Nuclear Chemistry

1. Nucleus, Binding energy, Nuclear Fission & Fusion Reaction

Q 1. 1 amu mass is equal to
(A) 0.511 MeV/C^2 (B) 931.5 MeV/C^2
(C) 921.5 MeV/C^2 (D) None of these

Q 2. Which atom has nucleus with higher density?
(A) He (B) H
(C) U (D) All have equal density

Q 3. Order of magnitude of density of Uranium Nucleus is [mp = $1.67\times10^{-27}\,Kg$] **[IIT 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

Q 4. The order of Net Force inside the Nucleus is
(A) $F_{n-P}=F_{n-n}>F_{P-P}$ (B) $F_{n-P}=F_{n-n}=F_{P-P}$
(C) $F_{n-P}=F_{n-n}<F_{P-P}$ (D) $F_{P-P}<F_{n-P}<F_{n-n}$

Q 5. Calculate the binding energy per nucleon (in MeV) in He atom (^{4}He) which has a mass of 4.00260 amu. m_n = 1.008655 amu, $m_{1H\text{-atom}}$ = 1.007825 amu
(A) 7.0745 MeV (B) 8.5 MeV
(C) 5.05 MeV (D) None of these

Q 6. If binding energy per nucleon in ^{7}Li & ^{4}He nuclei are 5.60 MeV & 7.06 MeV respectively, then in the reaction $P+{}^7_3Li\rightarrow 2({}^4_2He)$, energy of proton will be **[AIEEE 2006]**
(A) 1.46 MeV (B) 39.2 MeV
(C) 28,24 MeV (D) 17.28 MeV

Q 7. If M_O is the mass of Oxygen isotope $_8O^{17}$, M_P & M_N are the masses of proton & neutron respectively, then the nuclear Binding energy of the isotope is **[AIEEE 2007]**
(A) $(M_O-8M_P)C^2$ (B) $(8M_P+9M_N-M_O)C^2$
(C) M_oC^2 (D) $(M_o-17M_N)C^2$

Q 8. **Assertion (A):** A Nucleus with binding energy per nucleon is in the order ${}^9_4Be>{}^7_3Li>{}^4_2He$.
Reason (R): Binding energy per nucleon increases linearly with difference in number of neutrons & protons. **[AIIMS 2004]**
(A) Both assertion & reason are correct & reason is correct explanation of assertion.
(B) Both assertion & reason are correct & reason is not correct explanation of assertion.
(C) Assertion is true but reason is false
(D) Both Assertion & Reason are false.

Q 9. The energy equivalent of 2.0 mg mass defect is **[AIIMS 2008]**
(A) $1.8\times10^4\,ergs$ (B) $9\times10^{-19}\,ergs$
(C) $1.5\times10^{20}\,ergs$ (D) $1.8\times10^{18}\,ergs$

Q 10. ${}^{27}_{13}Al+{}^4_2He\rightarrow{}^{30}_{14}Si+{}^1_1H+Q$ **[AIIMS 2003]**
${}^{27}_{13}Al$ = 26.9815 amu &
${}^{30}_{14}Si$ = 29.9738 amu, ${}^1_1H$ = 1.0078 amu,
${}^4_2He$ = 4.0026 amu, Then Q is equal to
(A) 4.437 MeV (B) 6.578 MeV
(C) 8.328 MeV (D) 2.328 MeV

Q 11. Energy released in the following nuclear fusion reaction will be ${}_1H^2+{}_1H^3\rightarrow{}_2He^4+{}_0n^1$,
If atomic masses of ${}^2_1H$ = 2.014, ${}^3_1H$ = 3.016 & ${}^4_2He$ = 4.003 & ${}_0n^1$ = 1.009 **[AIIMS 2001]**
(A) 6.30 eV (B) 16.758 eV
(C) 500 J (D) 4 x 10^6 KCal

Q 12. Helium Nuclei combines to form an oxygen nucleus. The energy released per nucleon of oxygen nucleus is if m_O = 15.834 amu & m_{He} = 4.0026 amu
(A) 10.24 MeV (B) 0 MeV
(C) 5.24 MeV (D) 4 MeV

