21. Nuclear Chemistry- Multiple Choice Questions

1. Nucleus (Stability and Reaction)

1. The nucleus of radioactive element possesses

(a) Low binding energy (b) High binding energy

(c) Zero binding energy (d) High otential energy

2. Positron has nearly the same weight as that of

(a) α -particle (b) Proton

(c) Neutron (d) Electron

3. On comparing chemical reactivity of C^{12} and C^{14}, it is revealed that

(a) C^{12} is more reactive (b) C^{14} is more reactive

(c) Both are inactive (d) Both are equally active

4. Positronium is the name given to an atom-like combination formed between

(a) A positron and a proton

(b) A positron and a neutron

(c) A positron and α -particle

(d) A positron and an electron

5. ${}_6C^{14}$ is formed from ${}_7N^{14}$ in the upper atmosphere by the action of the particle

(a) Positron (b) Neutron

(c) Electron (d) Proton

6. Formation of nucleus from its nucleons is accompanied by

(a) Decrease in mass (b) Increase in mass

(c) No change of mass (d) None of them

7. The positron was discovered by

(a) Pauling (b) Anderson

(c) Yukawa (d) Segar

8. Which of the following atomic mass of uranium is the most radioactive

(a) 238 (b) 235

(c) 226 (d) 248

9. The measure of binding energy of a nucleus is the

(a) Mass defect (b) Energy of protons

(c) Energy of neutrons (d) Total energy of nucleons

10. In the nuclear reaction ${}^{9}_{4}Be(p,\alpha)X$, X is

(a) ${}^{4}_{2}He$ (b) ${}^{6}_{3}Li$

(c) ${}^{7}_{3}Li$ (d) ${}^{8}_{4}Be$

11. The binding energy of ${}_8O^{16}$ is 127 *MeV*. Its binding energy per nucleon is

(a) 0.794 *MeV* (b) 1.5875 *MeV*

(c) 7.94 *MeV* (d) 15.875 *MeV*

12. ${}_ZX^M + {}_2He^4 \rightarrow {}_{15}P^{30} + {}_0r^1$. Then

(a) $Z = 12, M = 27$ (b) $Z = 13, M = 27$

(c) $Z = 12, M = 17$ (d) $Z = 13, M = 28$

13. What is the packing fraction of ${}^{56}_{26}Fe$ (Isotopic mass = 55.92066)

(a) –14.167 (b) 173.90

(c) –14.187 (d) –73.90

14. The missing particle in the reaction, ${}^{235}_{92}U + {}^{1}_{0}n \rightarrow {}_{56}Ba^{146} + \ldots + 3{}^{1}_{0}n$ is

(a) ${}^{87}_{32}Ge$ (b) ${}^{89}_{35}Br$

(c) ${}^{87}_{36}Kr$ (d) ${}^{86}_{35}Br$

15. Stable nuclides are those whose n/p ratio is

(a) $n/p = 1$ (b) $n/p = 2$

(c) $n/p > 1$ (d) $n/p < 1$

16. Which of the following is the most stable atom

(a) Bi (b) Al

(c) U (d) Pb

17. Doubly magic nucleus is .....

(a) ${}_{82}Pb^{207}$ (b) ${}_{82}Pb^{206}$

(c) ${}_{82}Pb^{208}$ (d) ${}_{83}Bi^{209}$

18. Which can be used for carrying out nuclear reaction

(a) Uranium – 238 (b) Neptunium – 239

(c) Thorium – 232 (d) Plutonium – 239

19. In the sequence of following nuclear reactions

$${}_{92}X^{238} \xrightarrow{-\alpha} Y \xrightarrow{-\beta} Z \xrightarrow{-\beta} L \xrightarrow{-n\alpha} {}_{84}M^{218}$$

the value of n will be

(a) 3 (b) 4

(c) 5 (d) 6

20. $X \xrightarrow{-\alpha} Y \xrightarrow{-\beta} Z \xrightarrow{-\beta} W$

In the above sequence of reaction, the elements which are isotopes of each other are

(a) X and W (b) Y and Z

(c) X and Z (d) None of these

21. Identify the nuclear reaction that differs from the rest

(a) Positron emission (b) K– capture

(c) β–decay (d) α–decay

(e) γ – decay

22. The pair of atoms having the same number of neutrons is

(a) ${}^{12}_{6}C, {}^{24}_{12}Mg$ (b) ${}^{23}_{11}Na, {}^{19}_{9}F$

(c) ${}^{23}_{11}Na, {}^{24}_{12}Mg$ (d) ${}^{23}_{11}Na, {}^{39}_{19}K$

2. Radioactivity and α, β and γ - Rays

1. Radioactivity was discovered by

(a) Henry Becquerel (b) Rutherford

(c) J. J. Thomson (d) Madam- Curie

2. Uranium ultimately decays into a stable isotope of

(a) Radium (b) Carbon

(c) Lead (d) Neptunium

3. If radium and chlorine combine to form radium chloride, the compound would be

(a) Half as radioactive as radium

(b) Twice as radioactive

(c) As radioactive as radium

(d) Not radioactive

4. A nuclear reaction is accompanied by loss of mass equivalent to $0.01864\ amu$. Energy liberated is

(a) $931\ MeV$ (b) $186.6\ MeV$

(c) $17.36\ MeV$ (d) $460\ MeV$

5. Nuclear theory of the atom was put forward by

(a) Rutherford (b) Aston

(c) Neils Bohr (d) J.J. Thomson

6. Which of the following has the highest value of radioactivity

(a) 1 g of Ra (b) 1 g of $RaSO_4$

(c) 1 g of $RaBr_2$ (d) 1 g of $Ra(HPO_4)$

7. Penetrating power of α-particle is

(a) More than γ-rays (b) More than β-rays

(c) Less than β-rays (d) None of these

8. Of the following radiations, the one most easily stopped by air is

(a) α -rays (b) β -rays

(c) γ -rays (d) X-rays

9. What is the correct order of velocity of alpha (α), beta (β) and gamma (γ) rays

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

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

10. The relative penetrating power of α, β, γ and neutron (n) follows the order

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

(c) $\beta > \alpha > n > \gamma$ (d) None of these

11. Highest ionising power is exhibited by

(a) α – rays (b) β – rays

(c) γ – rays (d) X – rays

12. In successive emission of α and β particles, how many α and β particles should be emitted for the natural $(4n+1)$ series, conversion of ${}_{94}Pu^{241}$ to ${}_{92}U^{233}$

