PHYSICS

BOOKS - MODERN PUBLICATION

STRUCTURE OF NUCLEUS

Example

1. What are the number of protons and the number of neutrons in a nucleus of U^{238}_92?

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2. Calculate the radius of oxygen nucleus .Given that $R_0 = 1.1 \times 10^{-15} m.$

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3. Express 16 mg mass into equivalent energy in electron volt.

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4. Find binding energy per nucleon for helium nuclei. Given that mass of helium nucleus = 4.001509 amu, mass of proton=1.007277 amu and mass of neutron = 1.0086666 amu.

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5. A nucleus of mass number 225 splits into two fresh nuclei having mass numbers in the ratio $3:2$.If the nuclear radius is given by $R = 1.1 \times 10^{-15} a^{1/3} m$,find the radii of the new nuclei formed.

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6. Assuming that protons and neutrons have equal masses,calculate how many times nuclear matter is denser than water.Given that nuclear radius is given by $R = 1.2 \times 10^{-15} A^{1/3}$ metre and mass of a nucleon $=1.67 \times 10^{-27} kg$.

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7. The mass of deutron $\left({}_1h^2 \right)$ nucleus is 2.0135553 a.m.u.If the masses of proton and neutron are 1.007275 a.m.u. and 1.008665 a.m.u. respectrively.Calculate the mass defect,the packing fraction,binding energy and binding energy per nculeon.

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8. The binding energy per nucleon of $_{2}He^{4}$ is 7.075 MeV.

What is its total binding energy?

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9. The binding energy per nucleon of $_{2}He^{4}$ is 7.075 MeV.

If the masses of prton and neutron are 1.007270 a.m.u. and 1.008665 a.m.u. respectively,find the mass of $_{2}He^{4}$ nucleus.

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10. The binding energies per nucleon in case of deutron $\left(-1H^{2}\right)$ and α-particle $\left(-2He^{4}\right)$ are 1.25 MeV and 7.2 MeV respectively. Which nucleus is more stable?

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11. How many electrons, protons and neutrons are there in a nucleous of atomic number 11 and mass number 24?

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12. How many eelcrtrons,protons and neutons are there in 16g of $_8O^{16}$?

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13. Is free neutron a stable particle?

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14. Give an equation representing the decay of a free neutron.

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15. What are isotopes?

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16. What is meant by the terms'isotope'?

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17. What are isobars ?

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18. What are Isotones ?

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19. Select the pairs of isobars and isotones from the following :

$\_11\mathrm{Na}\hat{}22,\ {}_{12}Mg^{24}, \_11\mathrm{Na}\hat{}24,\ {}_{10}Na^{23}$

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20. Select the pairs of isotopes and isotones from the following:

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21. Select the pairs of isobars and isotones from the following :

$\_12\mathrm{Mg}\hat{}24, {}^{3}_{H}, \_2\mathrm{He}\hat{}4,\ {}_{11}Na^{23}$

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22. Write the expression for size of the nucleus.

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23. What will be the ratio of the radii of two nuclei of mass number A_1 and A_2?

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24. What is the order of the magnitude of the denstiy of the nucleus?

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25. Two nuclei have mass numbers in the ratio 1:3. What is the ratio of their nuclear densities?

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26. What is the ratio of the nuclear densities of the two nuclei having mass numbers in the ratio 1:4?

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27. All protons in an atom remain packed in a small nucleius inspite of the electrostatic repulsive force among them.Why?

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28. The forces holding the nucleus together inside the nucleus are called nuclear forces. (True /false)

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29. What are nuclear forces ? Discuss fourimportant properties of nuclear forces.

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30. State two characterstics properties of nuclear forces?

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31. What do you mean by the charge independent nature of nuclear forces?

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32. Why it is said that nuclear forces are saturated forces?

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33. What characteristic properties of nuclear force explains the constancy of binding energy per nucleon (B.E//A) in the range of mass number A lying $30 < A < 170$?

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34. What it Einstein's mass energy relation?

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35. Define atomic mass unit? Find its energy equivalent in MeV.

