Nuclear and Radioactivity Assignment

1. For uranium nucleus how does its mass vary with volume

(a) $m \propto V$ (b) $m \propto 1/V$ (c) $m \propto \sqrt{V}$ (d) $m \propto V^2$

2. The order of radius of the nucleus of an atom is

(a) 10^{-10} *m* (b) 10^{-12} *m* (c) 10^{-15} *m* (d) 10^{-17} *m*

3. Two protons exert a nuclear force on each other, the distance between them is

(a) 10^{-14} *m* (b) 10^{-10} *m* (c) 10^{-12} *m* (d) 10^{-8} *m*

4. Oxygen is more stable than nitrogen because

(a) Atomic number of oxygen is greater than that of nitrogen (b) The atomic weight of oxygen is less when compared to iron

(c) Oxygen helps burning (d) Oxygen has equal number of protons and neutrons

5. The sodium nucleus $^{23}_{11}Na$ contains

(a) 11 electrons (b) 12 protons (c) 23 protons (d) 12 neutrons

6. The electron emitted in beta radiation originates from

(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

7. The mass number of a nucleus is always

(a) Equal to atomic number (b) Less than atomic number (c) More than atomic number (d) Either (a) or (c)

8. In the given particles, which of the following is stable

(a) Electron (b) Proton (c) Positron (d) Neutron

9. 1 *amu* is equal to (QBP-64)

(a) 1 *g* (b) 4.8×10^{-10} *esu* (c) 6.023×10^{23} *g* (d) 1.66×10^{-27} *kg*

10. The density of nucleus in kg/m^3 is of the order of

(a) 10^4 (b) 10^9 (c) 10^{13} (d) 10^{17}

11. Fertile material among the following is

(a) U^{233} (b) U^{238} (c) U^{235} (d) Pu^{239}

12. The force between a neutron and a proton inside the nucleus is

(a) Only nuclear attractive (b) Only Coulomb force (c) Both of the above (d) None of these

13. 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 $eV = 1.6 \times 10^{-19}$ *J*)

(a) 3.125×10^{13} (b) 3.125×10^{14} (c) 3.125×10^{15} (d) 3.125×10^{16}

14. $M_P = 1.008$ *amu*, $Mn = 1.009$ *amu* and $M_{\ {}_2He^4} = 4.003$ *amu* then the binding energy of α-particle is

(a) 21.4 *MeV* (b) 8.2 *MeV* (c) 34 *MeV* (d) 28.8 *MeV*

15. The rest energy of an electron is 0.511 *MeV*. The electron is accelerated from rest to a velocity 0.5 *c*. The change in its energy will be

(a) 0.026 *MeV* (b) 0.051 *MeV* (c) 0.079 *MeV* (d) 0.105 *MeV*

16. 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

(a) 3.52 (b) 3.64 (c) 4.23 (d) 7.86

17. 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 $_1H^2 + {}_1H^2 \rightarrow {}_2He^4 + Q$

(a) 4 ($x_1 + x_2$) (b) 4 ($x_2 - x_1$) (c) 2 ($x_1 + x_2$) (d) 2 ($x_2 - x_1$)

18. The function of the control rods in nuclear reactor is

(a) Absorb neutrons (b) Accelerate neutrons (c) Slow down neutrons (d) No effect on neutrons

19. Complete the reaction $n + {}^{235}_{92}U \rightarrow {}^{144}_{56}Ba + ... + 3n$

(a) $^{89}_{36}Kr$ (b) $^{90}_{36}Kr$ (c) $^{91}_{36}Kr$ (d) $^{92}_{36}Kr$

20. Heavy water is ……

(a) Water, in which soap does not lather (b) Compound of heavy oxygen and heavy hydrogen

(c) Compound of deuterium and oxygen (d) Water at 4°*C*

21. The nuclear reactor at Kaiga is a ……

(a) Breeder reactor (b) Power reactor (c) Research reactor (d) Fusion reactor

22. The principle of controlled chain reaction is used in

(a) Atomic energy reactor (b) Atom bomb (c) In the core of sun (d) Artificial radioactivity

23. In the following reaction the value of '*X*' is

$${}_7N^{14} + {}_2He^4 \rightarrow X + {}_1H^1$$

(a) ${}_8N^{17}$ (b) ${}_8O^{17}$ (c) ${}_7O^{16}$ (d) ${}_7N^{16}$

24. What was the fissionable material used in bomb dropped at Nagasaki (Japan) in the year 1945

(a) Uranium (b) Nepturium (c) Berkalium (d) Plutonium

25. The atomic number and the mass number of an atom remains unchanged when it emits

(a) A photon (b) A neutron (c) β-particle (d) An α-particle

26. Light energy emitted by stars is due to

(a) Breaking of nuclei (b) Joining of nuclei (c) Burning of nuclei (d) Reflection of solar light