(a) α, β (b) $\alpha, 2\beta$

(c) $2\alpha, 3\beta$ (d) $2\alpha, 2\beta$

13. Which of the following does not contain material particles

(a) Alpha rays (b) Beta rays

(c) Gamma rays (d) Canal rays

14. When ${}_{3}Li^{7}$ is bombarded with proton, γ-rays are produced. The nuclide formed is

(a) ${}_{3}Li^{8}$ (b) ${}_{4}Be^{8}$

(c) ${}_{3}B^{9}$ (d) ${}_{4}Be^{9}$

3. Causes of Radioactivity and Group Displacement Law

1. In the reaction, $Po \xrightarrow{-\alpha} Pb \xrightarrow{-\beta} Bi$, if Bi, belongs to group 15, to which Po belongs

(a) 14 (b) 15

(c) 13 (d) 16

2. ${}_{95}Am^{241}$ and ${}_{90}Th^{234}$ belong respectively to

(a) $4n$ and $4n+1$ radioactive disintegration series

(b) $4n+1$ and $4n+2$ radioactive disintegration series

(c) $4n+1$ and $4n+3$ radioactive disintegration series

(d) $4n+1$ and $4n$ radioactive disintegration series

3. The number of α and β - particles emitted in the nuclear reaction ${}_{90}Th^{228} \rightarrow {}_{83}Bi^{212}$ are respectively

(a) 4, 1 (b) 3, 7

(c) 8, 1 (d) 4, 7

4. Identify [A] and [B] in the following ${}^{227}_{89}Ac \xrightarrow{-\beta} [A] \xrightarrow{-\alpha} [B] \xrightarrow{-\alpha} Rn$

(a) Po, Rn (b) Th, Po

(c) Ra, Th (d) Th, Ra

5. Which element is the end product of each natural radioactive series

(a) Sn (b) Bi

(c) Pb (d) C

6. $^{27}_{13}Al$ is a stable isotope. $^{29}_{13}Al$ is expected to disintegrate by

(a) α -emission (b) β -emission

(c) Positron emission (d) Proton emission

7. Which one of the following notations shows the product incorrectly

(a) $^{242}_{96}Cm(\alpha,2n)^{243}_{97}Bk$ (b) $^{10}_{5}B(\alpha,n)^{13}_{7}N$

(c) $^{14}_{7}N(n,p)^{14}_{6}C$ (d) $^{28}_{14}Si(d,n)^{29}_{15}P$

8. The radioactive series whose end product is $^{209}_{83}Bi$ is

(a) Thorium series (b) Fourier series

(c) Actinium series (d) Neptunium series

9. In the nuclear reaction $_{92}U^{238} \rightarrow {}_{82}Pb^{206}$, the number of alpha and beta particles decayed are

(a) $4\alpha, 3\beta$ (b) $8\alpha, 6\beta$

(c) $6\alpha, 4\beta$ (d) $7\alpha, 5\beta$

10. An artificial radioactive isotope gave $^{14}_{7}N$ after two successive $\beta-$particle emissions. The number of neutrons in the parent nucleus must be

(a) 9 (b) 14

(c) 5 (d) 7

11. Tritium undergoes radioactive decay giving

(a) α -particles (b) β -particles

(c) Neutrons (d) None of these

12. If it is assumed that $^{235}_{92}U$ decays only by emitting α and β -particles, the possible product of the decay is

(a) $^{225}_{89}Ac$ (b) $^{227}_{89}Ac$

(c) $^{230}_{89}Ac$ (d) $^{231}_{89}Ac$

13. If a noble gas emits one α-particle then it will be shifted in group

(a) 2 (b) 3

(c) 16 (d) 17

14. When radium atom, which is placed in II group, loses an α - particle, a new element is formed which should be placed in group

(a) Second (b) First

(c) Fourth (d) Zero

15. $_{92}U^{235}$ belongs to group III B of periodic table. If it loses one α -particle, the new element will belong to group

(a) I B (b) I A

(c) III B (d) V B

16. During the transformation of $^{b}X_{a} \rightarrow {}^{d}Y_{c}$ the number of β-particles emitted is

(a) $\frac{(b-d)}{4}$ (b) $(c-a)+\frac{1}{2}(b-d)$

(c) $(a-c)-\frac{1}{2}(b-d)$ (d) $(b-d)+2(c-a)$

(e) $(b-d)+\frac{1}{2}(c-a)$

17. In the nuclear reaction $^{234}_{90}Th \rightarrow {}^{234}_{91}Pa + X$. X is

(a) $^{0}_{-1}e$ (b) $^{0}_{1}e$

(c) H (d) $^{2}_{1}H$

18. In the radioactive disintegration series $^{232}_{90}Th \rightarrow {}^{208}_{82}Pb$, involving α and β decay, the total number of α and β particles emitted are

(a) 6α and 6β (b) 6α and 4β

(c) 6α and 5β (d) 5α and 6β

4. Rate of Decay and Half-Life

1. Half-life period of a metal is 20 days. What fraction of metal remains after 80 days

(a) 1 (b) 1/16

(c) 1/4 (d) 1/8

2. A radioactive isotope having a half-life of 3 days was received after 12 days. It was found that, there were 3 g of the isotope in the container. The initial weight of the isotope when packed was

