Time : 125 Mins **PHYSICS TEST 52 ATOMS AND NUCLAI 1** **Marks : 455**

1. Fusion reaction takes place at high temperature because:
   a) Nuclei break up at high temperature b) Atoms gets ionised at high temperature
   c) Kinetic energy is high enough to overcome the coulomb repulsion between nuclei
   d) Molecules break up at high temperature
2. The ionisation energy of hydrogen atom is 13.6 eV the ionisation energy of helium atom would be:
   a) 13.6 eV b) 27.2 eV c) 6.8 eV d) 54.4 eV
3. The energy of ground electronic state of hydrogen atom is -136 eV. The energy of the first excited state will be:
   a) -54.4 eV b) -27.2 eV c) -6.8 eV d) -3.4 eV
4. One requires energy E_n to remove a nucleon from a nucleus and an energy 'E_e' to remove an electron from the orbit of an atom. Then:
   a) $E_n = E_e$ b) $E_n < E_e$ c) $E_n > E_e$ d) $E_n \geq E_e$
5. Which of the following statements does not form part of Bohr's model of the hydrogen atom:
   a) Energy of the electrons in the orbit is quantized
   b) The electron in the orbit nearest the nucleus has the lowest energy
   c) Electrons revolve in different orbits around the nucleus
   d) The position and velocity of the electrons in the orbit cannot be determined simultaneously
6. Assertion: An α-particle is emitted when uranium 238 decays into thorium.
   Reason: The decay of uranium 238 to thorium is represented by ${}^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$ .The helium nuclei is called an alpha particle.
   a) If both assertion and reason are true and reason is the correct explanation of assertion.
   b) If both assertion and reason are true but reason is not the correct explanation of assertion.
   c) If assertion is true but reason is false. d) If both assertion and reason are false.
7. Let m_p be the mass of a proton, m_n the mass of a neutron, M_1 the mass of a ${}^{20}_{10}Ne$ nucleus and M_2 the mass of a ${}^{40}_{20}Ca$ nucleus. Then
   a) $M_2 = M_1$ b) $M_2 > 2M_1$ c) $M_2 < 2M_1$ d) $M_1 < 10\ (m_n + m_p)$
8. A radioactive decay can form an isotope of the original nucleus with the emission of particles
   a) one α and four β b) one α and two β c) one α and one β d) four α and one β
9. In a given reaction,
   $Z^{X^A 3/4 \rightarrow}{}_{Z+1}Y^A 3/4 \rightarrow {}_{Z-1}K^A \quad 43/4 \rightarrow_{Z-1} K^{A-4}$
   Radioactive radiations are emitted in the sequence of:
   a) a, b, g b) g, a, b c) b, a, g d) g, b, a
10. 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 wavelength $1_1 : 1_2$ emitted in the two cases is _____ .
    a) 7/5 b) 27/20 c) 27/5 d) 20/7
11. α-particles, β-particles and γ-rays are all having same energy. Their penetrating power in a given medium in increasing order will be _____ .
    a) b, g, a b) g, a, b c) a, b, g d) b, a, g
12. Which of the following spectral series falls within the visible range of electromagnetic radiation?
    a) Lyman series b) Balmer series c) Paschen series d) Pfund series
13. Which of the following statements is true for hydrogen atom?

a) Angular moment $\propto \frac{1}{n}$ b) Linear moment $\propto \frac{1}{n}$ c) Radius $\propto \frac{1}{n}$ d) Energy $\propto \frac{1}{n}$

14. In Balmer series of emission spectrum of hydrogen, first four lines with different wavelength H_α'H_β,H_γ and H_8 are obtained. Which line has maximum
frequency out of these?
a) H_α b) H_β c) H_γ d) H_8

15. A radioisotope 'X with a halflife 1.4 x 10^9 years decays to '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:
a) 1.96 x 10^9 years b) 3.92 x 10^9 years c) 4.20 x 10^9 years d) 8.40 x 10^9 years

16. In the Geiger-Marsden scattering experiment, in case of head-on collision the impact parameter should be
a) maximum b) minimum c) infinite d) zero

17. Pick out the incorrect statement from the following.
a) β^- from the nucleus is always accompanied with a neutrino.
b) The energy of the α-particle emitted from a given nucleus is always constant.
c) γ-ray emission makes the nucleus more stable d) Nuclear force is charge-independent.

