Chapter: 13

# Nuclei

***1 marks questions:***

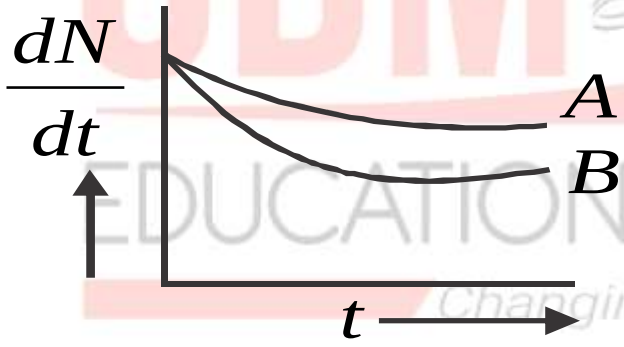
**01.** Define atomic mass unit (a.m.u.). Write the energy equivalent of the atomic mass unit. ***[1996]***

**02.** Draw a graph showing the variation of decay rate with the number of active nuclei.

**03.** In pair annihilation, an electron and a positron destroy each other to produce gamma radiation. How is the momentum conserved?

**04.** Why nuclear fusion reactions are difficult to be carried out?

**05.** Which sample, A or B has shown in the figure has shorter mean-life?




**06.** How is the radius of a nucleus related to its mass number? ***[1990]***

***2 and 3 Marks questions***

**07.** What is the binding energy of the nucleus? What is the mass defect? ***[2000]***

**8.** State the laws of radioactivity. **[1999]**

**09.** Two nuclei have a mass number of the ratio 1:2. What is the ratio of their nuclear densities? What is the ratio of their nuclear radii? ***[2009]***

**10.** Define the activity of a radionuclide. Write its S.I. unit. How does it depend upon temp? and pressure***?***

**11.** The half-life period of a radioactive substance is 30 days. What is the time taken for 3/4$^{th}$ of its original mass to disintegrate? **[1994]**

**12.** What are nuclear fission and fusion? Give one representative reaction for each.What is a thermal neutron

.

**13** Define two units of radioactivity. How are they related? ***[1995]***

**14.** Draw the graph showing the variation of binding energy per nucleon with mass number. Give the reason for the decrease of binding energy per nucleon for nuclei with high mass number. ***[1995]***

**15.** Explain whether the neutron-proton ratio in a nucleus increases or decreases due to decay.

16. A heavy nucleus X of mass 240 and binding energy per nucleon 7.6 MeV is split into two fragments Y and Z of mass number 110 and 130. The binding energy of nucleons in Y and Z is 8.5MeV per nucleon. Calculate the energy Q released per fission in MeV. **[2010]**

**17.** The radioactive sample decays 1/32 of its initial activity in 25 days. Calculate the half-life and decay constant of the substance. ***[2004]***

**18..** (a) a) Write symbolically $\beta^-$ decay process of $_{15}P^{32}$. (b) Derive the expression for the average lifetime of a radioactive substance. Gives its relationship with half-life.

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**19..** State the properties of nuclear forces. Explain the saturation of nuclear force. ***[1995]***

**20.** A neutron is absorbed by $Li_3^6$ the nucleus with the subsequent emission of an alpha particle. ***[2003]***

(i) Write the corresponding nuclear reaction.

(ii) Calculate the energy released in MeV, in this reaction.

Even : mass of Li=6.015126u; mass of neutron=1.0086654u and mass of alpha particle = 4.00260644u **[2006]**

**21.** State the law of radioactive decay. Plot a graph showing the number N of undecayed nuclei as a function of time t for a given radioactive sample having half-life $T_{1/2}$. Depict in the plot, the number of undecayed nuclei at

(a) $t = 3T_{1/2}$ (b) $t=5T_{1/2}$

**22.** A radioactive substance decays to 1/32 of its initial activity in 25 days. Calculate its half life. **[1992]**

**23.** What is the basic mechanism for the emission of $\beta^-$ *and* $\beta^+$ particles in a nuclide? Give an example by writing explicitly a decay process for $\beta$ - emission.

(a) The energy of the emitted $\beta$ -particles continuous or discrete?

(b) The daughter nucleus obtained through $\beta$ - decay, an isotope or an isobar of the parent nucleus?

**24.** (a) Deduce the expression, $N = N_0 e^{-\lambda t}$ for the law of radioactive decay.

(b) Write symbolically the process expressing the $\beta$ - decay of $^{22}_{11}Na$. Also, write the basic nuclear process underlying this decay.

(c) Is the nucleus formed in the decay of the nucleus $^{22}_{11}Na$ is isotope or isobar?

**25.** What is the nuclear radius of $^{125}\mathrm{Fe}$, if that of $^{27}\mathrm{Al}$ is 3.6 fermi?

**26**.. Two nuclei have mass numbers in the ratio 27:125. What is the ratio of their nuclear radii?

**27**. The nuclear radius of $_8\mathrm{O}^{16}$ is $3\times10^{-15}\,\mathrm{m}$. Find the density of nuclear matter.

**28**. Given the following atomic mass

$_{92}U^{238} = 238.05079U, {}_2He^4 = 4.00260U, {}_{90}Th^{234} = 234.04363U, {}_1H^1 = 1.00783U, {}_{91}Pa^{237} = 237.05121U$

(a) Calculate the energy released during $\alpha -$the decay of $_{92}U^{238}$

(b) Show that $_{92}U^{238}$ can't spontaneously emit a proton.

**29**. **T**he half-life of $_{92}U^{238}$ undergoing $\alpha$ decay is $4.5\times10^9\,yr$. What is the activity of 1g sample of $_{92}U^{238}$?

**30**. The half-life of the radioactive sample is 20 sec. calculate

(a) The decay constant and (b) Time is taken for the sample to decay by (7/8)th of initial value?

16. A radioactive sample has a half-life of 5 years. How long will it take the activity to reduce to 3.125%

**31**. Calculate the binding energy per nucleon of $_{20}Ca^{40}$ the nucleus. Given

$m\left(_{20}C^{40}\right) = 39.962589\,a.m.u,\ m_n = 1.005665\,amu, m_p = 1.007825\,amu$

**32**. Find the disintegration energy (Q) for the fission of $_{42}Mo^{98}$ into two equal fragments, $_{21}Sc^{49}$. If Q turns out to be positive, explain why this process does not occur spontaneously. Given that $m\left(_{42}Mo^{98}\right) = 97.90541amu, m\left(_{21}Sc^{49}\right) = 48.95002\,amu, M_n = 1.00867\,amu$