(a) 12 g (b) 24 g

(c) 36 g (d) 48 g

3. If 12 g of sample is taken, and 6 g of a sample decays in 1 hr. The amount of sample showing decay in next hour is

(a) 3 g (b) 1 g

(c) 2 g (d) 6 g

4. The half-life of $^{90}_{38}Sr$ is 20 *years*. If its sample having initial activity of 8000 *dis/min* is taken, what would be its activity after 80 *years*

(a) 500 *dis/min* (b) 800 *dis/min*

(c) 1000 *dis/min* (d) 1600 *dis/min*

5. A radioactive isotope has a half-life of 10 days. If today 125 mg is left over, what was its original weight 40 days earlier

(a) 2g (b) 600 mg

(c) 1 g (d) 1.5 g

6. Half-life of a radioactive substance is 120 days. After 480 days, 4 g will be reduced to

(a) 2 (b) 1

(c) 0.5 (d) 0.25

7. Radium has atomic weight 226 and a half-life of 1600 years. The number of disintegrations produced per second from 1g are

(a) 4.8×10^{10} (b) 9.2×10^{6}

(c) 3.7×10^{10} (d) Zero

8. In the case of a radio isotope the value of $T_{1/2}$ and λ are identical in magnitude. The value is

(a) 0.693 (b) $(0.693)^{1/2}$

(c) 1/0.693 (d) $(0.693)^{2}$

9. The half-life of radioactive sodium is 15.0 hours. How many hours would it take for 64 gms of sodium to decay one-eighth of its original value

(a) 3 (b) 15

(c) 30 (d) 45

10. The decay constant of Ra^{226} is $1.37\times10^{-11}s^{-1}$. A sample of Ra^{226} having an activity of 1.5 millicurie will contain ..... atoms

(a) 4.1×10^{18} (b) 3.7×10^{17}

(c) 2.05×10^{15} (d) 4.7×10^{10}

11. A wood piece is 11460 *years* old. What is the fraction of ^{14}C activity left in the piece (Half-life period of ^{14}C is 5730 *years*)

(a) 0.12 (b) 0.25

(c) 0.50 (d) 0.75

12. If the amount of radioactive substance is increased three times, the number of atoms disintegrated per unit time would

(a) Be double (b) Be triple

(c) Remain one third (d) Not change

13. If n_t number of radioatoms are present at time t, the following expression will be a constant

(a) n_t / t (b) $\ln n_t / t$

(c) $d\ln n_t / dt$ (d) $t.n_t$

14. The half-life of a radioactive element is 10 hours. How much will be left after 4 hours in 1 g atom sample

(a) 45.6×10^{23} atoms (b) 4.56×10^{23} atoms

(c) 4.56×10^{24} atoms (d) 4.56×10^{25} atoms

15. 2 g of a radioactive sample having half life of 15 days was synthesised on 1st Jan 2009. The amount of the sample left behind on 1st March, 2009 (including both the days)

(a) 0.125 g (b) 1 g

(c) 0.5 g (d) 0 g

16. When a radioactive substance is kept in vacuum, the rate of its disintegration per second

(a) Increases considerably

(b) Is not affected

(c) Suffers a slight decrease

(d) Increases only if the products are gaseous

17. The half-life period of a radioactive substance is 140 *days*. After how much time 15 g will decay from 16 g sample of it

(a) 140 *days* (b) 560 *days*

(c) 280 *days* (d) 420 *days*

18. The half-life period $t_{1/2}$ of a radioactive element is N years. The period of its complete decay is

(a) N^2 *years* (b) $2N$ *years*

(c) $\frac{1}{2}N^2$ *years* (d) Infinity

19. The half-life period of a radioactive material is 15 minutes. What % of radioactivity of that material will remain after 45 minutes

(a) 10 % (b) 12.5%

(c) 15% (d) 17.5%

20. The half-life for decay of ^{14}C by β -emission is 5730 years. The fraction of ^{14}C decays, in a sample that is 22,920 years old, would be

(a) 1/8 (b) 1/16

(c) 7/8 (d) 15/16

21. A radioactive nuclide X decays at the rate of 1.00×10^{5} disintegration $s^{-1}g^{-1}$. Radium decays at the rate of 3.70×10^{10} disintegration $s^{-1}g^{-1}$. The activity of X in millicurie g^{-1} $(mci\,g^{-1})$ is

(a) 0.027 (b) 0.270×10^{-5}

(c) 0.00270 (d) 0.000270

22. The half lives of two radioactive nuclides A and B are 1 and 2 min. respectively. Equal weights of A and B are taken separately and allowed to disintegrate for 4 min. What will be the ratio of weights of A and B disintegrated

(a) 1 : 1 (b) 5 : 4

(c) 1 : 2 (d) 1 : 3

23. A radioactive element gets spilled over the floor of a room. Its half-life period is 30 days. If the initial activity is ten times the permissible value; after how many days will it be safe to enter the room

(a) 1000 *days* (b) 300 *days*

(c) 10 *days* (d) 100 *days*

24. 1.0g of a radioactive isotope was found to reduce to 125mg after 24 hours. The half-life of the isotope is

(a) 8 *hours* (b) 24 *hours*

(c) 6 *hours* (d) 4 *hours*

25. What is the half-life of a radioactive substance if 75% of a given amount of the substance disintegrates in 30 minutes

(a) 7.5 *min* (b) 25 *min*

(c) 20 *min* (d) 15 *min*

26. The radioisotope of hydrogen has a half–life of 12.33 *y*. What is the age of an old bottle of wine whose ${}_1^3H$ radiation is 10% of that present in a new bottle of wine

(a) 41 *y* (b) 123.3 *y*

(c) 1.233 *y* (d) 410 *y*

27. $10g$ of a radioactive substance is reduced to $1.25g$ after 15 days. Its $1kg$ mass will reduce to $500g$ in

