ANSWER KEY-Assignment 1

MCQ: 1) b   2) d   3) b   4) a   5) c   6) d   7) c

ASSERTION AND REASON: 8) a 9) a   10) e

2-MARKS QUESTIONS

11.Due to large repulsive force between the large numbers of protons in the nucleus

12.Characteristic Features of Nuclear Force

Nuclear forces are short range attractive forces (range 2 to 3 fm) while Coulomb’s forces have range up to infinity and may be attractive or repulsive.

Nuclear forces are charge independent forces; while Coulomb's force acts only between charged particle

13. Protons are positively charged and repel one another electrically. This repulsion becomes so great in nuclei with more than 10 protons or so, that an excess of neutrons which produce only attractive forces, is required for stability

14. Atoms of same elements having same atomic number but different mass numbers known as isotopes. Eg. $_{17}Cl^{35}$, $_{17}Cl^{36}$ and $_{17}Cl^{37}$

Atoms of different elements with different atomic number but same mass number known as isobars.   Eg $_{18}Ar^{40}$, $_{20}Ca^{40}$

3-MARKS QUESTIONS

15. In nuclear fusion reaction, two or more than two smaller nucei get combine together to more stable nucleus. Nuclear fusion is not possible in laboratory because it requires very high temperature such as 10^6 to 10^7K. Such high temperature are often generated in nuclear fission. That is why fission precedes fusion. These processes cannot be carried out in laboratory

16. Mass of proton = 1.007825 u

Mass of neutron = 1.008665 u

Mass of Fe = 55.934939 u

Mass of 26 protons = 26 x 1.007825 u = 26.2035 u

No of neutrons = 56-26 = 30

Mass of 30 neutrons = 30 x 1,008665 u = 30.25995 u

Total mass of 56 nucleons = 26.2035 + 30.25995 = 56.4334 u

Mass defect = Total mass – mass of Fe = 56.4334 – 55.934939 = 0.528468 u

Binding energy = mass defect x 931.5 MeV = 0.528468 x 931.5 MeV

= 492.267942 MeV

Binding energy per nucleon = Binding energy/ mass number = 492.267942/56

= 8.790 MeV

1) No, the binding energy of ${}_1H^3$ is greater since more energy is required to bind 2 neutrons and 1 proton in ${}_1H^3$ than 2 protons and 1 neutron in ${}_2He^3$
2) As the number of nucleons is conserved in a nuclear reaction, the total rest mass of protons and neutrons on each other side of the reaction remains same. But the binding energies of nuclei on the two sides of the reaction different. It is this difference in B.E that appears as the energy released in the nuclear reactions.

5 MARKS QUESTIONS

17.

Nuclear Fission	**Nuclear Fusion**
When the nucleus of an atom splits into lighter nuclei through a nuclear reaction the process is termed nuclear fission.	Nuclear fusion is a reaction through which two or more light nuclei collide with each other to form a heavier nucleus.
When each atom split, a tremendous amount of energy is released	The energy released during nuclear fusion is several times greater than the energy released during nuclear fusion.
Fission reactions do not occur in nature naturally	Fusion reactions occur in stars and the sun
Little energy is needed to split an atom in a fission reaction	High energy is needed to bring fuse two or more atoms together in a fusion reaction
Atomic bomb works on the principle of nuclear fission	Hydrogen bomb works on the principle of a nuclear fusion bomb.

In both reactions there is a mass defect which is converted into energy.

Now energy released in the reaction

$Q = [\text{ mass}({}_1H^2) + \text{mass}({}_1H^3) – \text{mass}({}_2He^4) – \text{mass of neutron}]c^2$

= [2.014102 + 3.016049 -4.002603-1.008665] x 931.5 MeV

= 0.018883 x 931.5 MeV = 17.58 MeV

17. i) The approximate constancy of BE/A over most of the range is saturation property of nuclear force. In heavy nuclei, nuclear size > range of the nuclear force.

So a nuclear sense approximately a constant number of neighbhors and thus the nuclear BE/A levels off athigh A. This saturation of the nuclear force

ii) The mass of the nucleus of the atom of the mass number AA= A a.m.u.

$= A \times 1.660565\times10^{-27}$kg

The volume of the nucleus is $4/3\ \pi r^3 = 4/3\pi(R_O A^{-3})^3 = 4/3\pi R\ ^3 A_0$

$\therefore$Volume$=4/3\pi(1.1\times10^{-15})^3\times$Am3

Now the density of the nucleus= m/V; where m is mass and V is the volume of the nucleus.

$\rho = A \times 1.660565\times10^{-27}$kg $/4/3\pi(1.1\times10^{-15})^3 = 2.97\times10^{17}$ Kgm−3

Thus, we can see the density of the nuclei is independent of mass number and it is constant for all nuclei

3 MARKS QUESTIONS- CASE STUDY

18. (I) b (II) b (III) b (IV) a20.(I) a (II) d (III) d (IV) a