PHYSICS

BOOKS - MTG PHYSICS (ENGLISH)

NUCLEI

Mcqs

1. The set which repesents the isotope , isobar and isotone respectively is

A. $\left(._{1}^{2} H, ._{1}^{3} H\right), \left(._{79}^{197} Au, ._{80}^{198} Hg\right)$ and $\left(._{2}^{3} He, ._{1}^{2} H\right)$

B. $\left(._{2}^{3} H, ._{1}^{1} H\right), \left(._{79}^{197} Au, ._{80}^{198} Hg\right)$ and $\left(._{1}^{1} He, ._{1}^{3} H\right)$

C. $\left(._{2}^{3} H, ._{1}^{3} H\right), \left(._{1}^{2} H, ._{1}^{2} H\right)$ and $\left(._{79}^{197} Au, ._{80}^{198} Hg\right)$

D. $\left(._1^2 H, ._1^3 H\right), \left(._2^3 He, ._1^3 H\right)$ and $\left(._{79}^{197} Au, ._{80}^{198} Hg\right)$

Answer: D

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2. The natural boron of atomic weight 10.81 is found to have two isotopes $.^{10} B$ and $.^{11} B$ .The ratio of abundance of isotopes of natural boron should be

A. $11 : 10$

B. $81 : 19$

C. $10 : 11$

D. $19 : 81$

Answer: d

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3. Two stable isotopes of lithium $._3^6Li$ and $._3^7Li$ have respective abundances of 7.5% and 92.5% . These isotopes have masses 6.0152 u and 7.016004 u respectively. Find the atomic weight of lithium

A. 6.941 u

B. 3.321 u

C. 2.561 u

D. 0.621 u

Answer: a

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4. The most common kind of iron nucleus has a mass number of 56. Find the approximate density of the nucleus.

A. $2.29 \times 10^{16} \text{kg m}^{-3}$

B. $2.29 \times 10^{17} \text{kg m}^{-3}$

C. $2.29 \times 10^{18} \text{kg m}^{-3}$

D. $2.29 \times 10^{15} \text{kg m}^{-3}$

Answer: b

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5. Order of magnitude of density of uranium nucleus is , [m = 1.67 x 10^(-27) kg]`

A. 10^{20}kg m^{-3}

B. 10^{17}kg m^{-3}

C. 10^{14}kg m^{-3}

D. 10^{11}kg m^{-3}

Answer: b

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6. Two nuclei have their mass numbers in the ratio of 1:3. The ratio of their nuclear densities would be

A. $(3)^{1/3} : 1$

B. $1 : 1$

C. $1 : 3$

D. $3 : 1$

Answer: b

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7. The radius of a spherical nucleus as measured by electron scattering is 3.6 fm. What is the mass number of the nucleus most likely to be ?

A. 27

B. 40

C. 56

D. 120

Answer: a

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8. The ratio of the nuclear radii of the gold isotope $._{79}^{197}Au$ and silver isotope $._{47}^{107}Ag$ is

A. 1.23

B. 0.216

C. 2.13

D. 3.46

Answer: a

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9. If the nucleus of $._{13}Al^{27}$ has a nuclear radius of about 3.6 fm, then $._{52}Te^{125}$ would have its radius approximately as

A. 9.6 fm

B. 12 fm

C. 4.8 fm

D. 6 fm

Answer: d

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10. How much mass has to be converted into energy to produce electric power of 500 MW for one hour ?

A. 2×10^{-5} kg

B. 1×10^{-5} kg

C. 3×10^{-5} kg

D. 4×10^{-5} kg

Answer: a

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11. if in a nuclear fusion reaction, mass defect to 0.3% , then energy released in fusion of 1 kg mass

A. 27×10^{10} J

B. 27×10^{11} J

C. 27×10^{12} J

D. 27×10^{13} J

Answer: d

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12. The equivalent energy of 1 g of substance is

A. 9×10^{13} J

B. 6×10^{12} J

C. 3×10^{13} J

D. 6×10^{13} J

Answer: a

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13. Fission of nuclei is possible because the binding energy per nuclei in them

A. increases with mass number at low mass numbers

B. decreases with mass number at low mass numbers

C. increases with mass number at high mass numbers

D. decreases with mass number at high mass numbers

Answer: d

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14. The mass of $._{3}^{7}Li$ is 0.042 amu less than the sum of masses of its constituents. The binding energy per nucleon is

A. 5.586 MeV

B. 10.522 MeV

C. 2.433 MeV

D. 3.739 MeV

Answer: a

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15. The binding energy per nucleon of deuterium and helium nuclei are 1.1 MeV and 7.0 MeV respectively. When two deuterium nuclei fuse to form a helium nucleus the energy released in the fusion is

A. 23.6 MeV

B. 2.2 MeV

C. 28.0 MeV

D. 30.2 MeV

Answer: a

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16. Let m_p be the mass of a proton , m_n the mass of a neutron, M_1 the mass of a $._{10}^{20}Ne$ nucleus and M_2 the mass of a $._{20}^{40}Ca$ nucleus . Then

A. $M_2 = M_1$

B. $M_2 > M_1$

C. $M_2 < 2M_1$

D. $M_1 < 10(m_n + m_p)$

Answer: d

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17. The mass of proton is 1.0073 u and that of neutron is 1.0087 u (u=atomic mass unit). The binding energy of $._{2}^{4}He$, if mass of $._{2}^{4}He$ is 4.0015 u is

A. 0.0305 erg

B. 0.0305 J

C. 28.4 MeV

D. 0.061 u

Answer: c

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18. If the binding energy per nucleon of deuterium is 1.115 MeV, its mass defect in atomic mass unit is

A. 0.0048

B. 0.0024

C. 0.0012

D. 0.0006

Answer: b

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19. The half - life period of a radioactive element x is same as the mean life time of another radioactive element y Initially both of them have the same number of atoms. Then,n

A. X and Y decay at same rate always

B. X will decay faster than Y

C. Y will decay faster than X

D. X and Y have same decay rate initially

Answer: c

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20. Sample of two radioactive nuclides A and B are taken. λ_A and λ_B are the disintergration constants of A and B respectively. In which of the following cases, the two sample can simultaneously have the same decay rate at any time ?

A. Initial rate of decay of A is twice the initial rate of decay of B and $\lambda_A = \lambda_B$.

B. Initial rate of decay of A is twice the initial rate of decay of B and $\lambda_A > \lambda_B$.

C. Initial rate of decay of B is twice the initial rate of decay of A and $\lambda_A > \lambda_B$.

D. Initial rate of decay of B is twice the initial rate of decay of A at t=2h and $\lambda_B = \lambda_A$

Answer: b

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21. The half life of $._{92}^{238}U$ undergoing α-decay is 4.5×10^9 years. The activity of 1 g sample of $._{92}^{238}U$ is

A. 1.23×10^4 Bq

B. 1.23×10^5 Bq

C. 1.23×10^3 Bq

D. 1.23×10^6 Bq

Answer: a

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22. The half life of a radioactive substance is 20s, the time taken for the sample to decay by $7/8^{th}$ of its initial value is

A. 20 s

B. 40 s

C. 60 s

D. 80 s

Answer: c

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23. 1 mg redium has 2.68×10^{18} atoms. Its half life is 1620 years. How many radium atoms will disintegrate from 1 mg of pure radium in 3240 years ?

A. 2.01×10^{9}

B. 2.01×10^{18}

C. 1.01×10^{9}

D. 1.01×10^{18}

Answer: b

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24. Radon has 3.8 days as its half-life . How much radon will be left out of 15 mg mass after 38 days ?

A. 1.05 mg

B. 0.015 mg

C. 0.231 mg

D. 0.50 mg

Answer: b

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25. The half life of a radioactive substance is 30 days. What is the time taken to disintegrate to $3/4^{th}$ of its original mass ?

A. 30 days

B. 15 days

C. 60 days

D. 90 days

Answer: c

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26. The half life of polonium is 140 days. In what time will 15 g of polonium be disintegrated out of its initial mass of 16 g ?

A. 230 days

B. 560 days

C. 730 days

D. 160 days

Answer: b

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27. In a sample of radioactive material , what fraction of the initial number of active nuclei will remain undisintegrated after half of the half life of the sample ?