(a) 500 *days* (b) 125 *days*

(c) 25 *days* (d) 5 *days*

28. What will be half-life period of a nucleus if at the end of 4.2 *days*, $N = 0.798N_0$

(a) 15 *days* (b) 10 *days*

(c) 12.83 *days* (d) 20 *days*

29. If 2.0 *g* of a radioactive substance has half-life of 7 *days*. The half-life of 1 *g* sample is

(a) 7 *days* (b) 14 *days*

(c) 28 *days* (d) 35 *days*

30. Half-life period of a radioactive element is 10.6 *yr*. How much time will it take in its 99% decomposition

(a) 7046 *yr* (b) 7.046 *yr*

(c) 704.6 *yr* (d) 70.4 *yr*

31. Half-life of a radioactive substance which disintegrates by 75 % in 60 *minutes*, will be

(a) 120 *min* (b) 30 *min*

(c) 45 *min* (d) 20 *min*

32. Half-life of a radioactive disintegration ($A \rightarrow B$) having rate constant $231s^{-1}$ is

(a) 3.0×10^{-2} *s* (b) 3.0×10^{-3} *s*

(c) 3.3×10^{-2} *s* (d) 3.3×10^{-3} *s*

33. The activity of carbon-14 in a piece of an ancient wood is only 12.5%. If the half-life period of carbon-14 is 5760 years, the age of the piece of wood will be $(\log 2 = 0.3010)$

(a) 17.281×10^2 *years* (b) 172.81×10^2 *years*

(c) 1.7281×10^2 *years* (d) 1728.1×10^2 *years*

34. A wood specimen from an archaeological centre shows a ${}_6^{14}C$ activity of 5.0 *counts/min/gm* of carbon. What is the age of the specimen ($t_{1/2}$ for ${}_6^{14}C$ is 5000 *years*) and a freshly cut wood gives 15 *counts/min/g* of carbon

(a) 5.78×10^4 *years* (b) 9.85×10^4 *years*

(c) 7.85×10^3 *years* (d) 0.85×10^4 *years*

35. A radioactive element has a half-life of 20 *minutes*. How much time should elapse before the element is reduced to $\frac{1}{8}th$ of the original mass

(a) 40 *min*

(b) 60 *min*

(c) 80 *min*

(d) 160 *min*

36. The activity of a radioactive nuclide is 2×10^7 disintegrations per minute (dpm). After 23.03 minutes, its activity is reduced to 2×10^6 dpm. What is the average life (in min) of this nuclide

(a) 1000 (b) 10

(c) 1 (d) 0.1

37. The age of a specimen, *t*, is related to the daughter/parent ratio D/P by the equation

(a) $t = \frac{1}{\lambda}\ln\frac{D}{P}$ (b) $t = \frac{1}{\lambda}\ln\left(1+\frac{P}{D}\right)$

(c) $t = \frac{1}{\lambda}\ln\left(1+\frac{D}{P}\right)$ (d) $t = \frac{1}{\lambda}\ln\left(2+\frac{P}{D}\right)$

38. The half-life period of Uranium is 4.5 billion years. After 9.0 billion years, the number of moles of Helium liberated from the following nuclear reaction will be

$${}_{92}U^{238} \rightarrow {}_{90}Th^{234} + {}_2He^4$$

(a) 0.75 *mole* (b) 1.0 *mole*

(c) 11.2 *mole* (d) 22.4 *mole*

39. $8g$ of the radioactive isotope, cesium-137 were collected on February 1 and kept in a sealed tube. On July 1, it was found that only $0.25g$ of it remained. So the half-life period of the isotope is

(a) 37.5 *days* (b) 30 *days*

(c) 25 *days* (d) 50 *days*

40. The C^{14} to C^{12} ratio in a wooden article is 13% that of the fresh wood. Calculate the age of the wooden article. Given that the half-life of C^{14} is 5770 years

(a) 16989 *years* (b) 16858 *years*

(c) 15675 *years* (d) 17700 *years*

41. $T_{1/2}$ of C^{14} isotope is 5770 years. Time after which 72% of isotope left is

(a) 2740 *years* (b) 274 *years*

(c) 2780 *years* (d) 278 *years*

42. A piece of wood was found to have C^{14}/C^{12} ratio 0.7 *times* that in a living plant. The time period when the plant died is (Half-life of $C^{14} = 5760\,yr$)

(a) 2770 *yr* (b) 2966 *yr*

(c) 2980 *yr* (d) 3070 *yr*

43. The radium and uranium atoms in a sample of uranium mineral are in the ratio of $1:2.8\times10^6$. If half-life period of radium is 1620 years, the half-life period of uranium will be

(a) 45.3×10^9 years (b) 45.3×10^{10} years

(c) 4.53×10^9 years (d) 4.53×10^6 years

44. A sample of rock from moon contains equal number of atoms of uranium and lead ($t_{1/2}$ for $U=4.5\times10^9$ years). The age of the rock would be

(a) 9.0×10^9 *years* (b) 4.5×10^9 *years*

(c) 13.5×10^9 *years* (d) 2.25×10^9 *years*

45. Radioactivity of a sample $(Z=22)$ decreases 90% after 10 years. What will be the half- life of the sample

(a) 5 *years* (b) 2 *years*

(c) 3 *years* (d) 10 *years*

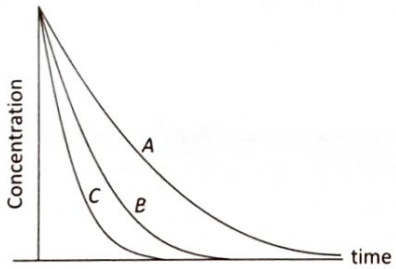
46. Two radioactive elements X and Y have half– lives of 6 min and 15 min respectively. An experiment starts with 8 times as many atoms of Y as X. How long it takes for the number of atoms of X left equals the number of atoms of Y left