18. The nature of ions knocked out from hot surfaces is:
a) protons b) electrons c) neutrons d) nuclei

19. In terms of Bohr radius a_0, the radius of the second Bohr orbit of a hydrogen atom is given by:
a) $4a_0$ b) $8a_0$ c) $\sqrt{2}a_0$ d) $2a_0$

20. The decay constant of a radioactive isotope is λ . If A_1 and A_2 are its activities at times t_1 and t_2 respectively, then the number of nuclei which have decayed during the time (t_1 - t_2)
a) $A_1t_1 - A_2t_2$ b) $A_1 - A_2$ c) $(A_1 - A_2)/\lambda$ d) $\lambda(A_1-A_2)$

21. An electron is accelerated from rest through a potential difference of V volt. If the de-Broglie wavelength of the electrons is 1.227×10^{-2} nm, the potential difference is:
a) 10^4 V b) 10 V c) 10^2 V d) 10^3 V

22. It is possible to understand nuclear fission on the basis of the :
a) liquid drop model of the nucleus b) meson theory of the nuclear forces c) proton-proton cycle
d) independent particle model of the nucleus

23. The half life of radium is about 1600 years. Of 100 g of radium existing now, 25 g will remain unchanged after _____ .
a) 3200 years b) 4800 years c) 6400 years d) 2400 years

24. **Assertion:** In the experiment of alpha particle scattering, extremely thin gold foils are preferred over other metals.
Reason: Gold is a ductile material.
a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) If both assertionand reason are true but reason is not the correct explanationof assertion.
c) If assertion is true but reason is false. d) If both assertion and reason are false.

25. Which of the following is not correct about Bohr model of the hydrogen atom?
a) An electron in an atom could revolve in certain stable orbits without the emission of radiant energy.
b) Electron revolves around the nucleus only in those orbits for which angular momentum $L_n = \frac{nh}{2\pi}$.
c)
When electron make a transition from one ofits stable orbit to lower orbit then a photon emitted with energy $h\upsilon = E_f - E_i$
d) Bohr model is applicable to all atoms.

26. An electron in the hydrogen atom jumps from excited state n to the ground state. The wavelength so emitted illuminates a photosensitive material having work function 2.15 eV. If the stopping potential of the photoelectron is 10 V, the value of n is _____ .
a) 3 b) 4 c) 5 d) 2

27. If the nuclear force between two protons, two neutrons and between proton and neutron is denoted by F_{pp}, F_{nn} and F_{pn} respectively, then _____ .
a) $F_{pp}^{pn} \approx F_{nn} \gg F_{pn}$ b) ${F_{pp}}^1 F_{nn} and F_{pp} = F_{nn}$ c) $F_{pp}^{pp} = F_{nn} = F_{pn}^{pn}$ d) ${F_{pp}}^1 {F_{nn}}^1 F_{pn}$

28. A nucleus represented by the symbol ${}^{A}_{Z}X$ has _____ .
    a) A protons and (Z-A) neutrons b) Z neutrons and (A-Z) protons c) Z protons and (A-Z) neutrons
    d) Z protons and A neutrons

29. 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:
    a) Isotope of parent b) Isobar of parent c) Isomer of parent d) Isotone of parent

30. The Rydberg formula, for the spectrum of the hydrogen atom where all terms have their usual meaning is
    a) $h\upsilon_{if} = \frac{me^4}{8\varepsilon_0^2 h^2}\left(\frac{1}{n_f} - \frac{1}{n_i}\right)$ b) $h\upsilon_{if} = \frac{me^4}{8\varepsilon_0^2 h^2}\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$ c) $h\upsilon_{if} = \frac{8\varepsilon_0^2 h^2}{me^4}\left(\frac{1}{n_f} - \frac{1}{n_i}\right)$
    d) $h\upsilon_{if} = \frac{8\varepsilon_0^2 h^2}{me^4}\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$

31. The radius of hydrogen atom in its ground state is 5.3 x 10^{-11} m. After collision with an electron it is found to have a radius of 21.2 x 10^{-11} m. What is the principal quantum number n of the final state of the atom?
    a) n = 4 b) n = 2 c) n = 16 d) n = 3

32. 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:
    a) 60s b) 80s c) 20s d) 40s