A. $\frac{1}{4}$

B. $\frac{1}{2\sqrt{2}}$

C. $\frac{1}{\sqrt{2}}$

D. $\sqrt{2}-1$

Answer: c

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28. At a given instant, there are 25% undecayed radioactive nuclei in a sample. After 10 seconds the number of undecayed nuclei reduces to 12.5%, the mean life of the nuclei is

A. 10.21 s

B. 14.43 s

C. 5.31 s

D. 7.43 s

Answer: b

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29. Two redioactive nuclei A and B have disintegration constants λ_A and λ_B and initially N_A and N_B number of nuclei of them are taken, then the time after which their undisintegrated nuclei are same is

A. $\frac{\lambda_A \lambda_B}{(\lambda_A - \lambda_B)} \text{In}\left(\frac{N_B}{N_A}\right)$

B. $\frac{1}{(\lambda_A + \lambda_B)} \text{In}\left(\frac{N_B}{N_A}\right)$

C. $\frac{1}{(\lambda_B - \lambda_A)} \text{In}\left(\frac{N_B}{N_A}\right)$

D. $\frac{1}{(\lambda_A - \lambda_B)} \text{In}\left(\frac{N_B}{N_A}\right)$

Answer: c

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30. A freshly prepared radioactive source of half-life $2h$ emits radiation of intensity which is 64 times the permissible safe level. The minimum time after which it would be possible to work safely with this source is

A. 128 h

B. 24 h

C. 6 h

D. 12 h

Answer: d

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31. Two samples X and Y contain equal amount of radioactive substances. If $\frac{1^{th}}{16}$ of the sample Y, remain after 8 hours, then the ratio of half life periods of X and Y is

A. $2:1$

B. $1:2$

C. $1:4$

D. $4:1$

Answer: a

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32. The decay constant of a radioactive isotope is λ. If A_1 and A_2 are its activites at time t_1 and t_2 respectively, then the number of nuclei which have decayed the time $(t_1 - t_2)$

A. $A_1 t_1 - A_2 t_2$

B. $A_1 - A_2$

C. $(A_1 - A_2)/\lambda$

D. $\lambda(A_1 - A_2)$

Answer: c

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33. A 280 day old radioactive substances shows an activity of 6000 dps, 140 days later its activity becomes 3000 dps. What was its initial activity ?

A. 20000 dps

B. 24000 dps

C. 12000 dps

D. 6000 dps

Answer: b

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34. Tritium has a half life of 12.5 years against beta decay. What fraction of a sample of pure tritium will remain undecayed after 25 years?

A. one half

B. one fourth

C. one third

D. can't say

Answer: b

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35. The decay constant , for a given radioactive sample, is 0.3465 day^{-1} .What percentage of this sample will get decayed in a period of 4 days ?

A. $100\ \%$

B. $50\ \%$

C. $75\ \%$

D. $10\ \%$

Answer: c

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36. The count rate of a radioactive sample falls from $4.0 \times 10^6 s^{-1}$ to $1.0 \times 10^6 s^{-1}$ in 20 hours. What will be the count rate after 100 hours from beginning ?

A. $3.91 \times 10^3 s^{-1}$

B. $3.91 \times 10^2 s^{-1}$

C. $3.91 \times 10^4 s^{-1}$

D. $3.91 \times 10^6 s^{-1}$

Answer: a

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37. Carbon dating is best suited for determining the age of fossils of their age in years is of the order of

A. 10^3

B. 10^4

C. 10^5

D. 10^6

Answer: b

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38. The half life of radioactive Radon is $3.8 days$. The time at the end of which $\frac{1}{20} th$ of the radon sample will remain undecayed is $(given \log e = 0.4343)$

A. 3.8 days

B. 16.5 days

C. 33 days

D. 76 days

Answer: b

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39. A radioactive element X with half life 2 h decays giving a stable element Y. After a time t, ratio of X and Y atoms is 1:16 .Time t is

A. 6 h

B. 4 h

C. 8 h

D. 16 h

Answer: c

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40. The half life of $._{38}^{90}Sr$ is 28 years. The disintegration rate of 15 mg of this isotope is of the order of

A. 10^{11} Bq

B. 10^{10} Bq

C. 10^{7} Bq

D. 10^{9} Bq

Answer: b

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41. A sample of a radioactive element has a mass of 10 g at an instant t=0. The approximate mass of this element in the sample left after two mean lives is

A. 1.35 g

B. 2.50 g

C. 3.70 g

D. 6.30 g

Answer: a

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42. The count rate from $100cm^3$ of a radioactive liquid is c. Some of this liquid is now discarded. The count rate of the remaining liquid is found to be $c/10$ after three half-lives. The volume of the remaining liquid, in cm^3, is

A. 20

B. 40

C. 60

D. 80

Answer: d

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43. A sample of radioactive material has mass m, decay constant λ, and molecular weight M. Avogadro constant $= N_A$. The initial activity of the sample is:

A. λm

B. $\frac{\lambda m}{M}$

C. $\frac{\lambda m N_A}{M}$

D. $m N_A \lambda$

Answer: c

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44. Two radioactive substance A and B have decay constants 5λ and λ respectively. At $t = 0$ they have the same number of nuclei. The ratio of number of nuclei of nuclei of A to those of B will be $\left(\frac{1}{e}\right)^2$ after a time interval

A. 4λ

B. 2λ

C. $1/2\lambda$

D. $1/4\lambda$

Answer: c

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45. Plutonium decays with half life of 24000 years. If plutonium is stored for 72000 years, the fraction of it that remains is

A. $1/8$

B. $1/3$

C. $1/4$

D. $1/2$

Answer: a

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46. A fraction f_1 of a radioactive sample decays in one mean life, and a fraction f_2 decays in one half life. Then

A. $f_1 > f_2$

B. $f_1 < f_2$

C. $f_1 = f_2$

D. either of (a),(b) or (c) depending on the values of the mean life and half life.

Answer: a

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47. The activity of a radioactive sample is measures as N_0 counts per minute at $t = 0$ and N_0 / e counts per minute at $t = 5$ min . The time (in minute) at which the activity reduces to half its value is.

A. $\frac{\log_e 2}{5}$

B. $\frac{5}{\log_e 2}$

C. $5 \log_{10} 2$

D. $5 \log_e 2$

Answer: d

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48. The number of beta particles emitter by radioactive sustance is twice the number of alpha particles emitter by it. The resulting daughter is an

A. isomer of parent

B. isotone of parent

C. isotope of parent

D. isobar of parent

Answer: c

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49. During negative B decay, an anti- neutrino is also emmited along with the ejected electron. Then

A. only linear momentum will be conserved

B. total linear momentum and total anuglar momentum but not total energy will be conserved

C. total linear momentum and total energy but not total angular momentum will be conserved

D. total linear momentum , total angular momentum and total energy will be conserved.

Answer: d

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50. Which of the following cannot be emitted by radioactive substances during their decay ?

A. Neutrinos

B. Protons

C. Electrons

D. Helium nuclei

Answer: b

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51. A radioactive decay can form an isotope of the original nucleus with the emission of particles

A. one α and four β

B. one α and two β

C. one α and one β

D. four α and one β

Answer: b

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52. Pick out the incorrect statement from the following .

A. β^{-} emission from the nucleus is always accompanied with a neutrino

B. The energy of the α -particle emitted from a given nucleus is always constant.

C. γ-ray emission makes the nucleus more stable.

D. Nuclear force is charge-independent

Answer: a

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53. Consider $\alpha -$, β- particles and $\gamma -$ rays, each having an energy fo $0.5 Mev$ in increasing order f penertation power, the radiations are:

A. α, β, γ

B. α, γ, β

C. β, γ, α

D. γ, β, α

Answer: a

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54. The electron emitted in beta radiation originates from

A. inner orbits of atom

B. free electrons existing in the nuclei

C. decay of a neutron in a nuclei

D. photon escaping from the nucleus

Answer: c

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55. Radioactive $._{27}^{60}Co$ is transformed into stable $._{28}^{60}$Ni by emitting two γ-rays of energies

A. 1.33 MeV and 1.17 MeV in succession

B. 1.17 MeV and 1.33 MeV in succession

C. 1.37 MeV and 1.13 MeV in succession

D. 1.13 MeV and 1.37 MeV in succession

Answer: b

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56. Complete the series $.^6 He \rightarrow e^- + .^6 Li +$

A. neutrino

B. antineutrino

C. proton

D. neutron

Answer: b

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57. A nucleus of Ux_1 has a half life of 24.1 days. How long a sample of Ux_1 will take to change to 90% of Ux_2.

