Nuclear Physics :

1. In Rutherford's famous gold foil scattering experiment, he found that most alpha particles would pass through the foil undeflected. Which one of the following nuclear properties can be inferred from this observation?

(A) The nucleus must have a positive charge

(B) Most of the mass of an atom is in the nucleus

(C) The nucleus contains both protons neutrons

(D) The diameter of the nucleus is small compared to the diameter of the atom

(E) None of these

2. Let u be denote one atomic mass unit. One atom of an element of mass number A has mass exactly equal to Au

(A) for any value of A (B) only for A = 1

(C) only for A = 12 (D) for any value of A provided the atom is stable

3. 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-

[AIEEE - 2005]

(A) 6 fermi (B) 8 fermi (C) 4 fermi (D) 5 fermi

4. The surface area of a nucleus varies with mass number A as

(A) $A^{2/3}$ (B) $A^{1/3}$ (C) A (D) None

5. A nucleus disintegrates into two nuclear parts which have their velocities in the ratio 2 : 1 The ratio of their nuclear sizes will be-

[AIEEE - 2004]

(A) $2^{1/3} : 1$ (B) $1 : 3^{1/2}$ (C) $3^{1/2} : 1$ (D) $1 : 2^{1/3}$

6. The binding energy per nucleon for C^{12} is 7.68 MeV and that for C^{13} is 7.5 MeV. The energy required to remove a neutron from C^{13} is

(A) 5.34 MeV (B) 5.5 MeV (C) 9.5 MeV (D) 9.34 MeV

7. The following nuclear reaction is an example of $^{12}_{6}C + ^{4}_{2}H \rightarrow ^{16}_{8}O$ + energy

(A) fission (B) fusion (C) alpha decay (D) beta decay

8. Fast neutrons may most easily be slowed down by which one of the following methods?

(A) passing them through a substance rich in hydrogen

(B) allowing them to collide elastically with heavy nuclei

(C) using lead shielding

(D) passing them through an increasing potential gradient space

9. A nuclear transformation is denoted by $X(n, \alpha) \rightarrow {}^{7}_{3}Li$. Which of the following is the nucleus of element X ? **[AIEEE - 2005]**

(A) ${}^{12}_{6}C$ (B) ${}^{10}_{5}B$ (C) ${}^{9}_{5}B$ (D) ${}^{11}_{4}Be$

10. A certain radioactive nuclide of mass number m_x disintegrates, with the emission of an electron and γ radiation only, to give second nuclide of mass number m_y. Which one of the following equation correctly relates m_x and m_y?

(A) $m_y = m_x + 1$ (B) $m_y = m_x - 2$ (C) $m_y = m_x - 1$ (D) $m_y = m_x$

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

(A) 76 (B) 78 (C) 82 (D) 74

12. In an α-decay the Kinetic energy of α particle is 48 MeV and Q-value of the reaction is 50 MeV. The mass number of the mother nucleus is: (Assume that daughter nucleus is in ground state)

(A) 96 (B) 100 (C) 104 (D) none of these

13. When U^{238} nucleus originally at rest, decays by emitting an alpha particle having a speed u, the recoil speed of the residual nucleus is- **[AIEEE - 2003]**

(A) $\frac{4u}{238}$ (B) $-\frac{4u}{234}$ (C) $\frac{4u}{234}$ (D) $-\frac{4u}{238}$

14. If a star converts all of its Helium into oxygen nucleus, find the amount of energy released per nucleus of oxygen. O = 15.9994 amu and He = 4.0026 amu **[JEE' 2005 (Scr)]**

(A) 7.26 MeV (B) 7 MeV (C) 10.24 MeV (D) 5.12 MeV

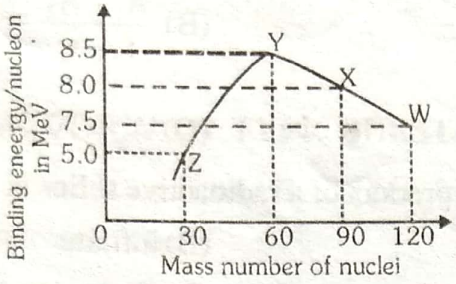
15. The nucleus of element X (A = 220) undergoes α-decay. If Q-value of the reaction is 5.5 MeV, then the kinetic energy of α-particle is : **[JEE 2003 (Scr)]**

(A) 5.4 MeV (B) 10.8 MeV (C) 2.7 MeV (D) None

16. In the uranium radioactive series the initial nucleus is ${}_{92}U^{238}$, and the final nucleus is ${}_{82}Pb^{206}$. When the uranium nucleus decays to lead, the number of α – particles emitted is.. and the number of β-particles emitted...