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36. What is atomic mass unit?

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37. Express unified atomic mass unit in kg.

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38. How many joules are there in MeV?

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39. Find mass defect

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40. What do you mean be mass defect of a nucleus?

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41. Define Binding energy of the nucleus. Draw and explain curve between Binding Energy per nucleon and mass number.

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42. A nucleus of mass number A, has a mass defect Δm. Give the formula, for the binding energy per nucleon of this nucleus.

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43. What are the constituents of the nucleus?Give four properties of neutrons.

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44. ifferentiate between Isotopes and Isobars with suitable examples.

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45. ifferentiate between Isotopes and Isobars with suitable examples.

Watch Video Solution

46. Differentiate between Isotones and Isotopes with suitableexamples.

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47. ifferentiate between Isotopes and Isobars with suitable examples.

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48. What is meant by size of nucleus? do all nuclei are of same size?

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49. The radius of $_{}(13)AI^{27}$ nucleus is estimated to be 3.6 fermi.Find the radius of $_{}(52)Te^{125}$ nucleus.

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50. State three properties of nuclear forces. Show that the density of nuclear matter is independent of mass number A.

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51. Why is nuclear density the same for all nuclei?

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52. State three properties of nuclear forces. Show that the density of nuclear matter is independent of mass number A.

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53. Why is the denstiy of nucleus more than that of the atom?

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54. You are given two nuclides ${}_3X^7$ and ${}_3X^4$:

Are they isotope of the same element? Why?

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55. You are given two nuclides ${}_3X^7$ and ${}_3X^4$:

Which one of the two is likely to be more stable?

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56. What are nuclear forces ? State their four properties.

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57. Give two important characteristics of nuclear forces.

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58. Draw a plot of potential energy of a pair of nucleons as a function of their separation.Write tow important conclusions,which yuou can draw regarding the nature of nuclear forces.

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59. The energy equivalent of one atomic mass unit is:

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60. Define atomic mass unit? Find its energy equivalent in MeV.

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61. Give the relation between a.m.u. and MeV.

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62. Express one Joule in eV.Taking 1 a.m.u. = 931 MeV,calculate the mass of C-12 atom.

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63. What is mass defect?

Watch Video Solution

64. What is mass defect?

Watch Video Solution

65. Value of tan A is always less than 1.

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66. The mass of a H-atom is less than the sum of the masses of a proton and electron. Why is this?

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67. Define Binding energy of the nucleus. Draw and explain curve between Binding Energy per nucleon and mass number.

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68. Draw the graph showing variation of binding energy per nucleon with mass number. Write the inferences drawn from the graph.

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69. Draw the graph showing variation of binding energy per nucleon with mass number. Write the inferences drawn from the graph.

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71. Draw the graph showing variation of binding energy per nucleon with mass number. Write the inferences drawn from the graph.

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72. For greater stability,a nucleius hsold have greater value of binding energy per nucleon.Why?

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73. What do you mean by binding energy ? Explain the significance of binding energy per nucleon in the stability of nucleus.

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74. How will you correlate B.E. with stability of a nucleus?

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75. Draw the graph showing variation of binding energy per nucleon with mass number. Write the inferences drawn from the graph.

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80. Heavy stable nuclie have more neutrons than protons. This is because of the fact that

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81. Heavy stable nuclie have more neutrons than protons. This is because of the fact that

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82. With the help of example explain how the neutron-proton ratio changes during $\alpha - decay$ of the nucleus.

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83. The neutron to proton ratio increases during β-decay. (True /false)

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84. The isotope $_8O^{16}$ has 8 proton ,8 neutrons and 8 electons,while $_4Be^8$ has 4 protons ,4 neutrons nad 4 electrons.Yet hte ratio fo theirr atomic masses is not exactly 2..Why?

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85. The atomic mass of an element is the weighted average of the atomic masses of different isotopes of that element .This

explains,why atomic masses of many elements show large departures from integer values.However ,even if we consider msases of individual isotpes,they are not strictly integer multiples of the mass of a hydroen atom.How do yo account for this fact?