A. 80 days

B. 40 days

C. 20 days

D. 10 days

Answer: a

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58. An element A decays into element C by a two-step process :

$A \rightarrow B + ._2 He^4$

$B \rightarrow C + 2e^-$

Then.

A. A and C are isotopes

B. A and C are isobars

C. B and C are isotopes

D. A and B are isobars

Answer: a

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59. The equation

$4H^{+} \rightarrow_{2}^{4} He^{2+} + 2e \overline{+} 26 MeV represents$

A. β-decay

B. γ-decay

C. fusion

D. fission

Answer: c

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60. Light energy emitted by star is due to

A. breaking of nuclei

B. joining of nuclei

C. burning of nuclei

D. reflection of solar light

Answer: b

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61. In a nuclear reaction, which of the following options are conserved?

A. mass only

B. energy only

C. momentum only

D. mass, energy and momentum

Answer: d

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62. Which of the following are used as control rods in a nuclear reactor ?

A. cadmium

B. graphite

C. krypton

D. plutonium

Answer: a

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63. Fast neutrons can easily be slowed down by

A. the use of lead shielding

B. passing them through water

C. elastic collisions with heavy nuclei

D. applying a strong electric field

Answer: b

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64. Which of the following equations, pick out the possible nuclear fusion reactions?

A. $._{6}^{13}C + ._{1}^{1}H \rightarrow ._{6}^{14}C$ +4.3 MeV

B. $._{6}^{12}C + ._{1}^{1}H \rightarrow ._{7}^{13}N$ + 2 MeV

C. $._{7}^{14}N + ._{1}^{1}H \rightarrow ._{8}^{15}O$ + 7.3 MeV

D. $._{92}^{235}U + ._{0}^{1}N \rightarrow ._{54}^{140}Xe + ._{38}^{94}Sr + ._{0}^{1}n + ._{0}^{1}n$ + 200 MeV

Answer: b and d

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65. If $200MeV$ energy is released in the fission of a single U^{235} nucleus, the number of fissions required per second to produce 1 kilowatt power shall be (Given $1eV = 1.6 \times 10^{-19}J$).

A. 3.125×10^{13}

B. 1.52×10^{6}

C. 3.125×10^{12}

D. 3.125×10^{14}

Answer: a

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66. In a nuclear fusion reaction, two nuclei, A & B , fuse to produce a nucleus C , releasing an amount of energy ΔE in the process.If the mass defects of the three nuclei are $\Delta M_A, \Delta M_B$ & ΔM_C respectively , then which of the following relations holds ? Here, c is the speed of light.

A. $\Delta M_A + \Delta M_B = \Delta M_C - \Delta E / c^2$

B. $\Delta M_A + \Delta M_B = \Delta M_C + \Delta E / c^2$

C. $\Delta M_A - \Delta M_B = \Delta M_C - \Delta E / c^2$

D. $\Delta M_A - \Delta M_B = \Delta M_C + \Delta E / c^2$

Answer: a

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67. Mass numbers of the elements A,B , C and D are 30,60,90 and 120 respectively. The specific binding energy of them are 5 MeV, 8.5 MeV , 6 MeV and 7 MeV respectively. Then, in which of the following reaction/s energy is released ?

(1)D $\rightarrow$ 2B , (2)C $\rightarrow$ B +A , (3)B $\rightarrow$ 2A

A. only in (1)

B. only in (3)

C. in (1) , (3)

D. in (1), (2) and (3)

Answer: a

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68. The fission properties of $._{94}^{239}Pu$ are very similar to those of $._{92}^{235}$ U. The average energy released per fission is 180 MeV. If all the atoms in 1 kg of pure $._{94}^{239}Pu$ undergo fission, then the total energy released in MeV is

A. 4.53×10^{26} MeV

B. 2.21×10^{14} MeV

C. 1×10^{13} MeV

D. 6.33×10^{24} MeV

Answer: a

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69. A ancleus of mass number 220, initially at rest, emits an α-particle, If the Q-value of the reaction is 5.5 Me V, then the energy of the emitted α-particle will be

A. 4.4 MeV

B. 5.4 MeV

C. 5.6 MeV

D. 6.5 MeV

Answer: b

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Hots

1. Sometimes a radioactive nucleus decays into a nucleus which inself is radioactive . An example is :

$^{38}\text{Sulphur} \xrightarrow[=2.48\text{ h}]{\text{half-life}} {}^{38}Cl \xrightarrow[=0.62\text{ h}]{\text{half-life}} {}^{38}Ar$ (stable)

Assume that we start with 1000 ^{38}S nuclei at time t=0 . The number of ^{38}Cl is of count zero at t=0 and will again be zero at $t = \infty$. At what value of t, would the number of counts be a maximum ?

A. 1.65 h

B. 2.62 h

C. 3.24 h

D. 3.95 h

Answer: a

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2. The deuteron is bound by nuclear forces just as H-atom is made up of p and e bound by electrostatic forces. If we consider the forces between neutron and proton in deuteron as given in the form of a Coulomb force but with an effective charge e': $F = \frac{1}{4\pi\varepsilon_0}\frac{e'^2}{r^2}$

estimate the value of (e'/e) given that the following binding energy of a deuteron is 2.2MeV.

A. 1.89

B. 9.24

C. 3.64

D. 7.62

Answer: c

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3. A fission reaction is given by $\_(92)^{236}U \rightarrow_{54}^{140} Xe +_{38}^{94} St + x + y$, where x and y are two particle Consider $\_(92)^{236}U$ to be at rest , the kinetic energies of the products are deneted by $k_{xe}K_{st}K_{x}(2MeV)$ and Ky(2MeV) repectively . Let the binding energy per nucleus of $\_(92)^{236}U,_{54}^{140} Xe$ and $_{38}^{94}Stbe 7.5MeV, 8.4MeV$ and $8.5MeV$, respectively Considering different conservation laws, the correct option (s) is (are)

A. x=n, y=n, K_{Sr}=129 MeV, K_{Xe}=86 MeV

B. x=p, y=e^{-} , K_{Sr}=129 MeV, K_{Xe}=86 MeV

C. x=p, y=n, K_{Sr}=129 MeV, K_{Xe}=86 MeV

D. x=n, y=n, K_{Sr}=86 MeV, K_{Xe}=129 MeV

Answer: a

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4. How long can an electric lamp of 100W be kept glowing by fusion of 2.0 kg of deuterium? The fusion reaction can be taken as $._1 H^2 + ._1 H^2 \rightarrow ._1 H^3 + n + 3.17 MeV$

A. 2.4×10^6 years

B. 7.4×10^4 years

C. 1.6×10^6 years

D. 4.9×10^4 years

Answer: d

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5. Nuclei of a radioactive element A are being produced at a constant rate α. The element has a decay constant λ. At time $t = 0$, there are N_0 nuclei of the element.

(a) Calculate the number N of nuclei of A at time t.

(b) If $\alpha = 2N_0\lambda$, calculate the number of nuclei of A after one half-life of A, and also the limiting value of N as $t \to \infty$.

