamma ray photons. This process forms the basis of an important diagnostic procedure called **[2003]**

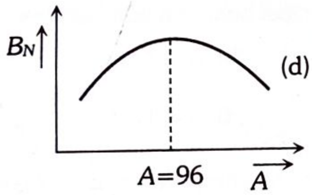
(a) MRI (b) PET

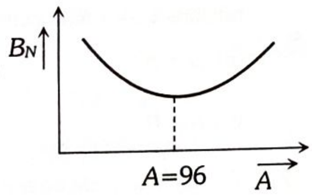
(c) CAT (d) SPECT

7. The dependence of binding energy per nucleon, B_N on the mass number, A, is represented by **[2004]**

(a) 

(b) 

(c) 

(d) 

8. The operation of a nuclear reactor is said to be critical, if the multiplication factor (k) has a value **[2006]**

(a) 1 (b) 1.5

(c) 2.1 (d) 2.5

9. Which one of the following nuclear reactions is a source of energy in the sun **[2006]**

(a) $^{9}_{4}Be + ^{4}_{2}He \to ^{12}_{6}C + ^{-1}_{0}n$

(b) $^{3}_{2}He + ^{3}_{2}He \to ^{4}_{2}He + ^{1}_{1}H + ^{1}_{1}H$

(c) $^{144}_{56}Ba + ^{92}_{56}Kr \to ^{235}_{92}U + ^{-1}_{0}n$

(d) $^{56}_{26}Fe + ^{112}_{48}Ca \to ^{167}_{74}W + ^{-1}_{0}n$

10. In an atomic bomb, the energy is released due to **[2001]**

(a) Chain reaction of neutrons and $_{92}U^{235}$

(b) Chain reaction of neutrons and $_{92}U^{238}$

(c) Chain reaction of neutrons and $_{92}P^{240}$

(d) Chain reaction of neutrons and $_{92}U^{236}$

11. Radioactive nuclei that are injected into a patient collect at certain sites within its body, undergoing radioactive decay and emitting electromagnetic radiation. These radiations can then be recorded by a detector. This procedure provides an important diagnostic tool called **[2003]**

(a) Gamma camera

(b) CAT scan

(c) Radiotracer technique

(d) Gamma ray spectroscopy

12. An archaeologist analyses the wood in a prehistoric structure and finds that C^{14} (Half life = 5700 *years*) to C^{12} is only one-fourth of that found in the cells of buried plants. The age of the wood is about **[2006]**

(a) 5700 *years* (b) 2850 *years*

(c) 11,400 *years* (d) 22,800 *years*

13. If a radioactive substance reduces to $\frac{1}{16}$ of its original mass in 40 *days*, what is its half-life **[2003]**

(a) 10 *days* (b) 20 *days*

(c) 40 *days* (d) None of these

14. A radioactive material has a half life of 10 days. What fraction of the material would remain after 30 days **[2005]**

(a) 0.5 (b) 0.25

(c) 0.125 (d) 0.33

15. Half-life of a radioactive substance is 20 *minutes*. Difference between points of time when it is 33% disintegrated and 67% disintegrated is approximately **[2000]**

(a) 10 *min* (b) 20 *min*

(c) 30 *min* (d) 40 *min*

16. Mass spectrometric analysis of potassium and argon atoms in a Moon rock sample shows that the ratio of the number of (stable) ^{40}Ar atoms present to the number of (radioactive) ^{40}K atoms is 10.3. Assume that all the argon atoms were produced by the decay of potassium atoms, with a half–life of 1.25×10^9 yr. How old is the rock **[2007]**

(a) $2.95 \times 10^{11} yr$ (b) $2.95 \times 10^{9} yr$

(c) $4.37 \times 10^{9} yr$ (d) $4.37 \times 10^{11} yr$

17. Carbon dating is best suited for determining the age of fossils if their age in years is of the order of **[2004]**

(a) 10^3 (b) 10^4

(c) 10^5 (d) 10^6

18. When a radioactive substance emits an α-particle, its position in the periodic table is lowered by **[2001]**

(a) One place (b) Two places

(c) Three places (d) Four places

19. A radioactive nucleus undergoes α-emission to form a stable element. What will be the recoil velocity of the daughter nucleus if V is the velocity of α-emission and A is the atomic mass of radioactive nucleus **[2004]**

(a) $\frac{4V}{A-4}$ (b) $\frac{2V}{A-4}$

(c) $\frac{4V}{A+4}$ (d) $\frac{2V}{A+4}$

6. In a material medium, when a positron meets an electron both the particles annihilate leading to the emission of two gamma ray photons. This process forms the basis of an important diagnostic procedure called **[2003]**