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86. M_1 and M_2 represent the masses of $_(10)Ne^{20}$ nucleus and $_(20)Ca^{40}$ nucleus respectively.State ,whether $M_1 = 2M_1$ or $M_2 > 2M_1$ or $M_2 < M_1$?

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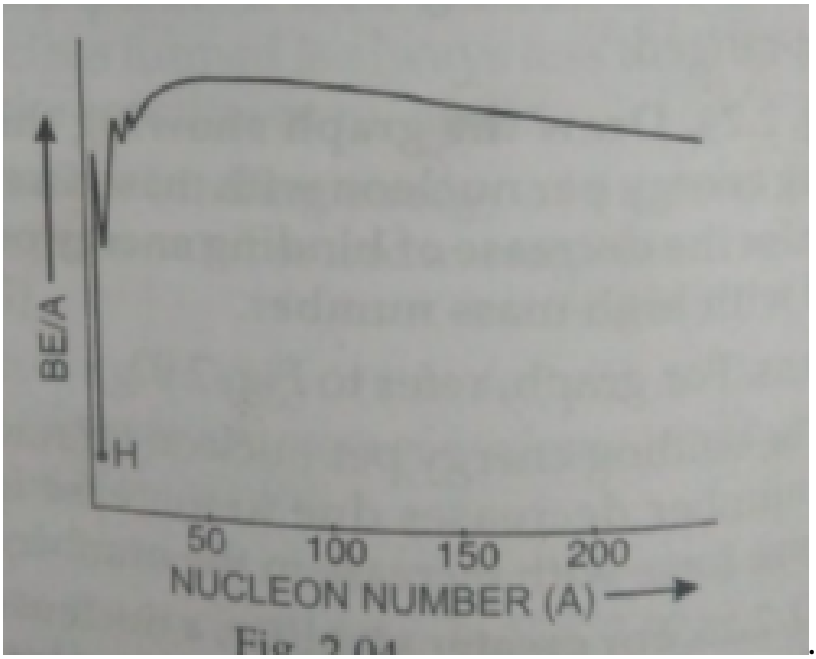
87. The variation with nucleon number A of the finding energy per nucleon of nuclei is hsown in Fig.2.04.

mark the approximate position of

iron-56 (label this pont Fe),



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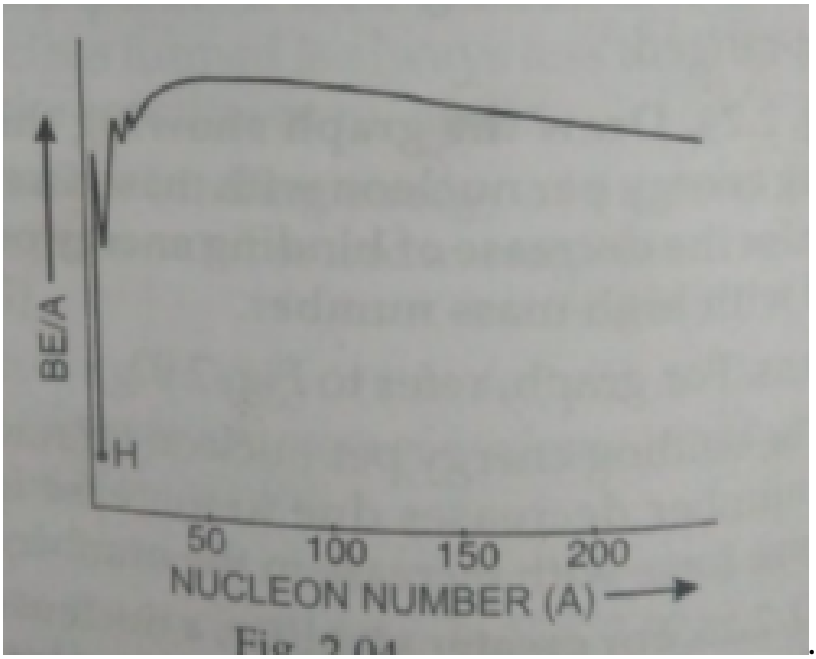
88. The variation with nucleon number A of hte inding energy per nucleon of nuclei is hsown in Fig.2.04.