(a) 6 *min* (b) 12 *min*

(c) 48 *min* (d) 30 *min*

(e) 24 *min*

47. The decay profiles of three radioactive species *A*, *B*, and *C* are given below



These profiles imply that the decay constants k_A, k_B and k_C follow the order

(a) $k_A > k_B > k_C$ (b) $k_A > k_C > k_B$

(c) $k_B > k_A > k_C$ (d) $k_C > k_B > k_A$

5. Artificial Transmutation

1. The age of most ancient geological formation is estimated by

(a) Potassium – Argon method

(b) Carbon – 14 dating method

(c) Radium – Silicon method

(d) Uranium – Lead method

2. The reaction ${}_{13}Al^{27} + {}_2He^4 \rightarrow {}_{14}Si^{30} + {}_1H^1$ is of the type

(a) Nuclear fusion (b) Nuclear fission

(c) Chemical reaction (d) Transmutation

3. The first artificial disintegration of an atomic nucleus was achieved by

(a) Geiger (b) Wilson

(c) Madame curie (d) Rutherford

(e) Soddy

4. Radioactive carbon dating was discovered by

(a) W.F. Libby (b) G.N. Lewis

(c) J. Willard Gibbs (d) W. Nernst

5. A possible material for use in the nuclear reactors as a fuel is

(a) Thorium (b) Zirconium

(c) Beryllium (d) Plutonium

6. Which one of the following radioactive isotope is used in the treatment of blood cancer

(a) P^{32} (b) I^{131}

(c) Co^{60} (d) Na^{24}

7. To determine the masses of the isotopes of an element, which of the following techniques is useful

(a) The acceleration of charged atoms by an electric field and their subsequent deflection by a variable magnetic field

(b) The spectroscopic examination of the light emitted by vaporised elements subjected to electric discharge

(c) The photographing of the diffraction patterns which arise when X-rays are passed through crystals

(d) The bombardment of metal foil with alpha particles

8. If two light nuclei are fused together in nuclear reaction, the average energy per nucleon

(a) Increases (b) Cannot be determined

(c) Remains same (d) Decreases

9. Match List I and List II and choose right one by using code given in list

List I (Nuclear reactor Component)	List II (Used substance)
1. Moderator	(A) Uranium
2. Control rods	(B) Graphite
3. Fuel rods	(C) Boron
4. Coolent	(D) Lead
	(E) Sodium

Code :

	1	2	3	4
(a)	B	A	C	E
(b)	B	C	A	E
(c)	C	B	A	E
(d)	C	D	A	B
(e)	D	C	B	A

10. When nuclear energy is intended to be harnessed for generation of electricity, potentially destructive neutron released in a nuclear reactor are absorbed by

(a) Long rods of *Cd* (b) Heavy water

(c) Cubical blocks of steel (d) Both (a) and (c)

11. The reaction $_1H^2 + _1H^3 \rightarrow _2He^4 + _0n^1 + \text{energy}$ represents

(a) Nuclear fission

(b) Nuclear fusion

(c) Artificial disintegration

(d) Transmutation of element

12. The radioactive isotope $^{60}_{27}Co$ which is used in the treatment of cancer can be made by (n, p) reaction. For this reaction the target nucleus is

(a) $^{60}_{28}Ni$ (b) $^{60}_{27}Co$

(c) $^{59}_{28}Ni$ (d) $^{59}_{27}Co$

13. Which is least effective for artificial transmutation

(a) Deuterons (b) Neutrons

(c) α-particles (d) Protons

14. $C-14$ is used in carbon dating of dead objects because

(a) Its half-life is 10^3 years

(b) Its half-life is 10^4 years

(c) It is found in nature abundantly and in definite ratio

(d) It is found in dead animals abundantly

15. Which of the following cannot be accelerated

(a) α-particle (b) β-particle

(c) Protons (d) Neutrons

16. Which metal Aprons are worn by radiographer to protect him from radiation

(a) Mercury coated apron (b) Lead apron

(c) Copper apron (d) Aluminimised apron

17. When a slow neutron goes sufficiently close to a U^{235} nucleus, then the process which takes place is

(a) Fusion of U^{235} (b) Fission of U^{235}

(c) Fusion of neutron (d) First (a) then (b)

18. Sulphur-35 (34.96903 *amu*) emits a $\beta-$particle but no $\gamma-$rays, the product is chlorine-35 (34.96885 *amu*). The maximum energy emitted by the $\beta-$particle is

(a) 0.016767 *MeV* (b) 1.6758 *MeV*

(c) 0.16758 *MeV* (d) 16.758 *M*

6. Isotopes-Isotones and Nuclear Isomers

1. In treatment of cancer, which of the following isotope is used

(a) $_{53}I^{131}$ (b) $_{15}P^{32}$

(c) $_{27}Co^{60}$ (d) $_1H^2$

2. Isotope of uranium used in atomic bomb is

(a) $^{237}_{92}U$ (b) $^{238}_{92}U$

(c) $^{239}_{92}U$ (d) $^{235}_{92}U$

3. An isotope of 'parent' is produced, when its nucleus loses

(a) One α-particle

(b) One β-particle

(c) One α and two β-particles

(d) One β and two α - particles

4. Which of the following radioactive isotope is used for hyperthyroidism

(a) ^{60}Co (b) ^{32}P

(c) ^{131}I (d) ^{14}C

5. Which of the following statement is false

(a) In chlorine gas, the ratio of Cl^{35} and Cl^{37} is $1:3$

(b) The hydrogen bomb is based on the principle of nuclear fusion

(c) The atom bomb is based on the principle of nuclear fission

(d) The penetrating power of a proton is less than that of an electron

6. Which among the following isotope is not found in natural uranium

(a) $_{92}U^{234}$ (b) $_{92}U^{235}$

(c) $_{92}U^{238}$ (d) $_{92}U^{239}$

7. Which of the following species is isotonic with $_{37}Rb^{86}$

(a) $_{36}Kr^{84}$ (b) $_{37}Rb^{85}$

(c) $_{38}Sr^{87}$ (d) $_{39}Y^{89}$

8. Radioactive isotope of hydrogen is

(a) Tritium (b) Deuterium

(c) Para hydrogen (d) Ortho hydrogen

9. Isotopes were discovered by

(a) Aston (b) Soddy

(c) Thomson (d) Mullikan

10. An ordinary oxygen contains

(a) Only $O-16$ isotopes

(b) Only $O-17$ isotopes

(c) A mixture of $O-16$ and $O-18$ isotopes

(d) A mixture of $O-16$, $O-17$ and $O-18$ isotopes

11. Two atoms are said to be isobars if

(a) They have same atomic number but different mass number

(b) They have same number of electrons but different number of neutrons

(c) They have same number of neutrons but different number of electrons

(d) Sum of the number of protons and neutrons is same but the number of protons is different