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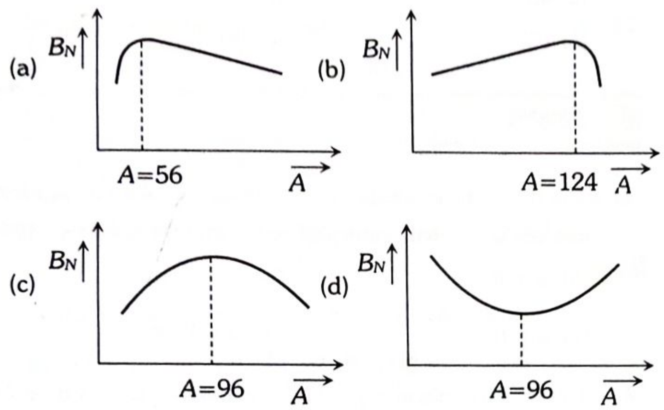

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(b) ${}_{2}^{3}He + {}_{2}^{3}He \rightarrow {}_{2}^{4}He + {}_{1}^{1}H + {}_{1}^{1}H$

(c) ${}_{56}^{144}Ba + {}_{56}^{92}Kr \rightarrow {}_{92}^{235}U + {}_{0}^{-1}n$

(d) ${}_{26}^{56}Fe + {}_{48}^{112}Ca \rightarrow {}_{74}^{167}W + {}_{0}^{-1}n$

10. In an atomic bomb, the energy is released due to **[2001]**

(a) Chain reaction of neutrons and ${}_{92}U^{235}$

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13. If a radioactive substance reduces to $\frac{1}{16}$ of its original mass in 40 *days*, what is its half-life **[2003]**

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14. A radioactive material has a half life of 10 days. What fraction of the material would remain after 30 days **[2005]**

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(c) 0.125 (d) 0.33

15. Half-life of a radioactive substance is 20 *minutes*. Difference between points of time when it is 33% disintegrated and 67% disintegrated is approximately **[2000]**

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16. Mass spectrometric analysis of potassium and argon atoms in a Moon rock sample shows that the ratio of the number of (stable) ${}^{40}Ar$ atoms present to the number of (radioactive) ${}^{40}K$ atoms is 10.3. Assume that all the argon atoms were produced by the decay of potassium atoms, with a half–life of 1.25×10^9 yr. How old is the rock **[2007]**

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(c) Three places (d) Four places

19. A radioactive nucleus undergoes α-emission to form a stable element. What will be the recoil velocity of the daughter nucleus if V is the velocity of α-emission and A is the atomic mass of radioactive nucleus **[2004]**

(a) $\frac{4V}{A-4}$ (b) $\frac{2V}{A-4}$

(c) $\frac{4V}{A+4}$ (d) $\frac{2V}{A+4}$

7. Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below:

(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of the assertion.

(c) If assertion is true but reason is false.

(d) If the assertion and reason both are false.

(e) If assertion is false but reason is true.

1. Assertion : It is not possible to use ^{35}Cl as the fuel for fusion energy.

   Reason : The binding energy of ^{35}Cl is too small.

2. Assertion : ^{90}Sr from the radioactive falling out from a nuclear bomb ends up in the bones of human beings through the milk consumed by them. It causes impairment of the production of red blood cells.

   Reason : The energetic β-particles emitted in the decay of ^{90}Sr damage the bone marrow.

3. Assertion : Neutrons penetrate matter more readily as compared to protons.

   Reason : Neutrons are slightly more massive than protons.

4. Assertion : Bohr had to postulate that the electrons in stationary orbits around the nucleus do not radiate.

   Reason : According to classical physics all moving electrons radiate.

5. Assertion : Radioactive nuclei emit β^{-1} particles.

   Reason : Electrons exist inside the nucleus.

6. Assertion : ${}_{Z}X^{A}$ undergoes $2\alpha -$ decays, $2\beta -$ decays and $2\gamma -$ decays and the daughter product is ${}_{Z-2}Y^{A-8}$.

   Reason : In α-decay the mass number decreases by 4 and atomic number decreases by 2. In β- decay the mass number remains unchanged, but atomic number increases by 1 only.

7. Assertion : Density of all the nuclei is same.

   Reason : Radius of nucleus is directly proportional to the cube root of mass number.

8. Assertion : Isobars are the element having same mass number but different atomic number.

   Reason : Neutrons and protons are present inside nucleus.