mark the approximate position of

zirconium -97 (label this point Zr),



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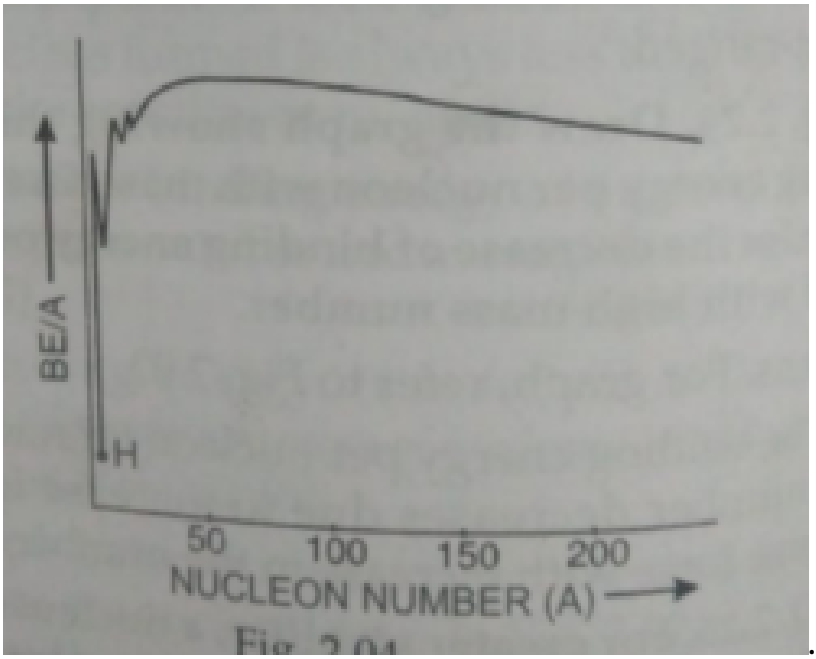
89. The variation with nucleon number A of hte inding energy per nucleon of nuclei is hsown in Fig.2.04.

mark the approximate position of

hydrogen - 2(lable this point H).



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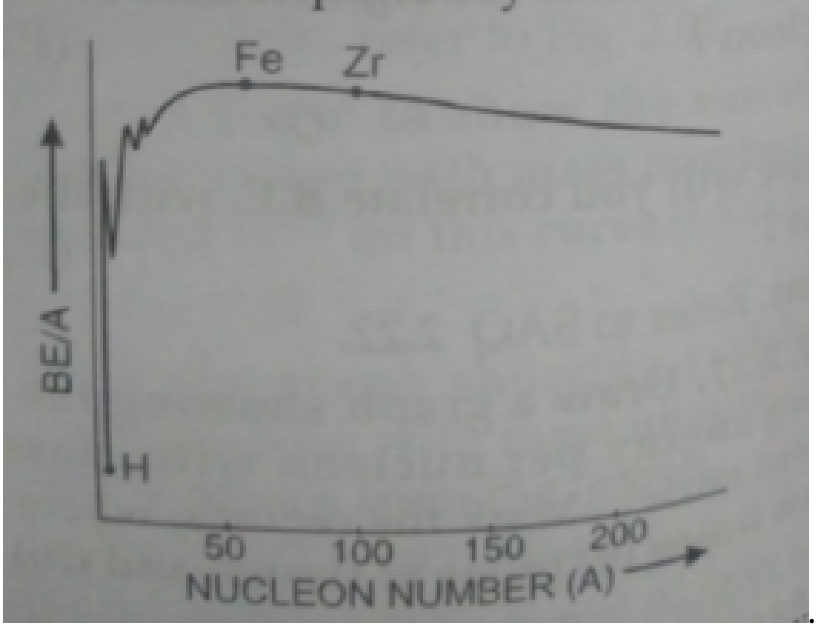
90. By refrerece to fig.2.05 explain how fission is energetically possible.