12. $^{13}_6C$ and $^{14}_7N$ are the

(a) Isotopes (b) Isotones

(c) Isobars (d) Isosteres

7. IIT-JEE/ AIEEE

1. $^{23}_{11}Na$ is the more stable isotope of Na. Find out the process by which $^{24}_{11}Na$ can undergo radioactive decay **[2003]**

(a) β^- emission (b) α emission

(c) β^+ emission (d) K electron capture

2. If ${}_{92}U^{235}$ nucleus absorbs a neutron and disintegrates in ${}_{54}Xe^{139}$, ${}_{38}Sr^{94}$ and X, then what will be the product X **[2010]**

(a) α-particle (b) β-particle
(c) 2-neutrons (d) 3-neutrons

3. The radionuclide ${}^{234}_{90}Th$ undergoes two successive β-decays followed by one α-decay. The atomic number and the mass number respectively of the resulting radionuclide are **[2003]**

(a) 92 and 234 (b) 94 and 230
(c) 90 and 230 (d) 92 and 230

4. Bombardment of aluminium by α-particle leads to its artificial disintegration in two ways, (I) and (II) as shown. Products X, Y and Z respectively are, **[2011]**

$$\begin{array}{ccc} {}^{27}_{13}Al & \xrightarrow{\text{(ii)}} & {}^{30}_{15}P + Y \\ \text{(i)}\downarrow & & \downarrow \\ {}^{30}_{14}Si + X & & {}^{30}_{14}Si + Z \end{array}$$

(a) Proton, neutron, positron
(b) Neutron, positron, proton
(c) Proton, positron, neutron
(d) Positron, proton, neutron

5. The radiations from a naturally occurring radio element, as seen after deflection in a magnetic field in one direction, are **[1984]**

(a) Definitely α-rays (b) Definitely β-rays
(c) Both α and β-rays (d) Either α or β-rays

6. A photon of hard gamma radiation knocks a proton out of ${}^{24}_{12}Mg$ nucleus to form **[2005]**

(a) The isotope of parent nucleus
(b) The isobar of parent nucleus
(c) The nuclide ${}^{23}_{11}Na$
(d) The isobar of ${}^{23}_{11}Na$

7. The reaction which disintegrates neutron is **[1988]**

(a) ${}_{96}Am^{240} + {}_{2}He^{4} \rightarrow {}_{97}Bk^{244} + {}_{+1}e^{0}$
(b) ${}_{15}P^{30} \rightarrow {}_{14}Si^{30} + {}_{1}e^{0}$
(c) ${}_{6}C^{12} + {}_{1}H^{1} \rightarrow {}_{7}N^{13}$
(d) ${}_{13}Al^{27} + {}_{2}He^{4} \rightarrow {}_{15}P^{30}$

8. Consider the following nuclear reactions,

$${}^{238}_{92}M \rightarrow {}^{x}_{y}N + 2\,{}^{4}_{2}He$$

$${}^{x}_{y}N \rightarrow {}^{A}_{B}L + 2\beta^{+}$$

The number of neutrons in the element L is **[2004]**

(a) 140 (b) 144
(c) 142 (d) 146

9. If uranium (mass no. 238 and atomic no. 92) emits α-particle, the product has mass number and atomic number **[1981]**

(a) 234, 90 (b) 236, 92
(c) 238, 90 (d) 236, 90

10. The half-life period of a radioactive element is 140 days. After 560 days, one gram of the element will reduce to **[1986]**

(a) $1/2\,g$ (b) $1/4\,g$
(c) $1/8\,g$ (d) $1/16\,g$

11. The half-life of a radioisotope is four hours. If the initial mass of the isotope was 200 g, the mass remaining after 24 hours undecayed is **[2004]**

(a) 3.125 g (b) 2.084 g
(c) 1.042 g (d) 4.167 g

12. The half-life of a radioactive isotope is three hours. If the initial mass of the isotope were 256 g, the mass of it remaining undecayed after 18 *hours* would be **[2003]**

(a) 4.0 g (b) 8.0 g
(c) 12.0 g (d) 16.0 g

13. If half-life of a substance is 5 *yrs*, then the total amount of substance left after 15 *years*, when initial amount is 64 *grams* is **[2002]**

(a) 16 *grams* (b) 2 *grams*
(c) 32 *grams* (d) 8 *grams*

14. A freshly prepared radioactive source of half-life 2 hours emits radiations of intensity which is 64 times the permissible safe level. The minimum time after which it would be possible to work safely with this source is **[1988]**

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

15. The decay constant of a radioactive sample is 'λ'. The half-life and mean life of the sample are respectively **[1989]**

(a) $\frac{1}{\lambda}, \frac{\ln 2}{\lambda}$ (b) $\frac{\ln 2}{\lambda}, \frac{1}{\lambda}$
(c) $\lambda \ln 2, \frac{1}{\lambda}$ (d) $\frac{\lambda}{\ln 2}, \frac{1}{\lambda}$

16. In the transformation of ${}^{238}_{92}U$ to ${}^{234}_{92}U$, if one emission is an α-particle, what should be the other emission (s) **[2006]**

(a) Two β^{-} (b) Two β^{-} and one β^{+}
(c) One β^{-} and one γ (d) One β^{+} and one β^{-}

17. Given that the abundances of isotopes ${}^{54}Fe$, ${}^{56}Fe$ and ${}^{57}Fe$ are 5%, 90% and 5%, respectively, the atomic mass of Fe is **[2009]**

