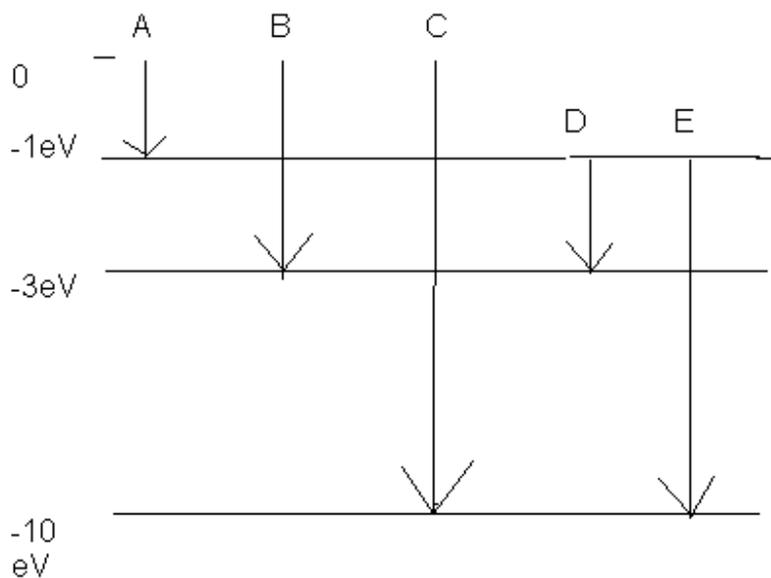


ATOMIC NUCLEI

- In an atom, two electrons moves around the nucleus in circular orbit of radius R and $4R$. Calculate the ratio of time taken to complete one revolution around the nucleus.
- The spectrum of hydrogen atom has many lines although hydrogen atom contains only one electron. Why?
- The energy level of an atom of an element 'X' are shown in the diagram. A photon of wavelength 620 nm is emitted. This corresponds to which of the transition A, B, C, D or E.



- Calculate the speed of electron revolving around the nucleus of a hydrogen atom in order that it may not be pulled into the nucleus by the electrostatic attraction?
- The spectrum of a star in the visible and the uv region was observed and the wavelength of some of the line that could be identified found to be : 824 \AA , 970 \AA , 1120 \AA , 2504 \AA , 5173 \AA , 6100 \AA . Which of these lines cannot belong to hydrogen spectrum?
 $R = 1.03 \times 10^7 \text{ m}^{-1}$
 $1/R = 960 \text{ \AA}$. Support the answer with suitable calculation.
- Prove that Instantaneous rate of change of change of the activity of a radioactive substance is inversely proportional to the square of its half life.
- A radio active nuclei decays to form a stable nucleide. Its half life is 3 min. What fraction of its 1gm will remain radioactive after 9 minutes?
8. How much mass has to be converted to energy to produce electric power 500 MW for one hour?

9. A certain radioactive substance disintegrates for an interval of time equal to its mean life.
A) What fraction of element remains undecayed? B) What fraction of element has disintegrated?

10. How are β rays emitted from a nucleus when it does not contain any electrons?

11. Explain why heavy water is preferred as a moderator to ordinary water in a nuclear reactor having uranium as a fuel?

12. The isotope ${}_{92}\text{U}^{238}$ decays successively to form ${}_{90}\text{Th}^{234}$, ${}_{91}\text{Pa}^{234}$, ${}_{92}\text{U}^{234}$, ${}_{90}\text{Th}^{230}$, ${}_{88}\text{Ra}^{226}$.

What are the radiations emitted in these 5 steps?

13. Binding energy of Lithium (39.22 MeV) is greater than binding energy of Helium (27.22 MeV). Even then Helium is more stable than Lithium. Explain.

14. 4 nuclei of an element fuse together to form a heavier nucleus. If the process is accompanied by release of energy, which of the two – the parent or the daughter nuclei would have higher binding energy per nucleon.

15. Two different radioactive elements with half-lives T_1 & T_2 have N_1 & N_2 atoms respectively present at a given instant. Determine the ratio of their activities at this instant.

16. A radioactive material is reduced to $1/16$ of its original amount in 4 days. How much material should one begin with so that 4×10^{-3} of the material left after 6 days.

17. What do you understand by the term mirror isobars?

18. Show that the decay rate R of a sample of radio nuclei is related to the number of radioactive nuclei N at same instant by the expression $R = N\lambda$

19. How many α and β particles are emitted when ${}_{92}\text{U}^{238}$ changes to ${}_{90}\text{Th}^{230}$

20. Draw a graph showing variation of P.E of a pair of nucleons as a function of their separation b . Indicate the reason in which nuclear force is

a) Attractive (b) Repulsive

21. Plot the distribution of K.E of β particles and state why the energy spectrum is continuous?

22. You are given two nuclei ${}_{3}\text{X}^7$ and ${}_{3}\text{Y}^4$. Explain giving reasons as to which one of the two nuclei is more stable?