Q 13. Sulphur = 35 (34.9603 u) emits a β-particle (Electron) but no γ-ray. The product is chlorine = 35 (34.96885 u). The maximum energy emitted by the β – particles is **[CBSE PMT 1999]**
(A) 16.758 MeV (B) 1.6758 MeV
(C) 0.16758 MeV (D) 0.016758 MeV

Q Q 14. ${}^{235}_{92}U+n^1_0\rightarrow$ fission product + neutron + $3.2\times10^{-11}J$. The energy released, when 1 g of ${}^{235}_{92}U$ finally undergoes fission, is **[CBSE PMT 97]**
(A) $12.75\times10^8\,KJ$ (B) $18.60\times10^9\,KJ$
(C) $8.21\times10^7\,KJ$ (D) $6.55\times10^6\,KJ$

Q 15. Nuclear reactor is based on
(A) Radioactivity (B) Nuclear Fission
(C) Nuclear Fusion (D) Spontaneous Reaction

Q 16. The purpose of moderator in nuclear reactor is
(A) to prevent corrosion of the core components
(B) to slow the fission neutrons so that they can be captured to sustain the chain reaction
(C) to cool the core to prevent melt down
(D) to dissolve the fission products for disposal

Q 17. Fission reactions can be run continuously to generate electric power commercially because
(A) the reactors generates more readily fissionable fuel than they consume
(B) more neutrons are produced in the fission reactions than they are consumed
(C) supercritical neutrons split into protons and electrons
(D) the different isoptopes of uranium interconvert under reaction to form the necessary Uranium – 235

Q 18. Hydrogen fusion
(A) is the reaction sequence that is proposed to take place in normal stars
(B) requires very large kinetic energy in the colliding nuclei in order to overcome huge activation energies associated with electrostatic repulsion.
(C) results in the conversion of hydrogen ncueli to form Helium nuclei
(D) all of the above

Q 19. The energy produced by sun involves which of the following nuclei?
(A) Pu (B) Li
(C) U (D) H

Q 20. The reaction of H^3 and H^2 to form He^4 and a neutron is an example of
(A) fission reaction
(B) fusion reaction
(C) both fusion & fission reaction
(D) Neither fusion nor fission reaction

Q 21. The radioisotope used in diagnosis in nuclear medicine is
(A) have short half lives
(B) Travel rapidly through tissue
(C) are usually gamma emiiters
(D) all of these

2. Type of Radioactive Process

Q 1. In the reaction ${}^{9}_{4}Be + X \rightarrow {}^{10}_{5}B + \gamma$, X is
(A) proton (B) deutron
(C) alpha Particle (D) Neutron

Q 2. *Number* of neutrons in a parent nuclei of X, Which give ${}_{7}N^{14}$ nucleus after 2 successive β emission will be **[CBSE PMT 1998]**
(A) 9 (B) 6 (C) 7 (D) 8

Q 3. ${}_{6}C^{12}$ & ${}_{1}H^{3}$ are formed in nature due to nuclear reaction of neutron with species, so correct relation is **[AIIMS 2009]**
(A) ${}_{7}N^{14}$ (B) ${}_{6}C^{13}$
(C) ${}_{2}He^{4}$ (D) ${}_{3}Li^{6}$

Q 4. The Reaction ${}^{2}_{1}D + {}^{3}_{1}T \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$, example of
(A) Radioactive disintegration (B) Nuclear fusion
(C) Artificial Radioactivity (D) Nuclear fission

Q 5. Which of the following nuclear changes is incorrect?
(A) ${}^{40}_{20}Ca + {}^{1}_{0}n \rightarrow {}^{40}_{19}B + {}^{1}_{1}H$
(B) ${}^{24}_{12}Mg + \alpha \rightarrow {}^{27}_{14}B + {}^{1}_{0}n$
(C) ${}^{113}_{48}Cd + {}^{1}_{0}n \rightarrow {}^{112}_{48}Cd + {}^{0}_{-1}e$
(D) ${}^{43}_{20}Ca + \alpha \rightarrow {}^{46}_{21}Cd + {}^{1}_{1}H$

Q 6. Which of the following particles is used to bombard ${}^{28}_{14}Si$ to give ${}^{31}_{15}P$ and a proton
(A) ${}_{1}H^{2}$ (B) γ (C) α (D) β