(a) 55.85 (b) 55.95
(c) 55.75 (d) 56.05

18. A positron is emitted from ${}^{23}_{11}Na$. The ratio of the atomic mass and atomic number of the resulting nuclide is **[2007]**

(a) 22/10 (b) 22/11
(c) 23/10 (d) 23/12

19. Which of the following nuclear reactions will generate an isotope **[2007]**

(a) Neutron particle emission
(b) Positron emission
(c) α – particle emission
(d) β – particle emission

20. The sum of the number of neutrons and proton in the radio isotope of hydrogen is **[1986]**

(a) 6 (b) 5
(c) 4 (d) 3

21. The triad of nuclei that is isotonic is **[1988]**

(a) ${}_6C^{14}, {}_7N^{15}, {}_9F^{17}$ (b) ${}_6C^{12}, {}_7N^{14}, {}_9F^{19}$
(c) ${}_6C^{14}, {}_7N^{14}, {}_9F^{17}$ (d) ${}_6C^{14}, {}_7N^{14}, {}_9F^{19}$

22. The most abundant elements by mass in the body of a healthy human adult are : Oxygen (61.4%); Carbon (22.9%), Hydrogen (10.0%); and Nitrogen (2.6%). The weight which a 75 *kg* person would gain if all ${}^1H$ atoms are replaced by ${}^2H$ atoms is **[2017]**

(a) 37.5 *kg* (b) 7.5 *kg*
(c) 10 *kg* (d) 15 *kg*

8. NEET/ AIPMT/ CBSE-PMT

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

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

2. In a radioactive decay, an emitted electron comes from **[1994]**

(a) Nucleus of the atom
(b) Inner orbital of the atom
(c) Outermost orbit of the atom
(d) Orbit having principal quantum number one

3. What happens when α-particle is emitted **[1989]**

(a) Mass number decreases by 12 unit, atomic number decreases by 4 unit
(b) Mass number decreases by 4 unit, atomic number decreases by 2 unit
(c) Only mass number decreases
(d) Only atomic number decreases

4. Number of neutrons in a parent nucleus X, which gives ${}_7N^{14}$ nucleus after two successive β emissions would be **[1998]**

(a) 9 (b) 8
(c) 7 (d) 6

5. After the emission of one α -particle followed by one $\beta-$ particle from the atom of ${}_{92}X^{238}$, the number of neutrons in the atom will be **[1995]**

(a) 142 (b) 146
(c) 144 (d) 143

6. The radioactive decay of ${}_{35}X^{88}$ by a beta emission produces an unstable nucleus which spontaneously emits a neutron. The final product is **[2001]**

(a) ${}_{37}X^{88}$ (b) ${}_{35}Y^{89}$
(c) ${}_{34}Z^{88}$ (d) ${}_{36}W^{87}$

7. A nuclide of an alkaline earth metal undergoes radioactive decay by emission of the α – particles in succession. The group of the periodic table to which the resulting daughter element would belong is **[2005]**

(a) *Gr.*14 (b) *Gr.*16
(c) *Gr.*4 (d) *Gr.*6

8. The radioisotope, tritium $({}_1^3H)$ has a half-life of 12.3 *years*. If the initial amount of tritium is 32 *mg*, how many milligrams of it would remain after 49.2 *years* **[2003]**

(a) 8 *mg* (b) 1 *mg*
(c) 2 *mg* (d) 4 *mg*

9. Half-life for radioactive C^{14} is 5760 years. In how many years $200mg$ of C^{14} sample will be reduced to $25mg$ **[1995]**

(a) 11520 *years* (b) 23040 *years*
(c) 5760 *years* (d) 17280 *years*

10. The half-life of ${}_6C^{14}$, if its decay constant is 6.31×10^{-4} is **[2001]**

(a) 1098 *yr* (b) 109.8 *yr*
(c) 10.98 *yr* (d) 1.098 *yr*

11. Carbon-14 dating method is based on the fact that **[1997]**

(a) Carbon-14 fraction is the same in all objects
(b) Carbon-14 is highly insoluble
(c) Ratio of carbon-14 and carbon-12 is constant
(d) All of these

9. AIIMS

1. Which of the following nuclear transformation is (n, p) type **[1980,83]**

(a) ${}_3Li^7 + {}_1H^1 \longrightarrow {}_4Be^7 + {}_0n^1$
(b) ${}_{33}As^{75} + {}_2He^4 \longrightarrow {}_{35}Br^{78} + {}_0n^1$
(c) ${}_{83}Bi^{209} + {}_1H^2 \longrightarrow {}_{84}Po^{210} + {}_0n^1$
(d) ${}_{21}Sc^{45} + {}_0n^1 \longrightarrow {}_{20}Ca^{45} + {}_1H^1$

2. What is X in the following nuclear reaction **[1983]**

${}_7N^{14} + {}_1H^1 \longrightarrow {}_8O^{15} + X$

(a) ${}_{+1}e^0$ (b) ${}_0n^1$
(c) γ (d) ${}_{-1}e^0$

3. Which is not emitted by radioactive substance **[1997]**

(a) α -rays (b) β -rays
(c) Positron (d) Proton

4. The ${}_{88}Ra^{226}$ is **[2001]**

(a) *n*-mesons (b) *u*-mesons
(c) Radioactive (d) Non-radioactive

5. ${}_6C^{12}$ and ${}_1T^3$ are formed in nature due to the nuclear reaction of neutron with **[2008]**

(a) ${}_7N^{14}$ (b) ${}_6C^{13}$
(c) ${}_2He^4$ (d) ${}_3Li^6$

6. The compound used in enrichment of uranium for nuclear power plant is **[2006]**

(a) U_3O_8 (b) UF_6

(c) $UO_2(NO_3)_2$ (d) UCl_4

7. α-particles can be detected using **[2005]**

(a) Thin aluminium sheet (b) Barium sulphate

(c) Zinc sulphide screen (d) Gold foil

8. $^{238}_{92}U$ emits 8 α-particles and 6 β-particles. The neutron/proton ratio in the product nucleus is **[2005]**