A. $\frac{1}{\lambda}\left[\alpha + (\alpha - N_0\lambda)e^{-\lambda t}\right]$

B. $\frac{1}{\lambda}\left[\alpha - (\alpha - N_0\lambda)e^{-\lambda t}\right]$

C. $\lambda\left[\alpha-(\alpha-N_0\lambda)e^{-\lambda t}\right]$

D. $\left[\alpha-(N_0\lambda-\alpha)e^{-\lambda t}\right]$

Answer: b

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6. If $\alpha=2N_0\lambda$, calculate the number of nuclei of A after one half-life of A, and also the limiting value of N as

A. $2N_0, \frac{5}{2}N_0$

B. $3N_0, 2N_0$

C. $4N_0, 2N_0$

D. $\frac{3}{2}N_0, 2N_0$

Answer: d

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7. The element curium $._{96}^{248}Cm$ has a mean life of $10^{13}s$. Its primary decay modes are spontaneous fission and α-decay, the former with a probability of 8% and the later with a probability of 92%, each fission releases $200MeV$ of energy. The masses involved in decay are as follows

$._{96}^{248}Cm = 248.072220u$,

$._{94}^{244}P_u = 244.064100u$ and $._{2}^{4}He = 4.002603u$. Calculate the power output from a sample of 10^{20} Cm atoms. ($1u = 931MeV/c^2$)

A. 4.42×10^{-3} W

B. 3.32×10^{-5} W

C. 4.42×10^{-5} W

D. 3.32×10^{-3} W

Answer: b

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Exemplar Problems

1. Suppose we consider a large number of containers each containing initially 10000 atoms of a radioactive material with a half life of 1 yr. After 1 yr

A. all the containers will have 5000 atoms of the material.

B. all the containers will contain the same number of atoms of the material but that number will only be approximately 5000

C. the containers will in general have different number of the atoms of the material but their average will be close to 5000

D. none of containers can have more than 5000 atoms.

Answer: c

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2. The gravitational force between a H-atom and another particle of mass m will be given by Newton's law $F = G\frac{M.m}{r^2}$, where r is in km and

A. $M = m_{\text{proton}} + m_{\text{electron}}$

B. $M = m_{\text{proton}} + m_{\text{electron}} - \frac{B}{c^2}$ (B=13.6 eV)

C. M is not related to the mass of hydrogen atom

D. $M = m_{\text{proton}} + m_{\text{electron}} - \frac{|V|}{c^2}$(|V|=magnitude of the potential energy of electron in the H-atom)

Answer: b

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3. When a nucleus in an atom undergoes a radioactive decay the electronic energy levels of the atom

A. do not change for any type of radioactivity

B. change for α and β radioactivity but not for γ-radioactivity

C. change for α-radioactivity but not for others

D. change for β-radioactivity but not for others

Answer: b

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4. M_x and M_y denote the atomic masses of the parent and the daughter nuclei respectively in radioactive decay . The Q - value for a β^- decay is Q_1 and that for a β^+ decay is Q_2. If m_e denotes the mass of an electron then which of the following statements is correct?

A. $Q_1 = (M_x - M_y)c^2$ and $Q_2 = (M_x - M_y - 2m_e)c^2$

B. $Q_1 = (M_x - M_y)c^2$ and $Q_2 = (M_x - M_y)c^2$

C. $Q_1 = (M_x - M_y - 2m_e)c^2$ and

$Q_2 = (M_x - M_y + 2m_e)c^2$

D. $Q_1 = (M_x - M_y + 2m_e)c^2$ and

$Q_2 = (M_x - M_y + 2m_e)c^2$

Answer: a

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5. Tritium is an isotope of hydrogen whose nucleus triton contains 2 neutrons and 1 proton. Free neutrons decay into $p + e^- + \overline{V}$. If one of the neutrons in triton decays, then it would transform into He^3 nucleus. This does not happen. This is because

A. Triton energy is less than that of a He^3 nucleus

B. The electron created in the beta decay process cannot remain in the nucleus

C. both the neutrons in triton have a decay simultaneously resulting in a nucleus with 3 protons which is not a He^3 nucleus .

D. because free neutrons decay due to external perturbations which is absent in a triton nucleus .

Answer: a

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6. Heavy stable nuclei have more neutrons than protons. This is because of the fact that

A. neutrons are heavier than protons .

B. electrostatic force between protons are repulsive

C. neutrons decay into protons through beta decay

D. nuclear forces between neutrons are weaker than that between protons.

Answer: b

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7. In a nuclear reactor, moderators slow down the neutrons which come out in a fission process. The moderator used have light nuclei. Heavy nuclei will not serve the purpose because

A. they will break up

B. elastic collision of neutrons with heavy nuclei will not slow them down

C. the net weight of the reactor would be unbearably high

D. substances with heavy nuclei do not occur in liquid or gaseous state at room temperature .

Answer: b

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Assertion Reason

1. Assertion:The whole mass of the atom is concentrated in the nucleus.

Reason:The whole mass of the atom is concentrated in the nucleus

Reason:The mass of a nucleus can be either less than or more than the sum of the masses of nucleons present in it.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: c

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2. Assertion : The radius of a nucleus determined by electron scattering is found to be slightly different from that determined by alpha particle scattering .

Reason : Electron scattering senses the charge distribution of the nucleus whereas alpha and similar particles sense the nuclear matter.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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3. Assertion:Isotopes of an element can be separated by using a mass spectrometer.

Reason: Separation of isotopes is possible because of difference in electron number of isotopes .

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: c

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4. Assertion:When a nucleus is in an excited state, it can make a transition to a lower energy state by the emission of gamma rays .

Reason:These are energy levels for a nucleus just like there are energy levels in atoms .

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: b

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5. Assertion:Binding energy per nucleon is nearly constant for element in the range A=30 to A=170 .

Reason : The nuclear force between two nucleons falls rapidly to zero as their distance is more than a few femtometres.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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6. Assertion:Nuclear force between neutron-neutron, proton-neutron and proton-proton is approximately the same

Reason : The nuclear force does not depend on the electric charge

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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7. Assertion:A free neutron is unstable

Reason : Free neutron disintegrates into proton, electron and an antineutrino i.e. $n \rightarrow p + e^{-} + \bar{v}$

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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8. Assertion:The detection of neutrinos is extremely difficult .

Reason : Neutrinos interact only very weakly with matter.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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9. Assertion:An α-particle is emitted when uranium 238 decays into thorium

Reason : The decay of uranium 238 to thorium is repesented by $._{92}^{238}U \rightarrow ._{90}^{234}Th + ._{2}^{4}He$. The helium nuclei is called an alpha particle.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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10. Assertion:The mass of β-particles when they are emitted is higher than the mass of electrons obtained by other means.

Reason:β-particle and electron , both are similar particles.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: b

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11. Assertion:Neutrons penetrate matter more readily as compared to protons.

Reason:A neutron has no charge .

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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12. Assertion:There occurs a chain reaction when uranium is bombarded with slow neutrons.

Reason:When uranium is bombarded with slow neutrons more neutrons are produced

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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13. Assertion:Fusion of hydrogen nuclei into helium nuclei is the source of energy of all stars.

Reason:In fusion heavier nuclei split to form lighter nuclei.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: c

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14. Assertion:Nuclear sources will give a million times larger energy than conventional sources.

Reason:Nuclear energy sources are massive than conventional energy sources.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: c

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15. Assertion:Naturally , thermonuclear fusion reaction is not possible on earth.

Reason : For thermonuclear fusion to take place, extreme condition of temperature and pressure are required .

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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Atomic Masses

1. The set which repesents the isotope , isobar and isotone respectively is

A. $\left(._1^2 H, ._1^3 H\right), \left(._{79}^{197} Au, ._{80}^{198} Hg\right)$ and $\left(._2^3 He, ._1^2 H\right)$

B. $\left(._2^3 H, ._1^1 H\right), \left(._{79}^{197} Au, ._{80}^{198} Hg\right)$ and $\left(._1^1 He, ._1^3 H\right)$

C. $\left(._2^3 H, ._1^3 H\right), \left(._1^2 H, ._1^2 H\right)$ and $\left(._{79}^{197} Au, ._{80}^{198} Hg\right)$

D. $\left(._1^2 H, ._1^3 H\right), \left(._2^3 He, ._1^3 H\right)$ and $\left(._{79}^{197} Au, ._{80}^{198} Hg\right)$

Answer: D

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2. The natural boron of atomic weight 10.81 is found to have two isotopes $.^{10}B$ and $.^{11}B$ .The ratio of abundance of isotopes of natural boron should be

A. $11:10$

B. $81:19$

C. $10:11$

D. $19:81$

Answer: d

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3. Two stable isotopes of lithium $._3^6 Li$ and $._3^7 Li$ have respective abundances of 7.5% and 92.5% . These isotopes have masses 6.0152 u and 7.016004 u respectively. Find the atomic weight of lithium

A. 6.941 u

B. 3.321 u

C. 2.561 u

D. 0.621 u

Answer: a

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Size Of The Nucleus

1. The most common kind of iron nucleus has a mass number of 56. Find the approximate density of the nucleus.

A. $2.29 \times 10^{16} \text{kg m}^{-3}$

B. $2.29 \times 10^{17} \text{kg m}^{-3}$

C. $2.29 \times 10^{18} \text{kg m}^{-3}$

D. $2.29 \times 10^{15} \text{kg m}^{-3}$

Answer: b

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2. Order of magnitude of density of uranium nucleus is , [m = 1.67 x 10^(-27) kg]`

A. 10^{20}kg m^{-3}

B. 10^{17}kg m^{-3}

C. 10^{14}kg m^{-3}

D. 10^{11}kg m^{-3}

Answer: b

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3. Two nuclei have their mass numbers in the ratio of 1:3. The ratio of their nuclear densities would be

A. $(3)^{1/3}:1$

B. $1:1$

C. $1:3$

D. $3:1$

Answer: b

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4. The radius of a spherical nucleus as measured by electron scattering is 3.6 fm. What is the mass number of the nucleus most likely to be ?