Q 7. ${}_{92}U^{235}$ nucleus absorbs a neutron and disintegrate in ${}_{54}Xe^{139}$ & ${}_{38}Sr^{94}$ and x, so what will be the product X ? **[CBSE PMT 2002]**
(A) 3 neutrons (B) 2 neutrons
(C) α – particle (D) β – particle

Q 8. What is X in the nuclear reaction
${}^{14}_{7}N + {}^{1}_{1}H \rightarrow {}^{15}_{8}O + X$
(A) ${}_{1}H^{1}$ (B) ${}_{0}n^{1}$
(C) γ (D) ${}_{1}e^{0}$

Q 9. Which of the following is (n, P) type reaction?
(A) ${}^{13}_{6}C + {}^{1}_{1}H \rightarrow {}^{14}_{6}C$
(B) ${}^{14}_{7}N + {}^{1}_{1}H \rightarrow {}^{15}_{8}O$
(C) ${}^{27}_{13}Al + {}^{1}_{o}n \rightarrow {}^{27}_{12}Mg + {}^{1}_{1}H$
(D) ${}^{235}_{92}U + {}^{1}_{o}n \rightarrow {}^{140}_{54}Xe + {}^{94}_{88}Sr$

Q 10. Which of the following is (α , P) type reaction?

(A) $^{9}_{4}Be + {}^{1}_{1}H \rightarrow {}^{6}_{3}Li + {}^{4}_{2}He$

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

(C) $^{27}_{13}Al + {}^{4}_{2}He \rightarrow {}^{30}_{15}P + {}^{1}_{1}H$

(D) $^{43}_{20}Ca + {}^{4}_{2}He \rightarrow {}^{46}_{21}Sc + {}^{1}_{1}H$

Q 11. Which of the following is (P , α) type reaction?

(A) $^{9}_{4}Be + {}^{1}_{1}H \rightarrow {}^{6}_{3}Li + {}^{4}_{2}He$

(B) $^{235}_{92}U + {}^{1}_{o}n \rightarrow {}^{140}_{54}Xe + {}^{94}_{88}Sr$

(C) $^{13}_{6}C + {}^{1}_{1}H \rightarrow {}^{14}_{6}C + {}^{0}_{1}e$

(D) $^{43}_{20}Ca + {}^{4}_{2}He \rightarrow {}^{46}_{21}Sc + {}^{1}_{1}H$

Q 12. The radioactive isotope $_{27}Co^{60}$ which is used in cancer treatment can be made by (n, p) Reaction. For this reaction, the target nucleus is **[CBSE PMT 2004]**

(A) $_{28}Ni^{59}$ (B) $_{27}Co^{59}$

(C) $_{28}Ni^{60}$ (D) $_{27}Co^{60}$

Q 13. 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

(A) 142 (B) 144 (C) 140 (D) 146

Q 14. Bombardment of Aluminum by α - particle leads to its artificial disintegration in two ways, (i) and (ii) as shown below, Product X, Y, Z respectively are **[IIT JEE 2011]**

$$^{27}_{13}Al \xrightarrow{(ii)} {}^{30}_{15}P + Y$$

$$\downarrow \qquad\qquad \downarrow$$

$$^{30}_{14}Si + X \qquad {}^{30}_{14}Si + Z$$

(A) Proton, Neutron, Positron

(B) Neutron, Positron, Proton

(C) Proton, Positron, neutron

(D) Positron, porton, neutron

Q 15. If $_{b}X^{a}$ species emits firstly a positron, then two α and two β and in last one α is also emitted and finally convert into $_{d}Y^{C}$ species, so correct relation is **[CBSE PMT 2001]**

(A) a = c+12 , d = b – 5 (B) a = c – 8, d = b–1

(C) a = c – 6, d = b – 0 (D) a = c – 4, d = b–2

Q 16. $^{23}_{11}Na$ is the most stable isotope of Na, find out the process by which $^{24}_{11}Na$ can undergo radioactive decay **[IIT JEE 2003S]**

(A) β^{-}emission (B) α emission

(C) β^{+} emission (D) K electron capture

Q 17. $^{27}_{13}Al$ is a stable isotope, $^{29}_{13}Al$ is expected to disintegrate by **[IIT JEE 1996S]**

(A) α-emission (B) β-emission

(C) positron emission (D) proton emission

Q 18. $^{180}_{80}Hg$ will undergo

(A) β^{-}emission (B) β^{+} emission

(C) electron capture (D) γ emission

Q 19. $^{52}_{26}Fe$ will undergo

(A) β^{-}emission (B) β^{+} emission

(C) α - emission (D) γ emission

Q 20. Which of the following is extra stable Nuclei.