33. Two radioactive materials X_1 and X_2 have decay constants 51 and 1 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 $\frac{1}{e}$ after a time:
    a) 1 b) $\frac{1}{2}\lambda$ c) $\frac{1}{4\lambda}$ d) $\frac{e}{\lambda}$

34. The natural boron of atomic weight 10.81 is found to have two isotopes ^{10}B and ^{11}B. The ratio of abundance of isotopes of natural boron should be
    a) 11:10 b) 81:19 c) 10:11 d) 19:81

35. The value of ionisation energy of the hydrogen atom is
    a) 3.4 eV b) 10.4 eV c) 12.09 eV d) 13.6 eV

36. The de-Broglie wavelength of an electron in the first Bohr orbit is
    a) equal to one-fourth the circumference of the first orbit b) equal to half the circumference of first orbit
    c) equal to twice the circumference of first orbit d) equal to the circumference of the first orbit.

37. Which of the following cannot be emitted by radioactive substances during their decay?
    a) Neutrinos b) Protons c) Electrons d) Helium nuclei

38. The inverse square law in electrostatics is $\left|\vec{F}\right| = \frac{e^2}{(4\pi\varepsilon_0).r^2}$ for the force between an electron and a proton. The $\left(\frac{1}{r}\right)$ dependence of $\left|\vec{F}\right|$ can be understood in quantum theory as being due to the fact that the 'particle' of light (photon) is massless. If photons had a mass m_p, force would be modified to $\left|\vec{F}\right| = \frac{e^2}{(4\pi\varepsilon_0)r^2}\left[\frac{1}{r^2} + \frac{\lambda}{r}\right].exp(-\lambda r)$ where $\lambda = m_p c/h$ and $h = \frac{h}{2\pi}$. The change ion the ground state energy (eV) of a H-atom if m_p were 10^{-6} times the mass of an electron. (r_B = Bohr's radius)
    a) 18.6 λ r_B b) -27.2 c) 27.2 λ r_B d) -λr_B

39. In a hydrogen atom the total energy of electron is
    a) $\frac{e^2}{4\pi\varepsilon_0 r}$ b) $\frac{-e^2}{4\pi\varepsilon_0 r}$ c) $\frac{-e^2}{8\pi\varepsilon_0 r}$ d) $\frac{e^2}{8\pi\varepsilon_0 r}$

40. Assertion: The whole mass of the atom is concentrated in the nucleus.
    Reason: The mass of a nucleus can be either less than or more than the sum of the masses of nucleons present in it.
    a) If both assertion and reason are true and reason is the correct explanation of assertion.
    b) If both assertion and reason are true but reason is not the correct explanation of assertion.
    c) If assertion is true but reason is false. d) If both assertion and reason are false.

41. The ground state energy of hydrogen atom is -13.6eV. The kinetic energy of the electron in this state is
    a) 2.18 x 10^{-14}J b) 2.18 x 10^{-16}J c) 2.18 x 10^{-18}J d) 2.18 x 10^{-19}J

42. The half life of $^{90}_{38}Sr$ is 28 years. The disintegration rate of 15 mg of this isotope is of the order of:

a) 10^{11} Bq b) 10^{10} Bq c) 10^{7} Bq d) 10^{9} Bq

43. Radon has 3.8 days as its half-life. How much radon will be left out of 15 mg mass after 38 days?
a) 1.05 mg b) 0.015 mg c) 0.231 mg d) 0.50 mg

44. If radius of the $^{27}_{12}\mathrm{AL}$ nucleus is taken to be RA1, then the radius of $^{125}_{53}\mathrm{Te}$ nucleus is nearly:
a) $\frac{5}{3}R_{A1}$ b) $\frac{3}{5}R_{A1}$ c) $\left(\frac{13}{53}\right)^{1/3}R_{A1}$ d) $\left(\frac{53}{13}\right)^{1/3}R_{A1}$

45. The relation between the orbit radius and the electron velocity for a dynamically stable orbit in a hydrogen atom is (where, all notations have their usual meanings)
a) $v=\sqrt{\frac{4\pi\varepsilon_0}{me^2r}}$ b) $r=\sqrt{\frac{e^2}{4\pi\varepsilon_0 v}}$ c) $v=\sqrt{\frac{e^2}{4\pi\varepsilon_0 mr}}$ d) $r=\sqrt{\frac{ve^2}{4\pi\varepsilon_0 m}}$