(A) 6, 8 (B) 8, 6 (C) 16, 6 (D) 32, 12

17. Binding energy per nucleon versus mass number curve for nuclei is shown in figure. W, X, Y and Z are four nuclei indicated on the curve. The process that would release energy is :



(A) $Y \rightarrow 2Z$ (B) $W \rightarrow X + Z$ (C) $W \rightarrow 2Y$ (D) $X \rightarrow Y + Z$

Radoactivity :

18. The half–life of ^{131}I is 8 days. Given a sample of ^{131}I at time t = 0, we can assert that :

(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

19. Activity of a radioactive substance is R_1 at time t_1 and R_2 at time $t_2 (t_2 > t_1)$. Then the ratio $\frac{R_2}{R_1}$ is:

(A) $\frac{t_2}{t_1}$ (B) $e^{-\lambda(t_1+t_2)}$ (C) $e\left(\frac{t_1 - t_2}{\lambda}\right)$ (D) $e^{\lambda(t_1-t_2)}$

20. A particular nucleus in a large population of identical radioactive nuclei did survive 5 half lives of that isotope. Then the probability that this surviving nucleus will survive the next half life :

(A) $\frac{1}{32}$ (B) $\frac{1}{5}$ (C) $\frac{1}{2}$ (D) $\frac{1}{10}$

21. A certain radio active substance has a half life of 5 years. Thus for a nucleus in a sample of the element, the probability of decay in ten years is

(A) 50% (B) 75% (C) 100% (D) 60%

22. The activity of a sample reduces from A_0 to $A_0/\sqrt{3}$ in one hour. The activity after 3 hours more will be

(A) $\frac{A_0}{3\sqrt{3}}$ (B) $\frac{A_0}{9}$ (C) $\frac{A_0}{9\sqrt{3}}$ (D) $\frac{A_0}{27}$

23. Half life of radium is 1620 years. How many radium nuclei decay in 5 hours in 5 gm radium? (Atomic weight of radium = 223)

(A) 9.1×10^{12} (B) 3.23×10^{15} (C) 1.72×10^{20} (D) 3.3×10^{17}

24. The activity of a sample of radioactive material is A_1 at time t_1 and A_2 at time t_2 ($t_2 > t_1$). Its mean life is T.

(A) $A_1 t_1 = A_2 t_2$ (B) $\frac{A_1 - A_2}{t_2 - t_1} = \text{constant}$

(C) $A_2 = A_1 e^{(t_1 - t_2)/T}$ (D) $A_2 = A_1 e^{(t_1/Tt_2)}$

25. The decay constant of the end product of a radioactive series is

(A) zero (B) infinite

(C) finite (non zero) (D) depends on the end product.

26. A radioactive substance is dissolved in a liquid and the solution is heated. The activity of the solution

(A) is smaller than that of element

(B) is greater than that of element

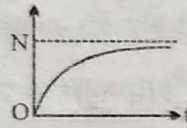
(C) is equal to that of element

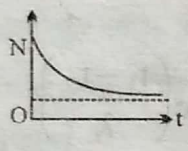
(D) will be smaller or greater depending upon whether the solution is weak or concentrated.

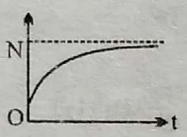
27. In a certain nuclear reactor, a radioactive nucleus is being produced at a constant rate = 1000 /s. The mean life of the radionuclide is 40 minutes. At steady state, the number of radionuclide will be

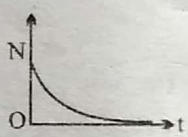
(A) 4×10^4 (B) 24×10^4 (C) 24×10^5 (D) 24×10^6

28. In the above question, if there were 20×10^5 radionuclide at t = 0, then the graph of N v/s t is

(A) 

(B) 

(C) 

(D) 

29. Which of the following cannot be emitted by radioactive substances during their decay ?

[AIEEE - 2003]

(A) Protons (B) Neutrinos (C) Helium nuclei (D) Electrons

30. A 280 days old radioactive substance shows an activity of 6000 dps, 140 days later it's activity becomes 3000dps. What was its initial activity.

[JEE 2004 (Scr)]

(A) 20000 dps (B) 24000 dps (C) 12000 dps (D) 6000 dps