A. 27

B. 40

C. 56

D. 120

Answer: a

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5. The ratio of the nuclear radii of the gold isotope $._{79}^{197}Au$ and silver isotope $._{47}^{107}Ag$ is

A. 1.23

B. 0.216

C. 2.13

D. 3.46

Answer: a

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6. If the nucleus of $._{13}Al^{27}$ has a nuclear radius of about 3.6 fm, then $._{52}Te^{125}$ would have its radius approximately as

A. 9.6 fm

B. 12 fm

C. 4.8 fm

D. 6 fm

Answer: d

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Mass Energy And Nuclear Binding Energy

1. How much mass has to be converted into energy to produce electric power of 500 MW for one hour ?

A. 2×10^{-5} kg

B. 1×10^{-5} kg

C. 3×10^{-5} kg

D. 4×10^{-5} kg

Answer: a

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2. if in a nuclear fusion reaction, mass defect to 0.3% , then energy released in fusion of 1 kg mass

A. 27×10^{10} J

B. 27×10^{11} J

C. 27×10^{12} J

D. 27×10^{13} J

Answer: d

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3. The equivalent energy of 1 g of substance is

A. 9×10^{13} J

B. 6×10^{12} J

C. 3×10^{13} J

D. 6×10^{13} J

Answer: a

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4. Fission of nuclei is possible because the binding energy per nuclei in them

A. increases with mass number at low mass numbers

B. decreases with mass number at low mass numbers

C. increases with mass number at high mass numbers

D. decreases with mass number at high mass numbers

Answer: d

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5. The mass of $._3^7 Li$ is 0.042 amu less than the sum of masses of its constituents. The binding energy per nucleon is

A. 5.586 MeV

B. 10.522 MeV

C. 2.433 MeV

D. 3.739 MeV

Answer: a

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6. The binding energy per nucleon of deuterium and helium nuclei are 1.1 MeV and 7.0 MeV respectively. When two deuterium nuclei fuse to form a helium nucleus the energy released in the fusion is

A. 23.6 MeV

B. 2.2 MeV

C. 28.0 MeV

D. 30.2 MeV

Answer: a

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7. Let m_p be the mass of a proton , m_n the mass of a neutron, M_1 the mass of a $._{10}^{20}Ne$ nucleus and M_2 the mass of a $._{20}^{40}Ca$ nucleus . Then

A. $M_2 = M_1$

B. $M_2 > M_1$

C. $M_2 < 2M_1$

D. $M_1 < 10(m_n + m_p)$

Answer: d

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8. The mass of proton is 1.0073 u and that of neutron is 1.0087 u (u=atomic mass unit). The binding energy of $._2^4 He$, if mass of $._2^4 He$ is 4.0015 u is

A. 0.0305 erg

B. 0.0305 J

C. 28.4 MeV

D. 0.061 u

Answer: c

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9. If the binding energy per nucleon of deuterium is 1.115 MeV, its mass defect in atomic mass unit is

A. 0.0048

B. 0.0024

C. 0.0012

D. 0.0006

Answer: b

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Radioactivity

1. The half - life period of a radioactive element x is same as the mean life time of another radioactive element y Initially both of them have the same number of atoms. Then,n

A. X and Y decay at same rate always

B. X will decay faster than Y

C. Y will decay faster than X

D. X and Y have same decay rate initially

Answer: c

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2. Sample of two radioactive nuclides A and B are taken. λ_A and λ_B are the disintergration constants of A and B

respectively. In which of the following cases, the two sample can simultaneously have the same decay rate at any time ?

A. Initial rate of decay of A is twice the initial rate of decay of B and $\lambda_A = \lambda_B$.

B. Initial rate of decay of A is twice the initial rate of decay of B and $\lambda_A > \lambda_B$.

C. Initial rate of decay of B is twice the initial rate of decay of A and $\lambda_A > \lambda_B$.

D. Initial rate of decay of B is twice the initial rate of decay of A at t=2h and $\lambda_B = \lambda_A$

Answer: b

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3. The half life of $._{92}^{238}U$ undergoing α-decay is 4.5×10^9 years. The activity of 1 g sample of $._{92}^{238}U$ is

A. 1.23×10^4 Bq

B. 1.23×10^5 Bq

C. 1.23×10^3 Bq

D. 1.23×10^6 Bq

Answer: a

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4. The half life of a radioactive substance is 20s, the time taken for the sample to decay by $7/8^{th}$ of its initial value is

A. 20 s

B. 40 s

C. 60 s

D. 80 s

Answer: c

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5. 1 mg redium has 2.68×10^{18} atoms. Its half life is 1620 years. How many radium atoms will disintegrate from 1 mg of pure radium in 3240 years ?

A. 2.01×10^{9}

B. 2.01×10^{18}

C. 1.01×10^{9}

D. 1.01×10^{18}

Answer: b

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6. Radon has 3.8 days as its half-life . How much radon will be left out of 15 mg mass after 38 days ?

A. 1.05 mg

B. 0.015 mg

C. 0.231 mg

D. 0.50 mg

Answer: b

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7. The half life of a radioactive substance is 30 days. What is the time taken to disintegrate to $3/4^{th}$ of its original mass ?

A. 30 days

B. 15 days

C. 60 days

D. 90 days

Answer: c

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8. The half life of polonium is 140 days. In what time will 15 g of polonium be disintegrated out of its initial mass of 16 g ?

A. 230 days

B. 560 days

C. 730 days

D. 160 days

Answer: b

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9. In a sample of radioactive material , what fraction of the initial number of active nuclei will remain undisintegrated after half of the half life of the sample ?

A. $\frac{1}{4}$

B. $\frac{1}{2\sqrt{2}}$

C. $\frac{1}{\sqrt{2}}$

D. $\sqrt{2}-1$

Answer: c

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10. At a given instant, there are 25% undecayed radioactive nuclei in a sample. After 10 seconds the number of undecayed nuclei reduces to 12.5%, the mean life of the nuclei is

A. 10.21 s

B. 14.43 s

C. 5.31 s

D. 7.43 s

Answer: b

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11. Two redioactive nuclei A and B have disintegration constants λ_A and λ_B and initially N_A and N_B number of nuclei of them are taken, then the time after which their undisintegrated nuclei are same is

A. $\frac{\lambda_A\lambda_B}{(\lambda_A - \lambda_B)}\text{In}\left(\frac{N_B}{N_A}\right)$

B. $\frac{1}{(\lambda_A + \lambda_B)}\text{In}\left(\frac{N_B}{N_A}\right)$

C. $\frac{1}{(\lambda_B - \lambda_A)}\text{In}\left(\frac{N_B}{N_A}\right)$

D. $\frac{1}{(\lambda_A - \lambda_B)}\text{In}\left(\frac{N_B}{N_A}\right)$

Answer: c

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12. A freshly prepared radioactive source of half-life $2h$ emits radiation of intensity which is 64 times the permissible safe level. The minimum time after which it would be possible to work safely with this source is

A. 128 h

B. 24 h

C. 6 h

D. 12 h

Answer: d

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13. Two samples X and Y contain equal amount of radioactive substances. If $\frac{1^{th}}{16}$ of the sample Y, remain after 8 hours, then the ratio of half life periods of X and Y is

A. $2:1$

B. $1:2$

C. $1:4$

D. $4:1$

Answer: a

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14. The decay constant of a radioactive isotope is λ. If A_1 and A_2 are its activites at time t_1 and t_2 respectively, then the number of nuclei which have decayed the time $(t_1 - t_2)$

A. $A_1t_1 - A_2t_2$

B. $A_1 - A_2$

C. $(A_1 - A_2)/\lambda$

D. $\lambda(A_1 - A_2)$

Answer: c

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15. A 280 day old radioactive substances shows an activity of 6000 dps, 140 days later its activity becomes 3000 dps. What was its initial activity ?