46. In the Bohr model of the hydrogen atom, let R, V and E represent the radius of the orbit, speed of the electron and the total energy of the electron respectively. Which of the following quantities are proportional to the quantum number n?
a) VR b) RE c) R/E d) none of these

47. The wavelength of radiation emitted is λ_0 when an electron jumps from the third to second orbit of hydrogen atom. For the electron jumping from the fourth to the second orbit of the hydrogen atom, the wavelength of radiation emitted will be
a) (16/25)λ_0 b) (20/27)λ_0 c) (27/20)λ_0 d) (25/16)λ_0

48. The total energy of an electron in an atom in an orbit is 3.4 eV. Its kinetic and potential energies are, respectively:
a) $-3.4\mathrm{eV}, -6.8\mathrm{eV}$ b) $3.4\mathrm{eV}, -6.8\mathrm{eV}$ c) $3.4\mathrm{eV}, 3.4\mathrm{eV}$ d) $-3.4\mathrm{eV}, -3.4\mathrm{eV}$

49. The transition from the state n=3 to n=1 in a hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition from:
a) $2\rightarrow 1$ b) $3\rightarrow 2$ c) $4\rightarrow 2$ d) $5\rightarrow 4$

50. In the nucleus of $_{11}\mathrm{Na}^{23}$, the number of protons, neutrons and electrons are:
a) 11,12,0 b) 23,12,11 c) 12,11,0 d) 23,11,12

51. The Balmer series for the H -atom can be observed
a) if we measure the frequencies of light emitted when an excited atom falls to the ground state
b)
if we measure the frequencies of light emitted due to transitions between excited states and the first excited state
c) in any transition in a H-atom d) none of these

52. Ratio of longest wave lengths corresponding to Lyman and Balmer series in hydrogen spectrum is:
a) 5/27 b) 3/23 c) 7/29 d) 9/3

53. The power obtained in a reactor using U^{235} disintegration is 1000 kW, The mass decay of U^{235} per hour is:
a) 10 microgram b) 20 microgram c) 40 microgram d) 1 microgram

54. An electron changes its position from orbit n = 2 to the orbit n = 4 of an atom. The wavelength of the emitted radiations is (R = Rydbery's constant)
a) $\frac{16}{R}$ b) $\frac{16}{3R}$ c) $\frac{16}{5R}$ d) $\frac{16}{7R}$

55. **Assertion:** The trajectory traced by an incident particle depends on the impact parameter of collision.
Reason: The impact parameter is the perpendicular distance of the initial velocity vector of the incident particle from the centre of the target nucleus.
a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) If both assertionand reason are true but reason is not the correct explanationof assertion.
c) If assertion is true but reason is false. d) If both assertion and reason are false.

56. 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 (Given $\log_{10}e = 0.4343$) is
a) 3.8 days b) 16.5 days c) 33 days d) 76 days

57. Atomic hydrogen has life period of :
a) one minute b) one day c) a fraction of a second d) one hour

58. How much mass has to be converted into energy to produce electric power of 500 MW for one hour?
a) 2 x 10^{-5}kg b) 1 x 10^{-5}kg c) 3 x 10^{-5}kg d) 4 x 10^{-5}kg

59. When an electron jumps from the fourth orbit to the second orbit, one gets the
a) second line of Paschen series b) second line of Balmer series c) first line of Pfund series
d) second line of Lyman series

60. The energy required to excite an electron in hydrogen atom to its first excited state is
a) 8.5 eV b) 10.2 eV c) 12.7 eV d) 13.6 eV

61. The ground state energy of hydrogen atom is 13.6 eV. When its electron is in the first excited state, its excitation energy is _____ .
a) 3.4 eV b) 6.8 eV c) 10.2 eV d) 0

62. The Bohr model of atoms
a) assumes that the angular momentum of electrons is quantized. b) uses Einstein's photoelectric equation.
c) predicts continuous emission spectra for atoms.
d) predicts the same emission spectra for all types of atoms.