(a) 60/41 (b) 61/40

(c) 62/41 (d) 61/42

9. The highest binding energy per nucleon will be for **[2001]**

(a) Fe (b) H_2

(c) O_2 (d) U

10. $_{84}Po^{210} \longrightarrow {}_{82}Pb^{206} + {}_2He^4$. From the above equation, deduce the position of polonium in the periodic table (lead belongs to group IV A) **[1980]**

(a) II A (b) IV B

(c) VI B (d) VI A

11. The amount of $_{53}I^{128}$ ($t_{1/2} = 25$ minutes) left after 50 minutes will be **[1982]**

(a) One – half (b) One – third

(c) One – fourth (d) Nothing

12. Half-life of radium is 1580 *yr*. Its average life will be **[1999]**

(a) $2.5 \times 10^3\, yr$ (b) $1.832 \times 10^3\, yr$

(c) $2.275 \times 10^3\, yr$ (d) $8.825 \times 10^2\, yr$

13. Wooden article and freshly cut tree are show activity of 7.6 and $15.2\,min^{-1}\,g^{-1}$ of carbon ($t_{1/2} = 5760$ years) respectively. The age of the artifact is **[1980]**

(a) 5760 *years*

(b) $5760 \times \frac{15.2}{7.6}$ *years*

(c) $5760 \times \frac{7.6}{15.2}$ *years*

(d) $5760 \times (15.2 - 7.6)$ *years*

14. A substance used as a moderator in nuclear reactors is **[2001]**

(a) Cadmium (b) Uranium-235

(c) Lead (d) Heavy water

15. Whose number is common in isotopes **[1988]**

(a) Proton (b) Neutron

(c) Proton and neutron (d) Nucleon

10. 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 : An example of K-capture is $^{133}_{56}Ba + e^- \rightarrow {}^{133}_{55}Cs + X - ray$.

Reason : The atomic number decreases by one unit as result of K-capture.

2. Assertion : Breeder reactor produces fissile $_{94}Pu^{239}$ from non-fissile uranium.

Reason : A breeder reactor is one that produces more fissionable nuclei than it consumes.

3. Assertion : The activation energies for fusion reactions are very low.

Reason : They require very low temperature to overcome electrostatic repulsion between the nuclei.

4. Assertion : The archaeological studies are based on the radioactive decay of carbon-14 isotope.

Reason : The ratio of C-14 to C-12 in the animals and plants is same as that in the atmosphere.

5. 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. **[AIIMS 2006]**

6. Assertion : A nuclear binding energy per nucleon is in the order $^9_4Be > {}^7_3Li > {}^4_2He$.

Reason : Binding energy per nucleon increases linearly with difference in number of neutrons and protons.

7. Assertion : Nuclear fission is always accompanied by release of energy.

Reason : Nuclear fission is a chain process. **[AIIMS 1994]**

8. Assertion : Protons are more effective than neutrons of equal energy in causing artificial disintegration of atoms.

Reason : Neutrons are neutral so they penetrate the nucleus. **[AIIMS 1998]**

9. Assertion : A beam of electrons deflect more than a beam of α -particles in an electric field.

Reason : Electrons possess negative charge while α -particles possess positive charge. **[AIIMS 2002]**

10. Assertion : $^{22}_{11}Na$ emits a positron giving $^{22}_{12}Mg$.

Reason : In β^+ emission neutron is transformed into proton. **[AIIMS 1994]**

11. Assertions : Lead is most effective in shielding radiation.

Reason : It is very stable, and many radio-active reactions finally yield lead. **[MP PMT 2008]**

21. Nuclear Chemistry - Answers Keys

1. Nucleus (Stability and Reaction)

1	a	**2**	d	**3**	d	**4**	d	**5**	b
6	a	**7**	b	**8**	b	**9**	a	**10**	b
11	c	**12**	b	**13**	a	**14**	c	**15**	a
16	d	**17**	c	**18**	d	**19**	b	**20**	a
21	e	**22**	c						

2. Radioactivity and α, β and γ- Rays

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

3. Causes of Radioactivity and Group Displacement Law

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

4. Rate of Decay and Half-life

1	b	**2**	d	**3**	a	**4**	a	**5**	a
6	d	**7**	c	**8**	b	**9**	d	**10**	a
11	b	**12**	b	**13**	c	**14**	b	**15**	a
16	b	**17**	b	**18**	d	**19**	b	**20**	d
21	c	**22**	b	**23**	d	**24**	a	**25**	d
26	a	**27**	d	**28**	c	**29**	a	**30**	d
31	b	**32**	b	**33**	b	**34**	c	**35**	b
36	b	**37**	c	**38**	a	**39**	b	**40**	a
41	a	**42**	b	**43**	c	**44**	b	**45**	c
46	d	**47**	d						

5. Artificial Transmutation

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

6. Isotope-Isotones and Nuclear Isomers

1	c	**2**	d	**3**	c	**4**	c	**5**	a
6	d	**7**	c	**8**	a	**9**	b	**10**	d
11	d	**12**	b						

7. IIT-JEE/ AIEEE

1	a	**2**	d	**3**	c	**4**	a	**5**	d
6	c	**7**	d	**8**	b	**9**	a	**10**	d
11	a	**12**	a	**13**	d	**14**	b	**15**	b
16	a	**17**	b	**18**	c	**19**	a	**20**	d
21	a	**22**	b						

8. NEET/ AIPMT/ CBSE-PMT

1	c	**2**	a	**3**	b	**4**	a	**5**	d
6	d	**7**	b	**8**	c	**9**	d	**10**	a
11	c								

9. AIIMS

1	d	**2**	c	**3**	d	**4**	c	**5**	a
6	a	**7**	c	**8**	c	**9**	a	**10**	d
11	c	**12**	c	**13**	a	**14**	d	**15**	a

10. Assertion & Reason

1	b	**2**	a	**3**	d	**4**	a	**5**	c
6	d	**7**	b	**8**	e	**9**	b	**10**	d
11	b								