A. 20000 dps

B. 24000 dps

C. 12000 dps

D. 6000 dps

Answer: b

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16. Tritium has a half life of 12.5 years against beta decay. What fraction of a sample of pure tritium will remain undecayed after 25 years?

A. one half

B. one fourth

C. one third

D. can't say

Answer: b

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17. The decay constant , for a given radioactive sample, is 0.3465 day^{-1} .What percentage of this sample will get decayed in a period of 4 days ?

A. $100\ \%$

B. $50\ \%$

C. $75\ \%$

D. $10\ \%$

Answer: c

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18. The count rate of a radioactive sample falls from $4.0 \times 10^6 s^{-1}$ to $1.0 \times 10^6 s^{-1}$ in 20 hours. What will be the count rate after 100 hours from beginning ?

A. $3.91 \times 10^3 s^{-1}$

B. $3.91 \times 10^2 s^{-1}$

C. $3.91 \times 10^4 s^{-1}$

D. $3.91 \times 10^6 s^{-1}$

Answer: a

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19. Carbon dating is best suited for determining the age of fossils of their age in years is of the order of

A. 10^3

B. 10^4

C. 10^5

D. 10^6

Answer: b

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20. The half life of radioactive Radon is $3.8 days$. The time at the end of which $\frac{1}{20}th$ of the radon sample will remain undecayed is $(given \log e = 0.4343)$

A. 3.8 days

B. 16.5 days

C. 33 days

D. 76 days

Answer: b

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21. A radioactive element X with half life 2 h decays giving a stable element Y. After a time t, ratio of X and Y atoms is 1:16 .Time t is

A. 6 h

B. 4 h

C. 8 h

D. 16 h

Answer: c

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22. The half life of $._{38}^{90}Sr$ is 28 years. The disintegration rate of 15 mg of this isotope is of the order of

A. 10^{11} Bq

B. 10^{10} Bq

C. 10^{7} Bq

D. 10^{9} Bq

Answer: b

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23. A sample of a radioactive element has a mass of 10 g at an instant t=0. The approximate mass of this element in the sample left after two mean lives is

A. 1.35 g

B. 2.50 g

C. 3.70 g

D. 6.30 g

Answer: a

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24. The count rate from $100cm^3$ of a radioactive liquid is c. Some of this liquid is now discarded. The count rate of the remaining liquid is found to be $c/10$ after three half-lives. The volume of the remaining liquid, in cm^3, is

A. 20

B. 40

C. 60

D. 80

Answer: d

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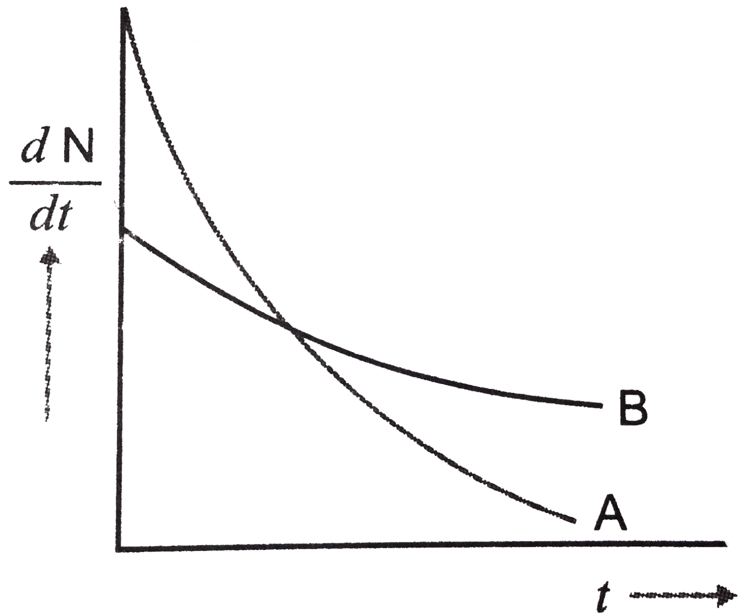
25. The variation of decay rate of two radioactive samples A and B with time is shown in fig.



Which of the following statements are true?

A. Decay constant of A is greater than that of B, hence A always decays faster than B.

B. Decay constant of A is greater than that of B, but it does not always decays faster than B.

C. Decay constant of B is smaller than that of A but still its decay rate becomes equal to that of A at a later instant.

D. Both (b) and (c)

Answer: d

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26. A sample of radioactive material has mass m, decay constant λ, and molecular weight M. Avogadro constant $= N_A$. The initial activity of the sample is:

A. λm

B. $\frac{\lambda m}{M}$

C. $\frac{\lambda m N_A}{M}$

D. $m N_A \lambda$

Answer: c

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27. Two radioactive substance A and B have decay constants 5λ and λ respectively. At $t = 0$ they have the same number of nuclei. The ratio of number of nuclei of nuclei of A to those of B will be $\left(\frac{1}{e}\right)^2$ after a time interval

A. 4λ

B. 2λ

C. $1/2\lambda$

D. $1/4\lambda$

Answer: c

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28. Plutonium decays with half life of 24000 years. If plutonium is stored for 72000 years, the fraction of it that remains is

A. $1/8$

B. $1/3$

C. $1/4$

D. $1/2$

Answer: a

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29. A fraction f_1 of a radioactive sample decays in one mean life, and a fraction f_2 decays in one half life. Then

A. $f_1 > f_2$

B. $f_1 < f_2$

C. $f_1 = f_2$

D. either of (a),(b) or (c) depending on the values of the mean life and half life.

Answer: a

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30. The activity of a radioactive sample is measures as N_0 counts per minute at $t = 0$ and N_0 / e counts per minute at $t = 5 \text{ min}$. The time (in minute) at which the activity reduces to half its value is.

A. $\frac{\log_e 2}{5}$

B. $\frac{5}{\log_e 2}$

C. $5 \log_{10} 2$

D. $5 \log_e 2$

Answer: d

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31. The number of beta particles emitter by radioactive sustance is twice the number of alpha particles emitter by it. The resulting daughter is an

A. isomer of parent

B. isotone of parent

C. isotope of parent

D. isobar of parent

Answer: c

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32. During negative B decay, an anti- neutrino is also emmited along with the ejected electron. Then

A. only linear momentum will be conserved

B. total linear momentum and total anuglar momentum but not total energy will be conserved

C. total linear momentum and total energy but not total angular momentum will be conserved

D. total linear momentum , total angular momentum and total energy will be conserved.

Answer: d

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33. Which of the following cannot be emitted by radioactive substances during their decay ?

A. Neutrinos

B. Protons

C. Electrons

D. Helium nuclei

Answer: b

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34. A radioactive decay can form an isotope of the original nucleus with the emission of particles

A. one α and four β

B. one α and two β

C. one α and one β

D. four α and one β

Answer: b

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35. Pick out the incorrect statement from the following .

A. β^- emission from the nucleus is always accompanied with a neutrino

B. The energy of the α -particle emitted from a given nucleus is always constant.

C. γ-ray emission makes the nucleus more stable.

D. Nuclear force is charge-independent

Answer: a

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36. Consider $\alpha -$, β- particles and $\gamma -$ rays, each having an energy fo $0.5 Mev$ in increasing order f penertation power, the radiations are:

A. α, β, γ

B. α, γ, β

C. β, γ, α

D. γ, β, α

Answer: a

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37. The electron emitted in beta radiation originates from

A. inner orbits of atom

B. free electrons existing in the nuclei

C. decay of a neutron in a nuclei

D. photon escaping from the nucleus

Answer: c

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38. Radioactive $._{27}^{60}Co$ is transformed into stable $._{28}^{60}$Ni by emitting two γ-rays of energies

A. 1.33 MeV and 1.17 MeV in succession

B. 1.17 MeV and 1.33 MeV in succession

C. 1.37 MeV and 1.13 MeV in succession

D. 1.13 MeV and 1.37 MeV in succession

Answer: b

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39. Complete the series $.^{6}He \rightarrow e^{-} + .^{6}Li +$

A. neutrino

B. antineutrino

C. proton

D. neutron

Answer: b

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40. A nucleus of Ux_1 has a half life of 24.1 days. How long a sample of Ux_1 will take to change to 90% of Ux_2.

