Nuclear Chemistry

SET Self Evaluation Test - 7

1. When $_3Li^7$ are bombarded with protons, γ-rays are produced. The nuclide formed is **[CPMT 1987]**

(a) $_3Li^8$ (b) $_4Be^8$

(c) $_3B^9$ (d) $_4Be^9$

2. Nuclides **[BVP 2003]**

(a) Have specific atomic numbers

(b) Have same number of protons

(c) Have specific atomic number and mass numbers

(d) Are isotopes

3. In the following nuclear reactions

$_7N^{14} + _2He^4 \rightarrow _8O^{17} + X_1$ and $_{13}Al^{27} + _1D^2 \rightarrow _{14}Si^{28} + X_2$

X_1 and X_2 are respectively

(a) $_1H^1$ and $_0n^1$ (b) $_0n^1$ and $_1H^1$

(c) $_2He^4$ and $_0n^1$ (d) $_0n^1$ and $_2He^4$

4. Gamma rays are **[NCERT 1978; MNR 1990; UPSEAT 1999, 2000]**

(a) High energy electromagnetic waves

(b) High energy electrons

(c) High energy protons

(d) Low energy electrons

5. Which particle can be used to change $_{13}Al^{27}$ into $_{15}P^{30}$ **[MP PMT 2003]**

(a) Neutron (b) α-particle

(c) Proton (d) Deuteron

6. Which of the following does not characterise *X*-rays **[UPSEAT 2001]**

(a) The radiation can ionise gases

(b) It causes *ZnS* to fluorescence

(c) Deflected by electric and magnetic field

(d) Have wavelengths shorter than ultraviolet rays

7. During emission of β-particle **[Bihar MEE 1996]**

(a) One electron increases

(b) One electron decreases

(c) One proton increases

(d) No change

(e) None of these

8. Emission is caused by the transformation of one neutron into a proton. This results in the formation of a new element having

(a) Same nuclear charge

(b) Very lower nuclear charge

(c) Nuclear charge higher by one unit

(d) Nuclear charge lower by one unit

9. The end product of $4n$ series is **[MNR 1983]**

(a) $_{82}Pb^{208}$ (b) $_{82}Pb^{207}$

(c) $_{82}Pb^{209}$ (d) $_{83}Bi^{204}$ **[MP PMT 1999]**

10. $_{92}U^{235}$ belongs to group III B of periodic table. If it loses one α-particle, the new element will belong to group **[MNR 1984; CPMT 2001]**

(a) I B (b) I A

(c) III B (d) V B

11. Radioactive disintegration differs from a chemical change in being **[UPSEAT 2000, 01, 02]**

(a) An exothermic change

(b) A spontaneous process

(c) A nuclear process

(d) A unimolecular first order reaction

12. Half-life is the time in which 50% of radioactive element disintegrates. Carbon-14 disintegrates 50% in 5770 years. Find the half-life of carbon-14 **[DPMT 1**

(a) 5770 years

(b) 11540 years

(c) $\sqrt{5770}$ years

(d) None of the above

13. The half-life of ^{14}C is about **[MP PET 1996]**

(a) 12.3 years

(b) 5730 years

(c) 4.5×10^9 years

(d) 2.52×10^5 years

14. Half-life for radioactive C^{14} is 5760 years. In how many years $200\,mg$ of C^{14} sample will be reduced to $25\,mg$

[CBSE PMT 1995]

(a) 11520 years (b) 23040 years

(c) 5760 years (d) 17280 years

15. The decay constant of a radioactive element is $3 \times 10^{-6}\ \text{min}^{-1}$. Its half-life is

[MP PET 1993; Pb. CET 2002]

(a) 2.31×10^5 min

(b) 2.31×10^6 min

(c) 2.31×10^{-6} min

(d) 2.31×10^{-7} min

16. A radioactive sample decays to half of its initial concentration in 6.93 *minutes*.It further decays half in next 6.93 *minutes*. The rate constant for the reaction is