(A) $^{12}_{6}C$ (B) $^{20}_{10}Ne$

(C) $^{40}_{20}Ca$ (D) $^{52}_{26}Fe$

Q 21. $^{209}_{83}Bi$ is stable because

(A) N/Z ratio is in stability Zone

(B) no. of neutron is 126, which is a magic no.

(C) Bi has all stable Nuclei

(D) None of these

3. Nuclear Stability, Radioactive decay

Q 1. Which of the following has maximum n/p ratio?

(A) ^{16}Ne (B) ^{16}O (C) ^{16}F (D) ^{16}N

Q 2. **Assertion (A):** Elements with high n/p ratio are less stable & emit β particles.

Reason (R): they tend to have lwer energy by β– emission. **[AIIMS 2005]**

(A) Both assertion & reason are correct & reason is correct explanation of assertion.

(B) Both assertion & reason are correct & reason is not correct explanation of assertion.

(C) Assertion is true but reason is false

(D) Both Assertion & Reason are false.

Q 3. Choose the INCORRECT Option

(A) Among α, β & γ rays, γ rays has maximum penetration power.

(B) γ rays has highest velocity

(C) γ rays has highest ionization power

(D) α Particle is also called Helium Nucleus

Q 4. In a radioactive decay, an emitted electron comes From **[CBSE PMT 1994]**

(A) the nucleus of atom
(B) the orbit with principle quantum number 1
(C) the inner orbital of the atom
(D) the outermost orbit of the atom

Q 5. Poistron is **[AIIMS 1999]**
(A) electron with positive charge
(B) a nucleus with one neutron & one proton
(C) a nucleus with two protons
(D) a Helium Nucleus

Q 6. In the Nuclear reaction, $^{238}_{92}U \rightarrow {}^{206}_{82}Pb$, the number of α & β particles emiited are
(A) 7α, 5β (B) 6α, 4β (C) 4α, 3β (D) 8α, 6β

Q 7. In the Nuclear reaction, $^{228}_{90}Th \rightarrow {}^{212}_{83}Bi$, the number of α & β particles emiited are
(A) 4α, β (B) 3α, 7β (C) 8α, β (D) α, 4β

Q 8. In the following radioactive decay, $_{92}X^{232} \rightarrow {}_{89}Y^{220}$, how many α & β particles are ejected from X to Y? **[CBSE PMT 1999]**
(A) 3α & 2β (B) 5α & 3β
(C) 3α & 3β (D) 5α & 5β

Q 9. Element $_ZM^A$ emits one α particle followed by 2 β particles. Which of the following is daughter Element?
(A) $^{A-4}_{Z-2}M$ (B) $_{Z-2}{}^{A}M$ (C) $^{A-4}_{Z}M$ (D) $^{A-4}_{Z+2}M$

Q 10. In the radioactive change
$^{A}_{Z}P \rightarrow {}^{A}_{Z+1}Q \rightarrow {}^{A-4}_{Z-1}R \rightarrow {}^{A-4}_{Z-1}S$
(A) α, β & γ (B) β, α & γ
(C) γ, α & β (D) β, γ & α

Q 11. In the decay series
$A \xrightarrow{-\alpha} B \xrightarrow{-\beta} C \xrightarrow{-\beta} D$
(A) A & B are isobars (B) A & C are isobars
(C) A & D are isotopes (D) B & C are isotopes

Q 12. In the decay series
$X \xrightarrow{-\alpha} Y \xrightarrow{-\alpha} Z \xrightarrow{-4\beta} W$
(A) X & Y are isodiapher (B) X & Z are isobars
(C) X & W are isotopes (D) both A & C