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91. Is the isotope $_{}(16)S^{38}$ of sulphur likely to be stable?

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Exercise

1. Define atomic number.

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2. Why is the denstiy of nucleus more than that of the atom?

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3. Explain any three properties of the nucleus.

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4. What it Einstein's mass energy relation?

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5. Define the atomic mass unit?

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6. Define the atomic mass unit?

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7. What are nuclear forces ? State their four properties.

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10. State and explain binding energy of a nucleus.

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11. Draw the graph showing variation of binding energy per nucleon with mass number. Write the inferences drawn from the graph.

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12. Define binding energy, binding energy per nucleon. Draw and explain a curve between binding energy per nucleon and mass number.

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13. State and explain mass defect and packing fraction.

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14. What is mass defect?

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15. With the help of example explain how the neutron-proton ratio changes during $\alpha - decay$ of the nucleus.

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16. Explain with the help of nuclear reaction in each of the following cases, how the neutron to proton ratio changes during beta decay?

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17. Draw a plot of potential energy of a pair of nucleons as a function of their separation.Write tow important conclusions,which yuou can draw regarding the nature of nuclear forces.

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18. What are nuclear forces ? Discuss fourimportant properties of nuclear forces.

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20. Draw a plot of potential energy of a pair of nucleons as a function of their separation.Write tow important conclusions,which yuou can draw regarding the nature of nuclear forces.

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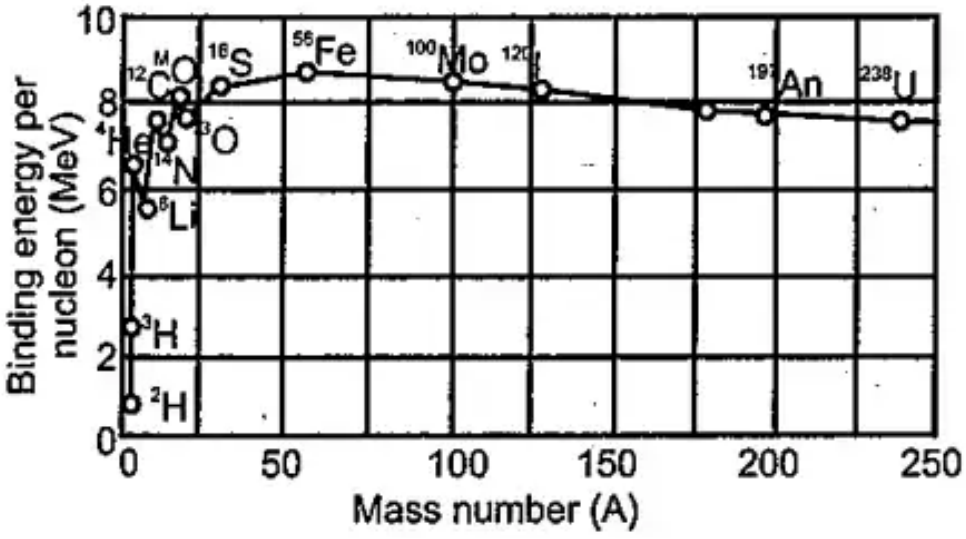
21. Use this graph to explain the release of energy in both the processes of nuclear fusion and fission.



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22. Write the basic nuclear processes of neutron undergiong β-decay .Why is the detection of neutrinos found very difficult?

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28. Write two characteristic features of nuclear force,which distiguish it from the \Coulomb force.

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29. The radius of oxygen nucleus $_8O^{16}$ is $2.8 \times 10^{-15} m$. Calculate the radius of the lead nucleus $_{(82)}Pb^{207}$.

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30. Compare the radii nuclei with mass number 1 and 27 respectively.

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31. Calculate the density of hydroen nucleus in SI units .Given , $R_0 = 1.1 \times 10^{-15} m$ and $1a.m.u = 1.66 \times 10^{-27} kg$.

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32. Express unified atomic mass unit in kg.

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33. The mass of $_3Li^7$ nucleus is 0.042 a.m.u. less than the sum of masses of its nucleons.Find th binding energy per nucleon.