A. 80 days

B. 40 days

C. 20 days

D. 10 days

Answer: a

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41. An element A decays into element C by a two-step process :

$A \rightarrow B + ._2 He^4$

$B \rightarrow C + 2e^-$

Then.

A. A and C are isotopes

B. A and C are isobars

C. B and C are isotopes

D. A and B are isobars

Answer: a

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42. The equation

$4H^{+} \rightarrow_{2}^{4} He^{2+} + 2e \overline{+} 26MeV represents$

A. β-decay

B. γ-decay

C. fusion

D. fission

Answer: c

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Nuclear Energy

1. Light energy emitted by star is due to

A. breaking of nuclei

B. joining of nuclei

C. burning of nuclei

D. reflection of solar light

Answer: b

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2. In a nuclear reaction, which of the following options are conserved?

A. mass only

B. energy only

C. momentum only

D. mass, energy and momentum

Answer: d

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3. Which of the following are used as control rods in a nuclear reactor ?

A. cadmium

B. graphite

C. krypton

D. plutonium

Answer: a

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4. Fast neutrons can easily be slowed down by

A. the use of lead shielding

B. passing them through water

C. elastic collisions with heavy nuclei

D. applying a strong electric field

Answer: b

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5. Which of the following equations, pick out the possible nuclear fusion reactions?

A. $._{6}^{13}C + ._{1}^{1}H \rightarrow ._{6}^{14}C$ +4.3 MeV

B. $._{6}^{12}C + ._{1}^{1}H \rightarrow ._{7}^{13}N$ + 2 MeV

C. $._{7}^{14}N + ._{1}^{1}H \rightarrow ._{8}^{15}O$ + 7.3 MeV

D. $._{92}^{235}U + ._{0}^{1}N \rightarrow ._{54}^{140}Xe + ._{38}^{94}Sr + ._{0}^{1}n + ._{0}^{1}n$ + 200 MeV

Answer: b and d

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6. If $200 MeV$ energy is released in the fission of a single U^{235} nucleus, the number of fissions required per second to produce 1 kilowatt power shall be (Given $1 eV = 1.6 \times 10^{-19} J$).

A. 3.125×10^{13}

B. 1.52×10^{6}

C. 3.125×10^{12}

D. 3.125×10^{14}

Answer: a

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7. In a nuclear fusion reaction, two nuclei, A & B , fuse to produce a nucleus C , releasing an amount of energy ΔE in the process.If the mass defects of the three nuclei are $\Delta M_A, \Delta M_B$ & ΔM_C respectively , then which of the following relations holds ? Here, c is the speed of light.

A. $\Delta M_A + \Delta M_B = \Delta M_C - \Delta E / c^2$

B. $\Delta M_A + \Delta M_B = \Delta M_C + \Delta E / c^2$

C. $\Delta M_A - \Delta M_B = \Delta M_C - \Delta E / c^2$

D. $\Delta M_A - \Delta M_B = \Delta M_C + \Delta E / c^2$

Answer: a

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8. Mass numbers of the elements A,B , C and D are 30,60,90 and 120 respectively. The specific binding energy of them are 5 MeV, 8.5 MeV , 6 MeV and 7 MeV respectively. Then, in which of the following reaction/s energy is released ?

(1)$D \rightarrow 2B$, (2)$C \rightarrow B + A$, (3)$B \rightarrow 2A$

A. only in (1)

B. only in (3)

C. in (1) , (3)

D. in (1), (2) and (3)

Answer: a

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9. The fission properties of $._{94}^{239}Pu$ are very similar to those of $._{92}^{235}$ U. The average energy released per fission is 180 MeV. If all the atoms in 1 kg of pure $._{94}^{239}Pu$ undergo fission, then the total energy released in MeV is

A. 4.53×10^{26} MeV

B. 2.21×10^{14} MeV

C. 1×10^{13} MeV

D. 6.33×10^{24} MeV

Answer: a

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10. A ancleus of mass number 220, initially at rest, emits an α-particle, If the Q-value of the reaction is 5.5 Me V, then the energy of the emitted α-particle will be

A. 4.4 MeV

B. 5.4 MeV

C. 5.6 MeV

D. 6.5 MeV

Answer: b

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Higher Order Thinking Skills

1. Sometimes a radioactive nucleus decays into a nucleus which inself is radioactive . An example is :

$^{38}\text{Sulphur} \xrightarrow[=2.48\text{ h}]{\text{half-life}} {}^{38}Cl \xrightarrow[=0.62\text{ h}]{\text{half-life}} {}^{38}Ar$ (stable)

Assume that we start with 1000 ^{38}S nuclei at time t=0 . The number of ^{38}Cl is of count zero at t=0 and will again be zero at $t = \infty$. At what value of t, would the number of counts be a maximum ?

A. 1.65 h

B. 2.62 h

C. 3.24 h

D. 3.95 h

Answer: a

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2. The deuteron is bound by nuclear forces just as H-atom is made up of p and e bound by electrostatic forces. If we consider the forces between neutron and proton in deuteron as given in the form of a Coulomb force but with an effective charge e': $F = \frac{1}{4\pi\varepsilon_0}\frac{e'^2}{r^2}$

estimate the value of (e'/e) given that the following binding energy of a deuteron is 2.2MeV.

A. 1.89

B. 9.24

C. 3.64

D. 7.62

Answer: c

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3. A fission reaction is given by $\_(92)^{236}U \rightarrow_{54}^{140} Xe +_{38}^{94} St + x + y$, where x and y are two particle Consider $\_(92)^{236}U$ to be at rest , the kinetic energies of the products are deneted by $k_{xe} K_{st} K_x (2MeV)$ and Ky(2MeV) repectively . Let the binding energy per nucleus of $\_(92)^{236}U,_{54}^{140} Xe$ and $_{38}^{94} St be 7.5 MeV, 8.4 MeV$ and $8.5 MeV$, respectively Considering different conservation laws, the correct option (s) is (are)

A. x=n, y=n, K_{Sr}=129 MeV, K_{Xe}=86 MeV

B. x=p, y=e^- , K_{Sr}=129 MeV, K_{Xe}=86 MeV

C. x=p, y=n, K_{Sr}=129 MeV, K_{Xe}=86 MeV

D. x=n, y=n, K_{Sr}=86 MeV, K_{Xe}=129 MeV

Answer: a

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4. How long can an electric lamp of 100W be kept glowing by fusion of 2.0 kg of deuterium? The fusion reaction can be taken as $._1 H^2 + ._1 H^2 \rightarrow ._1 H^3 + n + 3.17 MeV$

A. 2.4×10^6 years

B. 7.4×10^4 years

C. 1.6×10^6 years

D. 4.9×10^4 years

Answer: d

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5. Nuclei of a radioactive element A are being produced at a constant rate α. The element has a decay constant λ. At time $t = 0$, there are N_0 nuclei of the element.

(a) Calculate the number N of nuclei of A at time t.

(b) If $\alpha = 2N_0\lambda$, calculate the number of nuclei of A after one half-life of A, and also the limiting value of N as $t \to \infty$.

A. $\frac{1}{\lambda}\left[\alpha + (\alpha - N_0\lambda)e^{-\lambda t}\right]$

B. $\frac{1}{\lambda}\left[\alpha - (\alpha - N_0\lambda)e^{-\lambda t}\right]$

C. $\lambda\left[\alpha - (\alpha - N_0\lambda)e^{-\lambda t}\right]$

D. $\left[\alpha - (N_0\lambda - \alpha)e^{-\lambda t}\right]$

Answer: b

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6. If $\alpha = 2N_0\lambda$, calculate the number of nuclei of A after one half-life of A, and also the limiting value of N as

A. $2N_0, \frac{5}{2}N_0$

B. $3N_0, 2N_0$

C. $4N_0, 2N_0$

D. $\frac{3}{2}N_0, 2N_0$

Answer: d

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7. The element curium $._{96}^{248}Cm$ has a mean life of $10^{13}s$. Its primary decay modes are spontaneous fission and α-decay, the former with a probability of 8% and the later with a probability of 92%, each fission releases $200MeV$ of energy.