Q 13. In γ (gamma) decay, relation between parent & daughter nuclei is
(A) Isomer (B) Isobar
(C) Isoope (D) Isostere

Q 14. **Assertion (A):** The nuclear isomers are the atoms with same no of atomic number & same no of mass number, but with different radioactive properties.
Reason (R): The nucleus in the excited state will evidently have a different half life as compared to that in ground state. **[AIIMS 2009]**
(A) Both assertion & reason are correct & reason is correct explanation of assertion.
(B) Both assertion & reason are correct & reason is not correct explanation of assertion.
(C) Assertion is true but reason is false
(D) Both Assertion & Reason are false.

Q 15. Which element belongs to 4n series? **[AIIMS 2013]**
(A) Pb^{207} (B) Pb^{205} (C) Pb^{208} (D) Pb^{206}

Q 16. The end product of (4n+2) disintegration series is
(A) $^{204}_{82}Pb$ (B) $^{208}_{82}Pb$ (C) $^{209}_{82}Pb$ (D) $^{206}_{82}Pb$

Q 17. The nuclei $^{235}_{92}U$ undergo radioactive decay. The final product of nuclei is
(A) $^{206}_{82}Pb$ (B) $^{205}_{82}Pb$ (C) $^{207}_{82}Pb$ (D) $^{204}_{82}Pb$

Q 18. In the reaction $Po \xrightarrow{-\alpha} Pb \xrightarrow{-\beta} Bi$
If Bi belongs to group 15, to which group Po, belongs
(A) 14 (B) 15 (C) 13 (D) 16

Q 19. In the reaction $A \xrightarrow{-\alpha} B \xrightarrow{-\beta^+} C$
If A belongs to group 16, to which group C, belongs
(A) 15 (B) 14 (C) 18 (D) 13

Q 20. A nuclide of an alkaline earth metal undergoes radioactive decay by emission of three α particles in sucession. The group of the periodic table to which the daughter element belong is **[CBSE PMT 2005]**
(A) Group 14 (B) Group 16
(C) Group 4 (D) Group 6

Q 21. A radioactive substance $_{88}X^{228}$ (IIA) emits 3α & 2β patciles to from Y. To which group of long from of periodic table does 'Y' belong? **[AIIMS 2014]**
(A) IVA (B) VA (C) VIA (D) VIIA

Q 22. A radioactive nuclide emits one alpha and two beta partiles in succession. The daughter nuclide formed has
(A) same no. of protons as the parent nuclide
(B) same no of nucleons as the parent nculide
(C) mass no less by 4 than the parent nuclide
(D) same no of neutrons as the parent nuclide

Q 23. Pick out the correct statements
(A) negative beta decay decreases the propotion of neutrons and increase the proportion of proton
(B) postive beta decay increases the propotion of neutrons and decrease the proportion of proton
(C) K Capture increases the propotion of neutrons and increase the proportion of proton
(D) Positron & Electrons quickly combine to produce photons

Q 24. **Assertion (A):** Neutrons are more effective than protons of equal energy in causing artificial disintegration of atom
Reason (R): Neutrons are neutral & can penetrate the Nucleus. **[AIIMS 2001]**
(A) Both assertion & reason are correct & reason is correct explanation of assertion.
(B) Both assertion & reason are correct & reason is not correct explanation of assertion.
(C) Assertion is true but reason is false
(D) Both Assertion & Reason are false.

4. Radioactive Decay Law

Q 1. If 8.9 g of a radioactive isotope has a half life of 10 hr, then half life of 2.2 g of same substance is
(A) 2.6 hr (B) 5 hr
(C) 10 hr (D) 40 hr

Q 2. A human body reuired the 0.01 μActivity of a radioactive substance after 24 hrs. Half life of radioactive substance is 6 hrs. then the injection of maximum activity of radioactive substance that can be injected is
(A) 0.08 (B) 0.04
(C) 0.16 (D) 0.32

Q 3. The radioisotope tritium ($_1H^3$) has a half life of 12.3 years. If the initial amount of tritium is 32 mg, how many mg of it would remain after 49.2 years? **[CBSE PMT 2003]**
(A) 4 mg (B) 8 mg (C) 1 mg (D) 2 mg