63. Hydrogen atoms are excited from ground state of the principal quantum number 4. Then, the number of spectral lines observed will be:
a) 3 b) 6 c) 5 d) 2

64. 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 :
a) $\log_e 2/5$ b) $5/1\log_e 2$ c) $51\log_{10} 2$ d) $5\log_e 2$

65. The mass of ${}^{7}_{3}Li$ is 0.042 amu less than the sum of masses of its constituents. The binding energy per nucleon is
a) 2.433 MeV b) 3.739 MeV c) 5.586 MeV d) 10.522 MeV

66. Ionization potential of hydrogen atom is 13.6 eV. Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1 eV. According to Bohr's theory, the spectral lines emitted by hydrogen will be _____ .
a) Three b) Four c) One d) Two

67. Carbon dating is best suited for determining the age of fossils, if their age in years is of the order of
a) 10^3 b) 10^4 c) 10^5 d) 10^6

68. 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.

69. A 10 kg satellite circles earth once every 2 h in an orbit having a radius of 8000 km. Assuming that Bohr's angular momentum postulate applies to a satellite just as it does to an electron in the hydrogen atom, then the quantum number of the orbit of satellite is
a) 5.3×10^{40} b) 5.3×10^{45} c) 7.8×10^{48} d) 7.8×10^{50}

70. **Assertion:** Atoms of each element are stable and emit characteristic spectrum.
Reason: The spectrum provides useful information about the atomic structure.
a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) If both assertionand reason are true but reason is not the correct explanationof assertion
c) If assertion is true but reason is false d) If both assertion and reason are false.

71. A radio isotope X with a half life 1.4 x 10^9 years decays to 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::
a) 4.20 x 10^9 years b) 8.40 x 10^9 years c) 1.96 x 10^9 years d) 3.92 x 10^9 years

72. The stable nucleus that has a radius half that of Fe^{56} is:
a) Li^7 b) Na^{21} c) S^{16} d) Ca^{40}

73. Two stable isotopes ${}^{6}_{3}Li$ and ${}^{7}_{3}Li$ have respective abundances of 7.5% and 92.5%. These isotopes have masses 6.01512 u and 7.01600 u respectively. The atomic weight of lithium is
a) 6.941 u b) 3.321 u c) 2.561 u d) 0.621 u

74. In the Geiger-Marsden scattering experiment the number of scattered particles detected are maximum and minimum at the scattering angles respectively at
a) 0° and 180° b) 180° and 0° c) 90° and 180° d) 45° and 90°

75. The nucleus ${}_{48}Cd^{115}$, after two successive β-decay will give _____ .
a) ${}_{46}\mathrm{Pa}^{115}$ b) ${}_{49}In^{114}$ c) ${}_{50}Sn^{113}$ d) ${}_{50}Sn^{115}$

76. 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 $(1/e)^2$ after a time interval
a) 4λ b) 2λ c) $1/2\lambda$ d) $1/4\lambda$

77. The relationship between kinetic energy (K) and potential energy (U) of electron moving in a orbit around the nucleus is
a) U = -K b) U = -2K c) U = -3K d) $U = -\frac{1}{2}K$

78. The halflife of a radioactive nucleus is 50 days. The time interval (t_2-t_1) between the time t_2 when $\frac{2}{3}$ of it has decayed and the time t_1 when $\frac{1}{3}$ of it had decayed is:
a) 30 days b) 50 days c) 60 days d) 15 days

79. When an atomic gas or vapour is excited at low pressure, bypassing an electric current through it then
a) emission spectrum is observed b) absorption spectrum is observed c) band spectrum is observed
d) both (b) and (c)

80. In question number 70, what is the frequency of photon?
a) 3.1 x 10^{15}Hz b) 3.1 x 10^{18}Hz c) 9.1 X 10^{15}Hz d) 9.1 x 10^{18}Hz

81. Solar energy is due to :
a) fusion reaction b) fission reaction c) combustion reaction d) chemical reaction

82. In a nuclear fusion reaction, two nuclei, A & B, fuse to produce a nucleus C, releasing an amount of energy $\triangle$E in the process. If the mass defects of the three nuclei are $\triangle$ M_A , $\triangle$ M_B & $\triangle$ M_C respectively, then which of the following relations holds? Here, c is the speed of light.
a) $\triangle M_A + \triangle M_B = \triangle M_C - \triangle E/C^2$ b) $\triangle M_A + \triangle M_B = \triangle M_C + \triangle E/C^2$
c) $\triangle M_A - \triangle M_B = \triangle M_C - \triangle E/C^2$ d) $\triangle M_A - \triangle M_B = \triangle M_C + \triangle E/C^2$

