

Answers

Module 1 : Are Electrons Present Inside the Nucleus?

A.13.1.1 (C) During beta decay ${}_0^1n \rightarrow {}_{-1}^0e + {}_1^1p + \bar{\nu}$ results ${}_Z^AX \rightarrow {}_{Z+1}^AY + {}_{-1}^0e + \bar{\nu}$

A.13.1.2 (A) beta decay is ${}_0^1n \rightarrow {}_{-1}^0e + {}_1^1p + \bar{\nu}$

A.13.1.3 (D) Beta decay results in ${}_Z^AX \rightarrow {}_{Z+1}^AY + {}_{-1}^0e + \bar{\nu}$

A.13.1.4 (C) ${}_Z^AX \rightarrow {}_{+1}^0e + {}_{Z-1}^AY + \nu$

A.13.1.5 (D) During beta decay, neutrons get converted to proton. Total number of nucleons remain unchanged.

A.13.1.6 (C) Energy levels of the atom remains unaffected in gamma decay. Alpha particle carries two units of positive charge and beta particle carries one unit of negative charge.

A.13.1.7 (D) Alpha decay is emission of ${}_2^4He$ which results in ${}_Z^AX \rightarrow {}_{Z-2}^{A-4}Y + {}_2^4He$

A.13.1.8 (B) and (C) Neutrons , Protons and electrons are spin $\frac{1}{2}$ particles .Thus if ν or $\bar{\nu}$ each of spin $\frac{1}{2}$ are not included then spin angular momentum does not get conserved.

A.13.1.9 (A) Only in A total charge is conserved.

A.13.1.10 (A) ${}_1^1p \rightarrow {}_0^1n + {}_{-1}^0e + \nu$ is the positron emission (e^+ decay process).



Module 2: Nuclear Binding Energy

A.13.2.1 (B) Because very light nuclei and very high nuclei have comparatively lower values of lower binding energy. In (A), the values for large atomic number nuclei are very low, which is incorrect.

A.13.2.2 (D) Because ^{56}Fe has higher B.E. per nucleon.

A.13.2.3 (B) As the constancy of binding energy is possible only if the nuclear forces act only between immediate neighboring nucleons, i.e., the nuclear forces are short range forces. Otherwise, the binding energy would continuously increase with increase in mass number.

A.13.2.4 (B) The result is evident from the B.E. vs mass number graph. The B.E. has a low value for small nuclei with small A and increases with an increase in mass number.

A.13.2.5 (A) The result is evident from the B.E. vs mass number graph. The B.E. has a low value for very heavy nuclei and comparatively larger for nuclei with moderate mass number.

A.13.2.6 (A) The result is evident from the B.E. vs mass number graph. ^{56}Fe is the most stable nucleus. Spontaneous decays are possible only with the release of energy and production of more stable nuclei.

A.13.2.7 (C) By definition of amu.

A.13.2.8 (C) Presence of more neutrons causes a more attractive strong nuclear force to overcome proton-proton repulsion.

A.13.2.9 (C) Lighter nuclei fuse resulting in nucleons with greater B.E. and hence greater stability.

nucleus, some mass is converted into energy according to Einstein's mass-energy equivalence ($E = mc^2$), resulting in the release of nuclear binding energy.

A.13.2.10

Option (A) is correct. (Refer to Fig. A.13.2.1). The binding energy per nucleon (the binding energy divided by the number of nucleons) increases with increasing mass number until it reaches its maximum value around the mass number 56.

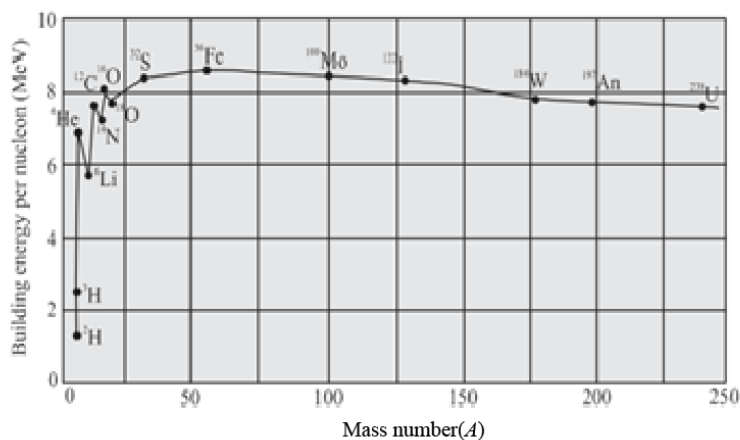


Fig. A.13.2.1

(B) is incorrect.

(C) and (D) Binding energy per nucleon, is practically independent of the atomic number for nuclei of middle mass number ($30 < A < 170$) only. Binding energy per nucleon curve has a maximum value for $A = 56$.



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