Q 4. A human body required the 0.01 M activity of radioactive susbstance is 6 hr. half life of radioactive substance is 6 hr. then, injection of maximum activity of radioactive substance that can be injected will be **[CBSE PMT 2001]**
(A) 0.08 (B) 0.04
(C) 0.16 (D) 0.32

Q 5. 1 microgram of radioactive sodium $_{11}Na^{24}$ with half life of 15 h was injected into a living system for bio-assay. How long will it take for the radioactivity to fall to 25 % of the initial value? **[CBSE PMT 1996]**
(A) 60 hr (B) 22.5 hr
(C) 375 hr (D) 30 hr

Q 6. A radioactive nuclide decays at such a rate that after 96 min , only $1/8^{th}$ of the original amount remains. The vlue of half life of the nuclide is **[AIIMS 1996]**
(A) 32 min (B) 12 min (C) 48 min (D) 24 min

Q 7. Two radioactive substance A_1 & A_2 have decay constant of $10\lambda_0$ & λ_0 . If initially they have same number of nuclei, then after time $\frac{1}{9\lambda 0}$ the ratio of number if theur undecayed nuclei will be
(A) $\frac{1}{e}$ (B) $\frac{1}{e^2}$ (C) $\frac{1}{e^3}$ (D) $\sqrt{e}$

Q 8. Two radioactive substance A & B of half life of t hr and 2t hr respectively, initially contain same number of radioactive atoms. At the end of t hrs, their rates of disintegration are in the ratio
(A) 2.828:1 (B) 1:8
(C) 1.414:1 (D) 0.693:1

Q 9. The half life of Tc^{99} is 6 hrs. The delivery of a sample of Tc^{99} from the reactor to the nuclear medicine lab of a certain hospital takes 3 hrs. what is the minimum amount of Tc^{99} that ust be shipped in order for the lab to receive 10 mg?
(A) 20 mg (B) 15 mg
(C) 14.1 mg (D) 12.5 mg

Q 10. Two radioactive substance A & B have half lifes 50 min & 10 min respectively. A fresh sample contains the nuclides of B to be eight time that of A. How much time should be elapse so that the number of nuclides of A becomes double of B
(A) 30 (B) 40
(C) 50 (D) None

Q 11. Two radioactive materials X_1 and X_2 have decay constants 10λ & λ respectively. If initially they have same no of nuclei, then the ratio of nuclei of X_1 and X_2 will be 1/e after a time
(A) $\frac{1}{10\lambda}$ (B) $\frac{1}{11\lambda}$ (C) $\frac{11}{10\lambda}$ (D) $\frac{1}{9\lambda}$

Q 12. A radioactive element has atomic mass 90 and half life of 28 years. The number of disintegrations per second per gram of the element is

(A) 524×10^{10} (B) 5.24×10^{8}

(C) 5.24×10^{-10} (D) 5.24×10^{12}

Q 13. The activity of radioactive nuclide (X^{100}) is 6.023 curie. If its disintegration constant is 3.7×10^{4} sec^{-1} . The mass of X is

(A) 10^{-3} g (B) 10^{-15} g

(C) 10^{-6} g (D) 10^{-14} g

Q 14. A radioactive sample has an intial activity of 56 dpm (dis per min). After 69.3 min it was found to have activity of 28 dpm. Find the no of atoms in a sample having having an activity of 10 dpm

(A) 693 (B) 1000

(C) 100 (D) 10000

Q 15. A sample of 0.42 mg of $_{92}U^{233}F_6$ shows an activity of 9.88 x 10^4 counts per second. Its half life is **[AIIMS 2011]**

(A) 5.13×10^{12} *years* (B) 1.627×10^{5} *years*

(C) 2.94×10^{-9} *years* (D) 2.35×10^{8} *years*

Q 16. The radioactivity of a sample is R_1 at time T_1 and R_2 at time T_2 . if the half life of the specimen isT, the number of atoms that have disintegrated in the time ($T_2 - T_1$) is

(A) $(R_1T_1 - R_2T_2)$ (B) $(R_1 - R_2)$

(C) $(R_1 - R_2)/T$ (D) $(R_1 - R_2)T/0.693$

Q 17. ^{32}P has a half life of 14.3 days. How many mCi will be left after 3 days in a sample that was originally 200 mCi?