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34. Find mass defect, binding energy and binding energy per nucleon for $_{26}Fe^{56}$ nucleus. Mass of $_{26}Fe^{56}$ nucleus = 55.934939 , Mass of neutron =1.008665 amu ,Mass of proton =1.007825 amu and 1 amu = 931 MeV

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35. Find out binding energy and binding energy per nucleon of ${}_3Li^7$ nucleus. Given mass of proton = 1.00782 amu mass of a neutron = 1.00866 amu and mass of "_3Li^7"_3(Lithium)^7` nucleus = 7.01599 amu.

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36. Find binding energy per nucleon for helium nuclei. Given that mass of helium nucleus = 4.001509 amu, mass of proton=1.007277 amu and mass of neutron = 1.0086666 amu.

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37. Obtain the binding energy (in MeV) of a nitrogen nucleus $\left({}_7^{14}N\right)$, given m $\left({}_7^{14}N\right)$ =14.00307 u

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38. Calculate the binding energy per nucleon of $_8O^{16}$ nucleus .Given that mass of $_8O^{16}$nucleus = 15.994914 a.m.u. mass of proton = 1.007825 a.m.u,mass of neutron = 1.008665 a.m.u. and $1.\ am.\ m.\ u = 931.5MeV$

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39. Calculate the binding enegy per nucleon of $_(17)Cl^{35}$ nucleus given that mass of $_(17)Cl^{35}$ nucleus = 34.98000 a.m.u. mass of proton = 1.007825 a.m.u.,mass of neturon = 1.008665 a.m.u. nad 1 a.m.u 931.5 MeV.

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40. Calculate the binding energy per nucleon of $_{20}Ca^{40}$nucleus. Given mass of $_{20}Ca^{40}$ nucleus = 39.962589 a.m.u., mass of proton = 1.007825 a.m.u., mass of neutron = 1.008665 a.m.u. and 1 a.m.u. = 931.5 MeV.

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41. Find mass defect, binding energy and binding energy per nucleon for $_{26}Fe^{56}$ nucleus. Mass of $_{26}Fe^{56}$ nucleus = 55.934939 , Mass of neutron =1.008665 amu ,Mass of proton =1.007825 amu and 1 amu = 931 MeV

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42. Calculate the binding enregy per nucleon of $_{}(83)Bi^{209}$. Given ,$m_N\left(_{}(83)Bi^{209}\right)$ = 208.980388 a.m.u.,m(neutron) =

1.008665 a.m.u and m(proton)=1.007825 a.m.u.Given that 1a.m.u. $=$ 931.5 MeV.

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43. Calculate mass defect, binding energy and binding energy per nucleon of deuteron $({}_1H^2)$ nucleus. Given mass of proton=1.007275 a.m.u., mass of neutron = 1.008665 a.m.u. and mass of deuteron =2.013553 a.m.u.

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44. Calculate the binding energy per nucleon (in MeV) of the nucleous ${}^{56}_{26}Fe$. [Given: mass of ${}^{1}_{1}H$=1.007825 u, mass of ${}^{1}_{0}n$ =1.008665 u,

mass of ${}^{56}_{26}Fe$=55.934939u. $1u = 931MeV/c^2$]

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45. Calculate the

the binding energy per nucleon for a $_6C^{12}$ nucleus. Nuclear mass of $_6C^{12}$= 12.000000 a.m.u.,mass of hydrogen nucleus =1.007825 a.m.u. and mass of neutron = 1.008665 a.m.u.

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46. Calculate the binding enegy per nucleon of $_(17)Cl^{35}$ nucleus given that mass of $_(17)Cl^{35}$ nucleus = 34.98000 a.m.u. mass of proton = 1.007825 a.m.u.,mass of neturon = 1.008665 a.m.u. nad 1 a.m.u 931.5 MeV.

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47. Find binding energy per nucleon for helium nuclei. Given that mass of helium nucleus = 4.001509 amu, mass of proton=1.007277 amu and mass of neutron = 1.0086666 amu.

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