27. A nuclear reaction given by ${}_ZX^A \rightarrow {}_{Z+1}Y^A + {}_{-1}e^0 + \overline{p}$ represents

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

28. 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

29. 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 number for A_4

(a) 172 and 69 (b) 174 and 70 (c) 176 and 69 (d) 176 and 70

30. Which of the following is in the increasing order for penetrating power

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

31. Which of the following is a correct statement

(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

32. 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

33. An element *A* decays into element *C* by a two step process

$A \rightarrow B + {}_2He^4$

$B \rightarrow C + 2e^-$, then

(a) *A* and *C* are isotopes (b) *A* and *C* are isobars (c) *A* and *B* are isotopes (d) *A* and *B* are isobars

34. In the disintegration series ${}^{238}_{92}U \xrightarrow{\alpha} X \xrightarrow{\beta-} {}^{A}_{Z}Y$ the value of Z and A respectively will be

(a) 92, 236 (b) 88, 230 (c) 90, 234 (d) 91, 234

35. The α-particle is the nucleus of an atom of

(a) Neon (b) Hydrogen (c) Helium (d) Deuterium

36. An atomic nucleus ${}_{90}Th^{232}$ emits several α and β radiations and finally reduces to ${}_{82}Pb^{208}$. It must have emitted

(a) 4α and 2β (b) 6α and 4β (c) 8α and 24β (d) 4α and 16β

37. Which of the following radiations has the least wavelength

(a) *X*-rays (b) γ-rays (c) β-rays (d) α-rays

38. 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

(a) MRI (b) PET (c) CAT (d) SPECT

39. Which of the following rays are not electromagnetic waves

(a) γ-rays (b) β-rays (c) Heat rays (d) X-rays

40. The half-life of a radioactive substance against α-decay is 1.2×10^7 *s*. What is the decay rate for 4.0×10^{15} atoms of the substance

(a) 4.6×10^{12} *atoms/s* (b) 2.3×10^{11} *atoms/s* (c) 4.6×10^{10} *atoms/s* (d) 2.3×10^{8} *atoms/s*

41. 10 *gm* of radioactive material of half-life 15 year is kept in store for 20 years. The disintegrated material is

(a) 12.5 *g* (b) 10.5 *g* (c) 6.03 *g* (d) 4.03 *g*

42. If half-life of a substance is 3.8 days and its quantity is 10.38 *gm*. Then substance quantity remaining left after 19 days will be

(a) 0.151 *gm* (b) 0.32 *gm* (c) 1.51 *gm* (d) 0.16 *gm*

43. Decay constant of radium is λ. By a suitable process its compound radium bromide is obtained. The decay constant of radium bromide will be

(a) λ (b) More than λ (c) Less than λ (d) Zero

44. 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

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

45. If the decay or disintegration constant of a radioactive substance is λ, then its half life and mean life are respectively ($\log_e 2$ can also be written as log 2)

(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 $\frac{1}{\lambda}$

46. The activity of a radioactive sample is 1.6 *curie*, and its half-life is 2.5 days. Its activity after 10 days will be

(a) 0.8 *curie* (b) 0.4 *curie* (c) 0.1 *curie* (d) 0.16 *curie*

47. The half-life of $^{42}_{19}K$ is 12.5 hours. If the original sample of it contained 256 *gm*., the amount of $^{42}_{19}K$ after 100 hours will be

(a) 1.00 *gm* (b) 2.00 *gm* (c) 2.56 *gm* (d) 5.12 *gm*

48. N_0 is the number of radioactive atoms at any instant and *N* is the number of the radioactive atoms remaining undecayed after time *t*. The graph drawn with $\log_e N$, where *e* is the base of natural logarithm along *y*-axis and *t* along the *X*-axis will be a straight line with slope

(a) λ (b) $-\lambda$ (c) $\frac{1}{\lambda}$ (d) $-\frac{1}{\lambda}$

49. 1 *mg* of radioactive substance has 2.68×10^{18} nuclei. Its half-life is 1620 year. After 3240 years how many nuclei would have disintegrated

(a) 1.82×10^{18} (b) 1.34×10^{18} (c) 0.67×10^{18} (d) 2.01×10^{18}

50. What fraction of radioactive material will get disintegrated in a period of two half-lives

(a) Whole (b) Half (c) One-fourth (d) Three-fourth