[RPET 2000]

(a) 0.10 min^{-1} (b) 0.01 min^{-1}

(c) 1.0 min^{-1} (d) 0.001 min^{-1}

17. The half-life of an isotope is 10 *hrs*. How much will be left behind after 4 *hrs* in $1gm$ sample**[BHU 1997]**

(a) 45.6×10^{23} atoms

(b) 4.56×10^{23} atoms

(c) 4.56×10^{21} atoms

(d) 45.6×10^{21} atoms

18. The half-life period $t_{1/2}$ of a radioactive element is N years. The period of its complete decay is**[KCET 1998]**

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

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

19. A radioactive element has a half-life of 20 minutes. How much time should elaspe before the element is reduced to $\frac{1}{8}th$ of the original mass**[EAMCET 1990]**

(a) 40 minutes

(b) 60 minutes

(c) 80 minutes

(d) 160 minutes

20. 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%

21. ^{226}Ra disintegrates at such a rate that after 3160 *years* only one-fourth of its original amount remains. The half-life of ^{226}Ra will be

(a) 790 *years* (b) 3160 *years*

(c) 1580 *years* (d) 6230 *years*

22. The ratio of the amount of two elements *X* and *Y* at radioactive equilibrium is $1:2 \times 10^{-6}$. If the half-life period of element *Y* is 4.9×10^{-4} days, then the half-life period of element X will be

(a) 4.8×10^{-3} days (b) 245 days

(c) 122.5 days (d) None of these

23. 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 **[AIEEE 2002]**

(a) 16 *grams* (b) 2 *grams*

(c) 32 *grams* (d) 8 *grams*

24. An element has half-life 1600 *years*. The mass left after 6400 *years* will be **[AFMC 2003]**

(a) 1/16 (b) 1/12

(c) 1/4 (d) 1/32

25. Wooden artitact and freshly cut tree are 7.6 and $15.2\,\text{min}^{-1}\,g^{-1}$ of carbon ($t_{1/2} = 5760$ years) respectively. The age of the artitact is **[AIIMS 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

26. An element has two main isotopes of mass numbers 85 and 87. In nature they occur in the ratio of 75% and 25% respectively. The atomic weight of the element will be approximately

(a) 86.0 (b) 86.5

(c) 85.5 (d) 85.75

27. A sample of rock from moon contains equal number of atoms of uranium and lead ($t_{1/2}$ for $U = 4.5 \times 10^9$ years). The age of the rock would be**[MNR 198**

(a) 9.0×10^9 years

(b) 4.5×10^{9} years

(c) 13.5×10^{9} years

(d) 2.25×10^{9} years

28. The value of one microcurie = ... disintegrations / second **[EAMCET 1982]**

(a) 3.7×10^{5} (b) 3.7×10^{7}

(c) 3.7×10^{4} (d) 3.7×10^{10}

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

(a) 6 (b) 5

(c) 4 (d) 3

Answers and Solutions

(SET -7)

1. (b) ${}_3Li^7 + {}_1H^1 \rightarrow {}_4Be^8 + \gamma$

2. (d) The isotopes of an element is represented by writing the symbol of the element and representing the atomic number and mass number as subscript and superscript respectively are called nuclides.

3. (a) Equate atomic no. and mass no.

4. (a) γ-rays are designated by *hv*.

5. (b) ${}_{13}Al^{27} + {}_2He^4 \rightarrow {}_{15}P^{30} + {}_on^1$

6. (c) *x*-rays do not carry any charge and hence are not deflected by electric and magnetic fields.

7. (c) During β-particle emission one proton increases.

8. (c) ${}_on^1 \rightarrow {}_{+1}p^1 + {}_{-1}e^o$ (β-particle comes out).

9. (a) The end product of 4n series is ${}_{82}Pb^{208}$.

10. (c) Elements 89 to 103 are placed in III group.

11. (c) Chemical reaction is not nuclear reaction, but radioactivity is nuclear distingration.