(A) 173 mCi (B) 175 mCi

(C) 179 mCi (D) 184 mCi

Q 18. 10 g atoms of an alpha active radioisotope are disintegrating in a sealed container. In 1 hr, the helium gas collected at NTP is 11.2 cc. Calculate the half life of radioisotope.

(A) 1.58 years (B) 2 years

(C) 2.56 years (D) 2.16 years

5. Radioactive decay Law – Part II

Q 1. An old sample of wood from an archaeological excavation was found to have radioactivity of 8.8 counts per minute due to C^{14} ($t_{1/2}$ = 5700 years) as against 15.3 counts per minute for that of a freshly cut piece of wood. The age of the sample is nearly:

(A) 9000 years (B) 7000 years

(C) 4500 years (D) 2500 years

Q 2. The cloth shroud from around a mummy is found to have activity of 8.9 dpm per g of carbon as compared with living organism that undergo 15.2 dpm per g of carbon. Find the age of the shroud if half life of C^{14} is 57300 years.

(A) 9.3×10^{-5} *years* (B) 4.4×10^{3} *years*

(C) 6.5×10^{5} *years* (D) 1.92×10^{3} *years*

Q 3. How old is fossil bone whose ^{14}C content is 15 % of that present in living bone. ($t_{1/2}$ = 5730 years)

(A) 25400 years (B) 15600 years

(C) 380 years (D) 6810 years

Q 4. The ratio of C^{14} in a living matter is measured to be $\frac{C^{14}}{C^{12}} = 1.3\times10^{-12}$ at the present time. Activity of 12 g carbon sample is 180 dpm. The half life of C^{14} is nearly ……x 10^{12} sec. [N_A = 6 x 10^{23}]

(A) 0.18 (B) 1.8

(C) 0.384 (D) 648

Q 5. *Carbon* -14 dating method is based on the fact that **[CBSE PMT 1997]**

(A) C-14 fraction is same in all objects

(B) $C-14$ is highly insoluble

(C) ratio of C-14 and C -12 is constant

(D) all of the above

Q 6. Which of the following option is correct? **[JEE Adv. 2006]**

(A) In living organisms, circulation of ^{14}C from atmosphere is high so the carbon content is constant in organism.

(B) Carbon dating can be used to find out the age of earth crust and rocks.

(C) radioactive absorption due to cosmic radiation is equal to the rate of radioactive decay, hence the carbon content remains constant in living organism.

(D) carbon dating can not be used to determine concentration of C^{14} in dead beings.

Q 7. If half life of C^{14} is about 5700 years then what should be the age of fossil for meaningful determination of its age. **[JEE Adv. 2006]**

(A) 6 years (B) 6000 years
(C) 60000 years (D) 6000 hours

Q 8. A nuclear explosion has taken place leading to increase in concentration of C^{14} in nearby areas. C^{14} concentration is C_1 in nearby areas and C_2 in areas far away. If the age of the fossil with same concentration is determined to be t_1 and t_2 at the place respectively then **[JEE Adv. 2006]**

(A) the age of the fossil will increase at the place where explosion has taken place & $t_1 - t_2 = \frac{1}{\lambda}\ln\frac{C_1}{C_2}$

(B)) the age of the fossil will decrease at the place where explosion has taken place and $t_1 - t_2 = \frac{1}{\lambda}\ln\frac{C_1}{C_2}$

(C) the age of the fossil will be determined to be the same

(D) $\frac{t_1}{t_2} = \frac{C_1}{C_2}$

Q 9. The age of most ancient geological formation is estimated by **[CBSE PMT 1989]**

(A) Potassium – argon method
(B) carbon – 14 dating method
(C) radium – silicon method
(D) uranium – lead method

Q 10. On analysis of the rock shows that relative number of Sr^{87} and Rb^{87} atoms is 0.052. Determine the age of the rock. Given that half life of β – decay of Rb to Sr is 4.7×10^{10} years.