23. If the nucleons bound in the nucleus are separated apart from each other, the sum of their masses is greater than the mass of the nucleus. Where does this mass difference come from. Explain.

24. The wavelength of the first line of Lyman series for Hydrogen is identical to that of second line of Balmer series for some hydrogen like ion x . Calculate the energies of the first 4 levels of x .

25. At time $t=0$ activity of a radioactive substance is 1600 Bq. At $t=8\text{s}$ activity remains 100 Bq. Find the activity at 2 seconds.

26. A radioactive nucleus undergoes a series of decay according to the scheme.
 $A \rightarrow A_1 \rightarrow A_2 \rightarrow A_3 \rightarrow A_4$. If the mass number and atomic number of A are 180 and 72 respectively. What are these numbers A_4

26. A gas of monoatomic hydrogen is bombarded with a stream of electrons that have been accelerated from rest through a potential difference of 12.75 V. Which spectral lines should be emitted?
27. An electron and anti particle, the positron, can form a bound system, called Positronium. What should be the ionization potential of positronium.
28. Estimate the energy needed to eject from a lead atom the electron with $n = 1$. What wavelength X ray would be required to do this ($Z = 82$).
29. An alpha particle comes to within 80 fm of gold nucleus. Assuming gold nucleus and the alpha particle are point charges, find the maximum repulsive force.
30. Show that if two ions of the same charge and velocity but of different mass pass through a uniform transverse magnetic field, the radii of the path are proportional to the masses. Find an expression for dm if dr is change in radius.
31. A nucleus X initially at rest, undergoes alpha decay according to the equation ${}_{92}X^A \rightarrow {}_Z Y^{228} + \text{Alpha particle}$. (a) find the values of A and Z. (b) the alpha particle in the above process is found to move in a circular track of radius 1.1×10^{-2} m in a uniform field 3×10^3 T, find the energy during process and binding energy of parent nucleus?
32. In experiment angles of scattering of alpha particle is 180. What is its impact parameter.
33. What will happen if electron revolving around the nucleus comes to rest.
34. By what factor must the mass number A change for the nuclear radius to double.
35. Initial amount of a radioactive substance is N_0 . How much amount of the substance is left after 10 half lifes?
36. Half life of a radioactive element A is same as mean life time of another radioactive element B. Initially both have same no of atoms. Explain why Beta decay faster than A.
37. Half life of radioactive substance A is two times the half life of another substance B. Initially the no of nuclei of A and B are N_A and N_B . After three half lifes of A number of nuclei of both are equal. What is ratio of N_A and N_B
38. ${}_{92}\text{U}^{238}$ changes to ${}_{85}\text{At}^{210}$ by series of alpha, Beta decays. How many alpha, beta decay underwent?
39. Find the ratio between total acceleration of electron in singly ionized helium atom and hydrogen atom when both are in ground state.
40. The shortest wavelength of Brackett series of a hydrogen atom is the same as the shortest wavelength of Balmer series of hydrogen. Find the atomic no?
41. Find the maximum angular velocity of a electron of hydrogen atom in stationary orbit?
42. Find the ratio of maximum wavelength of Lyman series in hydrogen spectrum to the maximum wavelength in Paschen Series?
43. A electron and photon have same wavelength. If P is the momentum and E is energy of photon. Find the ratio of P/E.
44. B.E. per nucleon of hydrogen and helium are 1.1 eV and 7 MeV. Find the energy released in the process?
45. Find the probability of survival of a radioactive nucleus for one mean life?
46. The ratio of molecular mass of two radio active substances is 3/2 and ratio of their decay constant is 4/3. Find the ratio of their initial activity per mole?
47. A freshly prepared radio active substance of half life 2 hours emits radiation of intensity which is 64 times the permissible safe level. Find the minimum time after which it would possible to work with this source safely.
48. A star can convert all He nuclei completely into oxygen nuclei. Find the energy released per oxygen nuclei?

49. A beam of electron is used in YDS experiment. The slit width is d . What happens to fringe width?
50. A nucleus disintegrates in to two nuclear parts which have their velocities in the ratio 2 : 1. Find the ratio of their sizes
51. When a uranium originally at rest decays by emitting alpha particle having speed u . Find the recoil speed of residual nucleus?
52. The activity of a radioactive sample diminishes from 1024 to 128 in 2 min. Find how much activity diminishes in 6 min.
53. The activity of a radioactive element decreased to $1/3$ of the original activity I_0 in a period of 9 years. What its activity after further lapse of 9 years?
54. Half life of two substances A and B are 20 min and 40 min. Initially the sample have equal no of nuclei. Find after 80 min the ratio of remaining no of A and B nuclei?