12. (a) $t_{1/2} = 5770$ *years*.

13. (b) $t_{1/2}$ of C^{14} = 5730 *years*.

14. (d) $25 = \left[\frac{1}{2}\right]^n \times 200, \left[\frac{1}{2}\right]^n = \frac{25}{200} = \frac{1}{8} = \left[\frac{1}{2}\right]^3$

n = 3, Number of half lives = 3

so time required = 3 × 5760 = 17280 *yrs*.

15. (a) $t_{1/2} = \frac{0.693}{\lambda} = \frac{0.693}{3\times10^{-6}\,min^{-1}} = 2.31\times10^5\,min.$

16. (a) $k = \frac{0.693}{t_{1/2}} = \frac{0.693}{6.93} = 0.10\ \text{min}^{-1}$

17. (b) 4.56 × 10^{23} atoms will be left behind after 4 *hrs* in 1 *gm*. sample.

18. (d) The $t_{1/2}$ of a radioactive element = *N years*

$\therefore$ The period of its complete decay is infinity.

19. (b) $t_{1/2} = 20$ minute, $N = \frac{1}{9}N_o$

Use, $t = \frac{2.303}{0.693}\times t_{1/2}\log\frac{N_o}{N}$.

20. (b) $N = \frac{N_o}{2^n}$ and $n = \frac{45}{15} = 3$

Also use $N_o = 100$ than $N = \frac{100}{2^3} = 12.5\%$.

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21. (c) For an element to disintegrate

$N = N_o\left(\frac{1}{2}\right)^n$ .....(i), $t = n \times t_{1/2}$ .....(ii)

For $Ra^{226}\ \frac{N}{N_o} = \frac{1}{4}$, from *eq*. (i)

$\frac{1}{4} = \left(\frac{1}{2}\right)^n$ or $\left(\frac{1}{2}\right)^n$ or $\left(\frac{1}{2}\right)^2 = \left(\frac{1}{2}\right)^n, n = 2$; from *eq*. (ii)

$T_{1/2} = \frac{t}{n} = \frac{3160}{2} = 1580$ yrs.

22. (b) $\frac{N_X}{N_Y} = \frac{t_{1/2}(X)}{t_{1/2}(Y)}, t_{1/2}(X) = \frac{4.9\times10^{-4}}{2\times10^{-6}} = 245$ days.

23. (d) $t_{1/2} = 5\,yrs., \text{t} = 15\ yrs$

$\therefore n = \frac{t}{t_{1/2}} = \frac{15}{5} = 3$

Now $N = \frac{N_o}{2^n} = \frac{N_o}{2^3} = \frac{1}{8}N_o = \frac{1}{8}\times64 = 8$ *grams*.

24. (a) $T_{1/2} = 1600\ yrs.,\ N_o = 1,\ N = ?,\ T = 6400\ yrs.$

$T = t_{1/2}\times n, or\ n = \frac{6400}{1600} = 4$

$N = N_o \times \left(\frac{1}{2}\right)^n,\ N = 1\times\left(\frac{1}{2}\right)^4,\ N = \frac{1}{16}$.

25. (a) $r_o = 15.2$ and $r = 7.6$, $\therefore t = \frac{2.303}{\lambda} \log \frac{r_o}{r}$.

26. (c) Isotopes have 75% and 25% respectively.

$\therefore$ Atomic mass = $\left[\frac{75}{100} \times 85 + \frac{25}{100} \times 87\right]$

= $\frac{6375 + 2175}{100} = 85.5$.

27. (b) $N = \frac{N_0}{2^n}$, use $t = \frac{2.303 \times t_{1/2}}{0.693} \log \frac{N_o}{N}$

28. (c) 1 Ci = $3.7 \times 10^{10}\, dps$ or $3.7 \times 10^{10}\, Bq$.

$1mCi = 3.7 \times 10^{4}\, dps$.

29. (d) Tritium $({}_1H^3)$ consist of 1 proton and 2 neutrons.