

## Additional Conceptual Short Questions with Answers

1. What is atomic mass unit (a.m.u) and show that

$$1U = 1.6606 \times 10^{-27} \text{ Kg}$$

- Ans.** Atomic mass unit is the unit of mass used in nuclear physics as adopted by the international union of pure and Applied Physics (IUPAP).

One amu is equal to  $\left(\frac{1}{12}\right)$ th of the mass of one  ${}^6\text{C}^{12}$  atom.

$$\text{Mass of one carbon atom} = \frac{12 \text{ gm}}{6.023 \times 10^{23}}$$

$$\text{Mass of one carbon atom} = \frac{12 \times 10^{-3} \text{ Kg}}{6.023 \times 10^{23}}$$

$$1 \text{ amu} = \frac{1}{12} (\text{mass of one carbon atom})$$

$$= \frac{1}{12} \left( \frac{12 \times 10^{-3} \text{ Kg}}{6.023 \times 10^{23}} \right)$$

$$= \frac{1}{12} (1.992678 \times 10^{-26} \text{ Kg})$$

$$1 \text{ amu} = 1U = 1.6606 \times 10^{-27} \text{ Kg}$$

2. Show that  $1U = 931 \text{ Mev}$  (approximately) OR  
What is relation between amu and Mev?

- Ans.**  $1U = 1.660565 \times 10^{-27} \text{ Kg}$

$$E = mc^2$$

$$\begin{aligned}\text{Energy of 1 U} &= 1.660565 \times 10^{-27} (2.998 \times 10^8)^2 \\ &= 1.4925 \times 10^{-10} \text{ J}\end{aligned}$$

$$1\text{U} = \frac{1.4925 \times 10^{-10}}{1.602 \times 10^{-19}}$$

$$1\text{U} = 931.64 \times 10^6 \text{ eV}$$

$$1\text{U} = 931 \text{ MeV (approximately)}$$

**3. What is the drawback of a Geiger counter as a radiation detector?**

**Ans.** It is not suitable for fast counting of the radiations, it is due to its long dead time ( $10^{-4}$  sec), some of the radiations remains unaccounted during long dead time.

**4. Will a single nucleus emit  $\alpha$  - particle,  $\beta$  - particle and  $\gamma$  - rays together?**

**Ans.** No, one nucleus can emit either  $\alpha$  - particle or  $\beta$  - particle at one time.

**5. What are isotopes? What do they have in common and what are their differences?**

**Ans.** Isotopes are the different atoms of the same the element which have same atomic or charge number  $Z$  but different mass numbers  $A$ .

**Similarities:**

- (i) Same atomic or charge number  $Z$ .
- (ii) Same chemical properties.

**Differences:**

- (i) Different mass numbers  $A$ .

(ii) Different physical properties.

**6. Why are heavy nuclei unstable?**

**Ans.** A nucleus is unstable if it is too big. i.e., its atomic number (becomes greater) than 82

**Reason:**

In the heavy nuclei which have too many neutrons relative to protons (i.e.  $N > Z$ ), the strong nuclear force between two nucleus falls off rapidly. Hence electrostatic repulsive force overcomes the strong nuclear force.

**7. What fraction of a radioactive sample decays after two half-lives have elapsed?**

**Ans.** If  $N_0$  = Number of original atoms then after 2 half-lives, Number of un-

decayed atoms =  $\frac{N_0}{4}$ .

Therefore, number of decayed atoms  $N_0 - \frac{N_0}{4} = \frac{3N_0}{4}$

So, radioactive sample will not be completely decayed after 2 half-lives,

only  $\frac{3N_0}{4}$  (75 %) will have decayed.

**8. A particle which produces more ionization is less penetrating. Why?**

**Ans.** A particle which produces more ionization loses its energy more rapidly and hence comes to rest soon after covering a smaller distance. So, it has less penetrating power.

**9. What factors make a fusion reaction difficult to achieve?**

**Ans.** Fusion reactions take place at very high temp e.g.,  $10^7$  K because charged nuclei have great repulsive force between them. This high temperature increases their K.E. so much that it overcome the repulsive forces. This factor of very high temperature & K.E. makes the fusion reactions difficult to achieve.

**10. If you swallowed an  $\alpha$ -source and a  $\beta$ -particle, which would be more dangerous to you? Explain why?**

**Ans.**  $\alpha$ -source is more dangerous if it swallowed, because it has 100 times more ionization power than the  $\beta$ -particle.

### Self-Assessment Paper 1

**Q.No.2 Write Short Answers any SIX of the following questions.**

1. Which radiation dose would deposit more energy to the body (a) 10 mGy to the hand (b) 1 mGy to the whole body?
2. State the radioactive decay laws.
3. Describe the principle of operation of solid-state detector of ionizing radiation in generation and detection of charge carriers.
4. What fraction of a radioactive sample decays after two half-lives have elapsed?
5. What do you mean by critical mass?
6. How can the radioactivity help in the treatment of cancer?
7. Prove that  $1 \text{ u} = 931 \text{ MeV}$ .

**Q.No.3 Extensive Question.**

Q. (a) What is mass spectrograph? Explain its working.

(b) Find the mass Defect and binding energy for helium nucleus?

### Self-Assessment Paper 2

**Q.No.2 Write Short Answers any SIX of the following questions.**

1. A particle which produces more ionization is less penetrating. why?

2. What information is revealed by the length and shape of the tracks of an incident particle in Wilson cloud chamber?

3. What do you mean by dead time in GM counter?

4. Discuss the advantages and disadvantages of fission power compared to the use of fossil fuel generated power

5. The half-life of  ${}_{38}^{91}\text{Sr}$  is 9.70 hours. Find its decay constant.

6. Find the binding energy of tritium. Mass of tritium nucleus = 3.016049u, mass of proton = 1.007276u, Mass of neutron = 1.008665u.

7. Describe the brief account of interaction of various type of radiations with matter.

**Q.No.3 Extensive Questions.**

Q. (a) What is nuclear reactor? Describe its principle and working in detail.

(b) Calculate the total energy released if 1 kg of  $\text{U}^{235}$  undergoes fission? Taking the disintegration energy per event to be  $Q = 208\text{MeV}$