9. Assertion : The positively charged nucleus of an atom has a radius of almost $10^{-15}m$.

   Reason : In α-particle scattering experiment, the distance of closest approach for α-particles is $\simeq 10^{-15}m$.

10. Assertion : Electrons in the atom are held due to coulomb forces.

    Reason : The atom is stable only because the centripetal force due to Coulomb's law is balanced by the centrifugal force.

11. Assertion : Balmer series lies in the visible region of electromagnetic spectrum.

    Reason : $\frac{1}{\lambda} = R\left[\frac{1}{2^2} - \frac{1}{n^2}\right]$, where $n = 3,4,5$.

12. Assertion : Cobalt-60 is useful in cancer therapy.

    Reason : Cobalt-60 is source of γ -radiations capable of killing cancerous cell.

13. Assertion : The mass of β-particles when they are emitted is higher than the mass of electrons obtained by other means.

    Reason : β-particle and electron, both are similar particles.

14. Assertion : The binding energy per nucleon, for nuclei with atomic mass number $A >$ 100, decreases with A.

    Reason : The nuclear forces are weak for heavier nuclei.

25. Atomic and Nuclear Physics – Answers and Solutions

1. Atomic Structure

1	a	2	d	3	c	4	a	5	a
6	a	7	a	8	d	9	a	10	b
11	a	12	c	13	d	14	a	15	a
16	b	17	c	18	c	19	c	20	d
21	d	22	c	23	b	24	a	25	d
26	a	27	b	28	b	29	b	30	d
31	c	32	d	33	a	34	d	35	d
36	a	37	a	38	b	39	b		

2. Nucleus, Nuclear Reaction

1	c	2	a	3	d	4	b	5	c
6	b	7	c	8	c	9	b	10	a
11	a	12	a	13	c	14	a	15	b
16	b	17	b	18	a	19	c	20	b
21	d	22	a	23	b	24	d	25	a
26	a	27	d	28	a	29	a		

3. Radioactivity

1	d	2	c	3	d	4	c	5	a
6	a	7	c	8	a	9	d	10	a
11	c	12	d	13	d	14	d	15	c
16	a	17	b	18	b	19	a	20	a
21	a	22	b	23	d	24	a	25	b
26	d	27	a	28	d	29	d	30	b

4. IIT-JEE/AIEEE

1	a	2	b	3	a	4	a	5	a
6	a	7	a	8	c	9	d	10	d
11	d	12	b	13	c	14	c	15	a
16	b	17	d	18	d	19	b	20	a
21	c	22	c	23	c	24	d	25	d
26	b	27	d	28	b	29	d	30	a
31	b	32	d	33	b	34	a	35	c
36	a	37	a	38	c	39	c	40	b
41	a	42	a	43	d	44	a	45	d
46	c	47	a	48	b	49	c	50	d
51	b	52	d	53	c	54	c	55	a
56	a	57	d	58	d	59	d	60	a
61	c	62	b	63	a	64	d	65	b
66	b	67	c	68	a	69	b	70	b
71	c	72	b	73	b	74	b	75	c
76	c	77	c	78	b	79	b	80	c
81	a	82	a	83	a	84	c	85	c
86	b	87	c						

5. NEET/AIPMT

1	c	2	a	3	a	4	b	5	b
6	c	7	d	8	b	9	d	10	d
11	c	12	b	13	d	14	d	15	d
16	b	17	d	18	c	19	a	20	a
21	a	22	d	23	b	24	d	25	d
26	a	27	a	28	c	29	b	30	a
31	c	32	a	33	b	34	b	35	b
36	b	37	d	38	a	39	c	40	d
41	d	42	b	43	a	44	a	45	b
46	b	47	c	48	c	49	a	50	a
51	c	52	c	53	a	54	b	55	b
56	c	57	d	58	c	59	c	60	d
61	d	62	c	63	d	64	a	65	d
66	a	67	b	68	c	69	b	70	b
71	b	72	c	73	d	74	b	75	d
76	b	77	d	78	b	79	d	80	b
81	b	82	c	83	b	84	b	85	a
86	b								

6. AIIMS

1	a	2	b	3	a	4	a	5	b
6	b	7	a	8	a	9	b	10	a
11	c	12	c	13	a	14	c	15	b
16	c	17	b	18	b	19	a		

7. Assertion & Reason

1	c	2	a	3	b	4	b	5	c
6	a	7	a	8	b	9	a	10	a
11	a	12	a	13	b	14	c		