The masses involved in decay are as follows

$._{96}^{248}Cm = 248.072220u$,

$._{94}^{244}P_u = 244.064100u$ and $._2^4He = 4.002603u$. Calculate the power output from a sample of 10^{20} Cm atoms. ($1u = 931MeV/c^2$)

A. 4.42×10^{-3} W

B. 3.32×10^{-5} W

C. 4.42×10^{-5} W

D. 3.32×10^{-3} W

Answer: b

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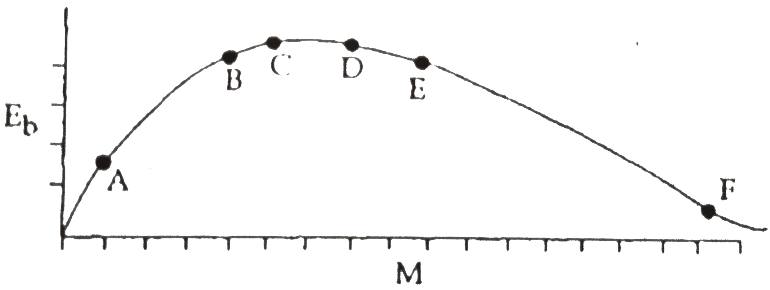
8. The above is a plot of binding energy per nucleon E_b, against the nuclear mass M, A, B, C, D, E, F correspond to different nuclei. Consider four reactions

(i) $A + B \rightarrow C + \varepsilon$ (ii) $C \rightarrow A + B + \varepsilon$

(iii) $D + E \rightarrow F + \varepsilon$ and (iv) $F \rightarrow D + E + \varepsilon$

where ε is the energy released ? In which reactions is ε positive ?



A. (i) and (iii)

B. (ii) and (iv)

C. (ii)and (iii)

D. (i) and (iv)

Answer: d

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Ncert Exemplar

1. Suppose we consider a large number of containers each containing initially 10000 atoms of a radioactive material with a half life of 1 yr. After 1 yr

A. all the containers will have 5000 atoms of the material.

B. all the containers will contain the same number of atoms of the material but that number will only be approximately 5000

C. the containers will in general have different number of the atoms of the material but their average will be close to 5000

D. none of containers can have more than 5000 atoms.

Answer: c

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2. The gravitational force between a H-atom and another particle of mass m will be given by Newton's law $F = G\frac{M.m}{r^2}$, where r is in km and

A. $M = m_{\text{proton}} + m_{\text{electron}}$

B. $M = m_{\text{proton}} + m_{\text{electron}} - \frac{B}{c^2}$ (B=13.6 eV)

C. M is not related to the mass of hydrogen atom

D. $M = m_{\text{proton}} + m_{\text{electron}} - \frac{|V|}{c^2}$(|V|=magnitude of the potential energy of electron in the H-atom)

Answer: b

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3. When a nucleus in an atom undergoes a radioactive decay the electronic energy levels of the atom

A. do not change for any type of radioactivity

B. change for α and β radioactivity but not for γ-radioactivity

C. change for α-radioactivity but not for others

D. change for β-radioactivity but not for others

Answer: b

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4. M_x and M_y denote the atomic masses of the parent and the daughter nuclei respectively in radioactive decay . The Q - value for a β^- decay is Q_1 and that for a β^+ decay is Q_2. If m_e denotes the mass of an electron then which of the following statements is correct?

A. $Q_1 = (M_x - M_y)c^2$ and $Q_2 = (M_x - M_y - 2m_e)c^2$

B. $Q_1 = (M_x - M_y)c^2$ and $Q_2 = (M_x - M_y)c^2$

C. $Q_1 = (M_x - M_y - 2m_e)c^2$ and $Q_2 = (M_x - M_y + 2m_e)c^2$

D. $Q_1 = (M_x - M_y + 2m_e)c^2$ and

$Q_2 = (M_x - M_y + 2m_e)c^2$

Answer: a

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5. Tritium is an isotope of hydrogen whose nucleus triton contains 2 neutrons and 1 proton. Free neutrons decay into $p + e^- + \overline{V}$. If one of the neutrons in triton decays, then it would transform into He^3 nucleus. This does not happen. This is because

A. Triton energy is less than that of a He^3 nucleus

B. The electron created in the beta decay process cannot remain in the nucleus

C. both the neutrons in triton have a decay simultaneously resulting in a nucleus with 3 protons which is not a He^3 nucleus .

D. because free neutrons decay due to external perturbations which is absent in a triton nucleus .

Answer: a

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6. Heavy stable nuclei have more neutrons than protons. This is because of the fact that

A. neutrons are heavier than protons .

B. electrostatic force between protons are repulsive

C. neutrons decay into protons through beta decay

D. nuclear forces between neutrons are weaker than that between protons.

Answer: b

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7. In a nuclear reactor, moderators slow down the neutrons which come out in a fission process. The moderator used have light nuclei. Heavy nuclei will not serve the purpose because

A. they will break up

B. elastic collision of neutrons with heavy nuclei will not slow them down

C. the net weight of the reactor would be unbearably high

D. substances with heavy nuclei do not occur in liquid or gaseous state at room temperature .

Answer: b

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Assertion And Reason

1. Assertion:The whole mass of the atom is concentrated in the nucleus.

Reason:The whole mass of the atom is concentrated in the nucleus

Reason:The mass of a nucleus can be either less than or more than the sum of the masses of nucleons present in it.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: c

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2. Assertion : The radius of a nucleus determined by electron scattering is found to be slightly different from that determined by alpha particle scattering .

Reason : Electron scattering senses the charge distribution of the nucleus whereas alpha and similar particles sense the nuclear matter.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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3. Assertion:Isotopes of an element can be separated by using a mass spectrometer.

Reason: Separation of isotopes is possible because of difference in electron number of isotopes .

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: c

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4. Assertion:When a nucleus is in an excited state, it can make a transition to a lower energy state by the emission of gamma rays .

Reason:These are energy levels for a nucleus just like there are energy levels in atoms .

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: b

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5. Assertion:Binding energy per nucleon is nearly constant for element in the range A=30 to A=170 .

Reason : The nuclear force between two nucleons falls rapidly to zero as their distance is more than a few femtometres.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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6. Assertion:Nuclear force between neutron-neutron, proton-neutron and proton-proton is approximately the same

Reason : The nuclear force does not depend on the electric charge

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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7. Assertion:A free neutron is unstable

Reason : Free neutron disintegrates into proton, electron and an antineutrino i.e. $n \rightarrow p + e^{-} + \bar{v}$

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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8. Assertion:The detection of neutrinos is extremely difficult .

Reason : Neutrinos interact only very weakly with matter.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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9. Assertion:An α-particle is emitted when uranium 238 decays into thorium

Reason : The decay of uranium 238 to thorium is repesented by $._{92}^{238}U \rightarrow ._{90}^{234}Th + ._{2}^{4}He$. The helium nuclei is called an alpha particle.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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10. Assertion:The mass of β-particles when they are emitted is higher than the mass of electrons obtained by other means.

Reason:β-particle and electron , both are similar particles.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: b

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11. Assertion:Neutrons penetrate matter more readily as compared to protons.

Reason:A neutron has no charge .

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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12. Assertion:There occurs a chain reaction when uranium is bombarded with slow neutrons.

Reason:When uranium is bombarded with slow neutrons more neutrons are produced

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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13. Assertion:Fusion of hydrogen nuclei into helium nuclei is the source of energy of all stars.

Reason:In fusion heavier nuclei split to form lighter nuclei.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: c

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14. Assertion:Nuclear sources will give a million times larger energy than conventional sources.

Reason:Nuclear energy sources are massive than conventional energy sources.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: c

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15. Assertion:Naturally , thermonuclear fusion reaction is not possible on earth.

Reason : For thermonuclear fusion to take place, extreme condition of temperature and pressure are required .

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false

Answer: a

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