83. Which of the following statements is true for nuclear forces?
a) They obey the inverse square law of distance b) They obey the inverse third power law of distance
c) They are short range forces d) They are equal in strength to electromagnetic forces

84. The ratio of the speed of the electron in the ground state of hydrogen atom to the speed of light in vacuum is
a) $\frac{1}{2}$ b) $\frac{2}{237}$ c) $\frac{1}{137}$ d) $\frac{1}{237}$

85. Nuclei of a radioactive element A are being produced at a constant rate α. The element has a decay constant λ. At time t = 0, there are N_o. nuclei of the element. The number N of nuclei of A at time t is :
a) $\frac{1}{\lambda}[\alpha + (\alpha - N_o\lambda)e^{-\lambda t}]$ b) $\frac{1}{\lambda}[\alpha - (\alpha - N_o\lambda)e^{-\lambda t}]$ c) $[\alpha - (\alpha - N_o\lambda)e^{-\lambda t}]$
d) $[\alpha - (N_o\lambda - \alpha)e^{-\lambda t}]$

86. Half-lives of two radioactive substances A and B are respectively 20 minutes and 40 minutes. Initially, the samples of A and B have equal number of nuclei. After 80 minutes the ratio of remaining 'numbers of A and B nuclei is :
a) 1: 16 b) 4: 1 c) 1: 4 d) 1: 1

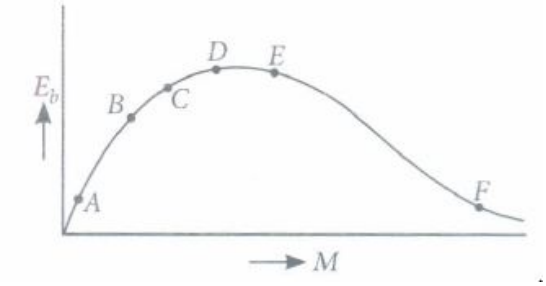
87. An electron in a hydrogen atom makes a transition from n = n_1 to n = n_2. The time period of the electron in the initial state is eight times that in the final state. The possible values of n_1 and n_2 are
a) n_1 = 4, n_2 = 2 b) n_1 = 8, n_2 = 2 c) n_1 = 8, n_2 = 1 d) n_1 = 6, n_2 = 2

88. Samples of two radioactive nuclides A and B are taken. λ_A and λ_B are the disintegration constants of A and B respectively. In which of the following cases, the two samples can simultaneously have the same decay rate at any time? Initial rate of decay of A is twice the initial rate of decay of Band AA = AB.
a) Initial rate of decay of A is twice the initial rate of decay of B and $\lambda_A = \lambda_B$
b) Initial rate of decay of A is twice the initial rate of decay of B and $\lambda_A > \lambda_B$

c) Initial rate of decay of B is twice the initial rate of decay of A and $\lambda_A > \lambda_B$

d) Initial rate of decay of B is twice the initial rate of decay of A at t = 2h and $\lambda_B = \lambda_A$

89. Given figure shows a plot of binding energy per nucleon e,against the nuclear mass M. A, B, C, D, E, F correspond to different nuclei. Consider four reactions



(i) A + B ⟶ C + ε (ii) C ⟶ A + B + ε

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

Where E is the energy released. In which reactions is ε positive?

a) (i) and (iii) b) (ii) and (iv) c) (ii) and (iii) d) (i) and (iv)

90. The mass of alpha-particle is :

a) less than the sum of masses of two protons and two neutrons b) equal to mass of four protons

c) equal to mass of four neutrons d) equal to sum of masses of two protons and two neutron

91. Electron occupies the available orbital singly before pairing in anyone orbital occurs, it is :

a) Pauli's exclusion principle b) Hund's Rule c) Heisenberg's principle d) Prout's hypothesis

92. 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

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 $|E_H| < |E_{Li}|$

93. The equation $4{}_1^1H^+ \rightarrow {}_2^4He^{2+}$ +2e$^-$ + 26 MeV represents

a) β- decay b) $\gamma-$decay c) fusion d) fission

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

a) x = n, y = n, K_{sr} = 129 MeV, K_{Xe}= 86 MeV b) x = p,y =$\bar{e}$, 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

95. 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 ris in km and

a) M is not related to the mass of the hydrogen atom.

