MULTIPLE CHOICE QUESTIONS

1. Which of the following quantities is not conserved in a nuclear reaction?
   a. Mass b. Charge c. Momentum d. None of the above

Answer: (a) Mass

2. A radioactive nucleus emits a beta particle, then the parent and daughter nuclei are
   a. Isotones b. Isotopes c. Isomers d. Isobars

Answer: (d) Isobars

3. An electron emitted in beta radiation originates from
   a. free electrons existing in the nuclei b. inner orbits of an atom
   c. photon escaping from the nucleus d. decay of a neutron in a nuclei

Answer: (c) photon escaping from the nucleus

4. The light energy emitted by a star is due to
   a. Joining of nuclei b. Burning of nuclei
   c. Breaking of nuclei d. Reflection of solar light

Answer: (a) Joining of nuclei

5. In nuclear reactions, there is a conservation of
   a. Energy only b. Mass only c. Mass, energy and momentum d. Momentum only

Answer: (d) Momentum only

6. Which of the following are not emitted by radioactive substances?
   a. Protons b. Electrons c. Gamma Rays d. Helium Nuclei

Answer: (a) Protons

7. From where are the gamma rays originated?
   a. The innermost shell of the nucleus b. The outermost shell of the nucleus
   c. Nucleus d. The outermost shell of the atom

Answer: (c) Nucleus

8. Sun's radiant energy is due to
   a. Nuclear Fusion b. Nuclear Fission c. Photoelectric Effect d. Radioactive Decay

Answer: (a) Nuclear Fusion

9. A nucleus undergoes gamma decay due to
   a. Excess of neutrons b. Excess of protons c. Its excited state d. Large mass

Answer: (d) Its excited state

10. Isotones have the same number of
    a. Protons b. Electrons c. Neutrons d. All of the above

Answer: (c) Neutrons

11. The radioactive decay in which a helium nucleus is emitted is called ……
    (a) Gamma decay (b) alpha decay (c) negative beta decay (d) positive beta decay

12. Chlorine has two isotopes having masses 34.98 u and 36.98 u, then the mass of chlorine is

(a) **35.47 u** (b) 37.47 u (c) 34.98 u (d) 36.98 u

13. Which of the following is an isotopes of hydrogen

(a) **Tritium** (b) helium (c) carbon (d) oxyzen

14. The masses of the nuclei of hydrogen, deuterium and tritium are in the ratio of

(a) 3:2:1 **(b)1:2:3** (c) 2:1;3 (d) 3:1:2

15. The relation between mass number A and radius of atom is given by It has been found that a nucleus of mass number A has a radius

(a) $R = R_0\sqrt{A}$ (b) $R = \frac{R_0 A^2}{3}$ **(c)** $\boldsymbol{R = R_0 A^{\frac{1}{3}}}$ (d) $R = R_0 A^{\frac{5}{2}}$

16. The relation between mass number A and radius of atom is given by It has been found that a nucleus of mass number A has a radius

(a) $\boldsymbol{A \propto R^3}$ (b) $A^2 \propto R^3$ (c) $A \propto R^{\frac{1}{3}}$ (d) $A \propto \frac{1}{R^3}$

17. For all nuclei, the density of nucleus is ……

(a) Constant (b) independent of mass number

(c) both (a) and (b) are correct (d) $\rho \propto R^3$

18. The density of nuclear matter is approximately

(a) 10.3×10^{17} kg m^{-3} **(b) 2.3×10^{17} kg m^{-3}**

(c) 201.3×10^{17} kg m^{-3} (d) 23×10^{17} kg m^{-3}

19. Einstein mass-energy equivalence relation is

(a) $E = mc^2$ (b) $E = mc$ (c) $E = mc^3$ (d) $E = mc^{1/2}$

20. Which of the following statement is correct

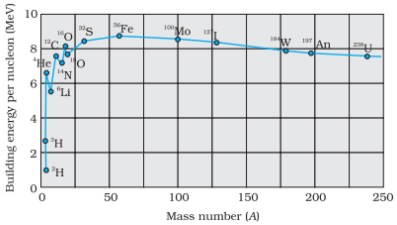
(a) The mass of the nucleus is more than the total mass of its individual protons and neutrons

(b) The mass of the nucleus is less than the total mass of its individual protons and neutrons

(c) The mass of the nucleus is equal to the total mass of its individual protons and neutrons

(d) All the above are correct.

21. Study the binding energy curve, and say which of the following statement is/are correct.



(a) It gives information about stability of the element.

(b) Binding energy of a heavy nucleus (A>170) is low. This idea is used in nuclear fission.

(c) Binding energy of a light nucleus (A<30) is low. This idea is used in nuclear fusion.

(d) All the above are correct

22. Which of the following statement is correct

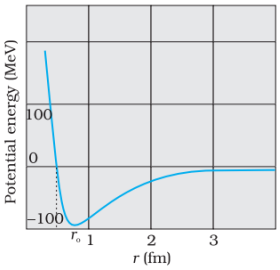
(a) The nuclear force is much stronger than the Coulomb force acting between charges

(b) The nuclear force is much weaker than the gravitational forces between masses

(c) The nuclear force is much weaker than the coulomb forces between masses

(d) The coulomb force is much weaker than the gravitational forces between masses

23. Study the Potential energy of a pair of nucleons as a function of their separation curve. which of the following statement is/are correct.