(A) 4.35×10^9 years (B) 3.43×10^9 years
(C) 6.25×10^7 years (D) 8.35×10^6 years

Q 11. The nuclide ratio of ^3H to ^1H in a sample of water is 8.0×10^{-18}:1. ^3H undergoes decay with a half life period of 12.3 years. How many ^3H atoms would 10 g of such s sample contains 40 year after the original sample is collected? **[IIT-JEE 1992]**

(A) 1.2×10^8 years (B) 1.2×10^9 years
(C) 6×10^8 years (D) None of these

Q 12. The analysis of a mineral of uranium reveals that ratio of mole of ^{208}Pb & ^{238}U in sample is 0.2. if effective decay constant of process $U^{238} \rightarrow Pb^{208}$ is λ then the age of rock is

(A) $\frac{1}{\lambda}\ln\frac{5}{4}$ (B) $\frac{1}{\lambda}\ln\frac{5}{1}$
(C) $\frac{1}{\lambda}\ln\frac{4}{1}$ (D) $\frac{1}{\lambda}\ln\frac{6}{5}$

Q 13. A sample of U^{238} (half life = 4.5×10^9 years) ore is found to contain 23.8 g of U^{238} and 20.6 g of Pb^{206}. Calculate the age of the ore.

(A) 9×10^9 *years* (B) 4.5×10^9 *years*
(C) 4.5×10^{10} *years* (D) 45×10^9 *years*

Q 14. Ac^{227} has a half life of 22 years with respect to radioactive decay. They decay follows two parallel paths, one leading the Th^{227} & the other leading to Fr^{223}. The percentage yields of these two daughters nuclides are 2 % & 98 % respectively. What is the rate constant in Y^{-1} for each of the separate paths? **[IIT-JEE 1996]**

(A) $6.3 \times 10^{-4}\, y^{-1}$ & $3.087 \times 10^{-2}\, y^{-1}$
(B) $6.3 \times 10^{-2}\, y^{-1}$ & $3.087 \times 10^{-4}\, y^{-1}$
(C) $6.3 \times 10^{-3}\, y^{-1}$ & $6.15 \times 10^{-3}\, y^{-1}$
(D) None of these

Q 15. ^{64}Cu (half life = 12. Hrs) decays by β emission (38 %) β^+ emission (19 %) & electron capture (43 %). Calculate the half life of β decay.

(A) 29.76 years (B) 33.68 years
(C) 67.36 years (D) None of these

Q 16. The mean life of a radioactive nucleus is 1620 years and 405 years for alpha emission and beta Emission respectively. Find the time during which ¾ th of a sample will decay if it is decaying both by alpha emission and beta emission simultaneously.

Answer Key

1. Nucleus, Binding energy, Nuclear Fission & Fusion Reaction

(1). B	(2). D	(3). B
(4). A	(5). A	(6). D
(7). B	(8). D	(9). D
(10). D	(11). B	(12). A
(13). C	(14). C	(15). B
(16). B	(17). B	(18). D
(19). D	(20). B	(21). D

2. Type of Radioactive Process

(1). A	(2). A	(3). A
(4). B	(5). C	(6). C
(7). A	(8). C	(9). C
(10). D	(11). A	(12). C
(13). B	(14). A	(15). A
(16). A	(17). B	(18). C
(19). B	(20). C	(21). B

3. Nuclear Stability, Radioactive decay

(1). D	(2). A	(3). C
(4). A	(5). A	(6). D
(7). A	(8). C	(9). C
(10). B	(11). C	(12). D
(13). A	(14). B	(15). C
(16). D	(17). C	(18). D
(19). D	(20). A	(21). D
(22). A, C	(24). A, B, D	(24). A

4. Radioactive Decay Law – Part I

(1). C	(2). C	(3). D
(4). C	(5). D	(6). A
(10). A	(8). C	(9). C
(13). C	(11). D	(12). D
(16). B	(14). B	(15). B
(19). D	(17). C	(18). A

5. Radioactive decay Law – Part II

(1). C	(2). B	(3). D
(4). B	(5). C	(6). C
(7). B	(8). A	(9). D
(10). B	(11). B	(12). D
(13). B	(14). A	(15). B

(16). 449.257 $years^{-1}$