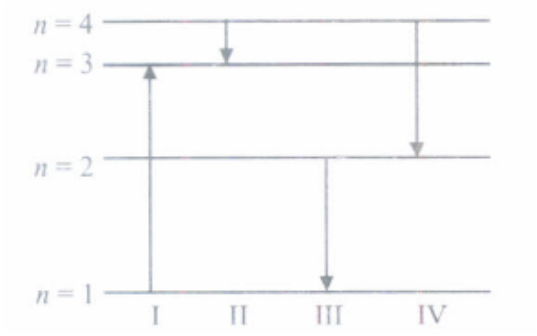
b) M = m_{proton} + $m_{electron} - \frac{|V|}{C^2}$ ($|V|$ =magnitude of the potential energy of electron in the H-atom).

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

96. The count rate of a radioactive sample falls from 4.0 x 10^6 s^{-1} to 1.0 X 10^6 s^{-1} in 20 hours. What will be the count rate after 100 hours from begining?

a) 3.91 x 10^3 s^{-1} b) 3.91 x $10^2 s^{-1}$ c) 3.91 X 10^4 s^{-1} d) 3.91 x 10^6 s^{-1}

97. 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?



a) I b) II c) III d) IV

98. If in 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:
a) $m_3 > (m_1 + m_2)$ b) $m_3 = m_1 + m_2$ c) $m_3 = | m_1 - m_2 |$ d) $m_3 < (m_1 + m_2)$

99. If 200 MeV energy is released in the fission of a single nucleus of $^{235}_{92}U$,the fissions which are required to produce a power of 1 kW is
a) 3.125×10^{13} b) 1.52×10^{6} c) 3.125×10^{12} d) 3.125×10^{14}

100. Mass numbers of the elements A, B, C and D are 30, 60, 90, and 120 respectively. The specific binding energy of them are 5 MeV, 8.5 MeV, 8 MeV and 7 MeV respectively. Then, in which of the following reaction/s energy is released?
(1) $D \rightarrow 2B$
(2) $C \rightarrow B + A$
(3) $B \rightarrow 2A$
a) only in (1) b) in (2), (3) c) in (1), (3) d) in (1), (2) and (3)

101. The radius of a spherical nucleus as measured by electron scattering is 3.6 fm. What is the mass number of the nucleus most likely to be?
a) 27 b) 40 c) 56 d) 120

102. J.J. Thomson's cathode-ray tube experiment demonstrated that.
a) The e/m ratio of the cathode-ray particles changes when a different gas is placed in the discharge tube
b) Cathode rays are streams of negatively charged ions
c) All the mass of an atom is essentially in the nucleus.
d) The e/m of electrons is much greater than the e/m of protons

103. A free neutron decays into a proton, an electron and:
a) a beta particle b) an alpha particle c) an anti-neutrino d) a neutrino

104. The binding energy per nucleon in deuterium and helium nuclei are 1.1 MeV and 7.0 MeV, respectively. When two deuterium nuclei fuse to form a helium nucleus the energy released in the fusion is:
a) 30.2 MeV b) 23.6 MeV c) 2.2 MeV d) 28.0 MeV

105. In the question number 5, if $\alpha = 2N_o\lambda$, calculate the number of nuclei of A after one half-life of A, and also the limiting value of N as
a) $2N_o, \frac{5}{2}N_o$ b) $3N_o, 2N_o$ c) $4N_o, 2N_o$ d) $\frac{3}{2}N_o, 2N_o$

106. The mass defect for the nucleus of helium is 0.0303 a.m.u. What is the binding energy per nucleon for helium in MeV:
a) 28 b) 7 c) 4 d) 1

107. Hydrogen atom in ground state is excited by a monochromatic radiation of $1 = 975\ \mathring{A}$. Numbér of spectral lines in the resulting spectrum emitted will be _____ .
a) 3 b) 2 c) 6 d) 10

108. If speed of electron in ground state energy level is 2.2×10^6 m s^{-1}, then its speed in fourth excited state will be
a) 6.8×10^6 m s^{-1} b) 8.8×10^5 m s^{-1} c) 5.5×10^5 m s^{-1} d) 5.5×10^6m s^{-1}

109. Existence of positively charged nucleus was established by :

a) Positive ray analysis b) a-ray scattering experiments c) X-ray analysis d) Discharge tube experiments

110. Fission of nuclei is possible because the binding energy per nucleon in them
    a) increases with mass number at low mass numbers.
    b) decreases with mass number at low mass numbers.
    c) increases with mass number at high mass numbers.
    d) decreases with mass number at high mass numbers.