(a) For a separation greater than r_0 , the force is repulsive and for separations less than r_0 , the force is strongly repulsive.

(b)For a separation greater than r_0 , the force is attractive and for separations less than r_0 , the force is strongly atractive.

(c)For a separation greater than r_0 , the force is attractive and for separations less than r_0 , the force is strongly repulsive.

(d)For a separation greater than r_0 , the force is repulsive and for separations less than r_0 , the force is strongly attractive..

24. Which of the following is true in case of natural radio active decay,α
(a) α-decay in which a helium nucleus 4 2He is emitted;
(b) β-decay in which electrons or positrons are emitted;
(c) γ-decay in which high energy photons are emitted.
(d) All the above are correct

25. The enormous energy released in an atom bomb comes from
(a) **uncontrolled nuclear fission** (b) controlled nuclear fission
(b) uncontrolled nuclear fusion (d) controlled nuclear fusion

26. Fusion in the sun involves .....whose energies are much above the average energy
(a) **Protons** (b) electron (c) neutron (d) positron

27. The radioactive decay in which a helium nucleus is emited is .....
(a) Gamma decay **(b) alpha decay**
(c) negative beta decay (d) positive beta decay

FILL IN THE BLANKS

1. The atomic masses of various elements expressed in ..... (atomic mass unit)
2. Accurate measurement of atomic masses is carried out with a .....(mass spectrometer)
3. atomic species of the same element differing in mass are called ..... (isotopes)
4. All nuclides with same mass number A are called .....(isobars)
5. Nuclides with same neutron number N but different atomic number are called .....(isotones)
6. The difference in mass of a nucleus and its constituents is called .....(mass defect)
7. If a certain number of neutrons and protons are brought together to form a nucleus of a certain charge and mass, an energy will be released in the process, this energy is called ..... (binding energy)
8. If nuclei with less total binding energy transform to nuclei with ..... binding energy (greater)
9. The greater the binding energy, the ..... is the total mass of a bound system (less)
10. ..... is the source of energy output in the interior of stars. (Thermonuclear fusion)

3 MARKS QUESTIONS

1. Calculate the binding energy and binding energy per nucleon of an oxygen nucleus ($^{16}O_{8}$) using the following data (MeV).
   Mass of proton = 1.007825 u
   Mass of neutron = 1.008665 u
   Mass of oxygen nucleus = 15.995 u
2. Calculate the binding energy and binding energy per nucleon(in MeV) of a nitrogen nucleus($^{14}N_7$) From the following data:
   Mass of proton M=1.00783u ; Mass of neutron=1.00867u ; Mass of nitrogen nucleus=14.00307u ; Number of protons(Z)=7;Number of neutrons(n)=7; mass defect $\Delta m=[Z \times m_p + (A-Z) \times m_n] - M$.
3. Calculate the mass defect and binding energy (in MeV) of a nitrogen nucleus ($^{14}_{7}N$), given m ($^{14}_{7}N$) = 14.00307 u. and rest mass of proton is 1.00783 u, mass of neutron is 1.00867 u.
4. Obtain the binding energy of the nuclei $^{56}_{26}Fe$ and $^{209}_{83}Bi$ in units of MeV from the following data: m($^{56}_{26}Fe$) = 55.934939 u, m ($^{209}_{83}Bi$) = 208.980388 u.
5. A given coin has a mass of 3.0g. Calculate the nuclear energy that would be required to separate all the neutrons and protons from each other. For simplicity assume that the coin is entirely made of $^{63}_{29}Cu$ atoms (of mass 62.92960 u).
6. Find the Q value and the kinetic energy of the emitted α particle in the α decay of
   (i) $^{226}_{88}Ra$ (ii) $^{220}_{86}Rn$ given Mass of ($^{226}_{88}Ra$) = $226.02540u$, Mass of ($^{220}_{86}Rn$) = $222.01750u$.
7. The Q value of a nuclear reaction A +b →C + d is defined by $Q = [m_A + m_b - m_C - m_d]C^2$ where the masses refer to the respective nuclei. Determine from the given data the Q-value of the following reactions and state whether the reactions are exothermic or endothermic.
   (i) $^{1}_{1}H + ^{3}_{1}H \rightarrow ^{2}_{1}H + ^{2}_{1}H$ (ii) $^{12}_{6}C + ^{12}_{6}C \rightarrow ^{20}_{10}Ne + ^{4}_{2}He$, given m($^{2}_{1}H$) = 2.014102 u, m($^{3}_{1}H$) = 3.016049 u m($^{12}_{6}C$) =12.000000 u, m($^{20}_{10}Ne$) = 19.992439 u
8. The fission of a $^{56}_{26}Fe$ nucleus into two equal fragments, $^{28}_{13}Al$. Is the fission energetically possible? Find out the value of Q. Given Mass of ($^{56}_{26}Fe$) = $55.93494u$, Mass of ($^{28}_{13}Al$) = $27.98191u$.