111. The total energy (E_n) of the electron in the stationary states in the n_{th} orbit of the hydrogen atom is
    a) $\frac{-13.6}{n}eV$ b) $\frac{-13.6}{n^2}eV$ c) $\frac{-136}{n}eV$ d) $\frac{-136}{n^2}eV$

112. 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 aminimum energy
    c) angular momentum must be in the direction of spin of electron
    d) because electrons go around only in horizontal orbits

113. Suppose an electron is attracted towards the origin by a force klr, 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 nth orbit of the electron is found to be rn and the kinetic energy of the electron is found to be Tn. Then which of the following is true?
    a) $T_n \propto \frac{1}{n^2}$ b) T_n is independent of n; $r_{n \propto n}$ c) $T_n \propto \frac{1}{n} and\ r_n$ d) $T_n \propto \frac{1}{n} and\ r_n \propto n^2$

114. An alpha nucleus of energy 1/2mv^2 bombards a heavy nuclear target of charge Ze. Then the distance of closest approach for the alpha nucleus will be proportional to :
    a) 1/Ze b) ν^2 c) 1/m d) 1/ν^2

115. The ground state energy of an atom is -13.6 eV. The photon emitted during the transition of electron from n = 3 to n = 1 state, is incident on a photosensitive material of unknown work function. The photoelectrons are emitted from the materials with a maximum kinetic energy of 9 eV. The threshold wavelength of the material used is
    a) 0.9 $\times$ 10^{-7} m b) 4 $\times$ 10^{-7} m c) 0.47 $\times$ 10^{-7} m d) 9 $\times$ 10^{-7} m

116. The total energy of an electron in the first excited state of hydrogen atom is about -3.4 eV. Its kinetic energy in this state is _____ .
    a) 3.4 eV b) 6.8 eV c) -3.4 eV d) -6.8 eV

117. If n is the orbit number of the electron in a hydrogen atom, the correct statement among the following is
    a) electron energy increases as n increases.
    b) hydrogen emits infrared rays for the electron transition from n = ∞ to n = 1.
    c) electron energy is zero for n = 1. d) electron energy varies as n^2.

118. 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 _____ .
    a) n=3 to n=1 states b) n=2 to n=1 states c) n=4 to n=3 states d) n=3 to n=2 states

119. The nuclei of which one of the following pairs of nuclei are isotones?
    a) $34\mathrm{Se}^{74}, {}_{31}\mathrm{Ga}^{71}$ b) ${}_{38}\mathrm{Sr}^{84}, {}_{38}\mathrm{Sr}^{86}$ c) ${}_{42}\mathrm{Mo}^{92}, {}_{40}\mathrm{Zr}^{92}$ d) ${}_{20}\mathrm{Ca}^{40}, {}_{16}\mathrm{S}^{32}$

120. In the Bohr model of the hydrogen atom, the lowest orbit corresponds to
    a) infinite energy b) maximum energy c) minimum energy d) zero energy

121. In which of the following Bohr's orbit (n) a hydrogen atom emits the photons of lowest frequency?
    a) n = 2 to n = 1 b) n = 4 to n = 2 c) n = 4 to n = 1 d) n = 4 to n = 3

122. The mass number of He is 4 and that for sulphur is 32. The radius of sulphur nuclei is larger than that of helium by :
    a) $\sqrt{8}$ b) 4 c) 2 d) 8

123. The number of de Broglie wavelengths contained in the second Bohr orbit of Hydrogen atom is
    a) 1 b) 2 c) 3 d) 4

124. Radioactive material 'N 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 'N will be 1/e?
a) 1/7λ b) 1/8λ c) 1/9λ d) 1/λ

125. The energy of a hydrogen atom in the ground state is - 13.6 eV. The energy of He^+ ion in the first excited state will be :
a) -13.6 eV b) - 27.2 eV c) - 54.4 eV d) - 6.8 eV