PHYSICS

BOOKS - CENGAGE PHYSICS (HINGLISH)

NUCLEAR PHYSICS

Illustration

1. How many electrons protons, and neutrons are there in $12g$ of $._6 C^2$ and in $14g$ of $._6 C^{14}$?.

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2. a. Find an approximate expression for the mass of a nucleus of mass number A, B. Find an expression for the volume of this nucleus in terms of the mass number. C. Find a numerical value for its density.

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3. Calcualte the radius of $70Ge$.

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

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5. Calculate the electric potential energy due to the electric repulsion between two nuclei of $\hat{\ } 12C$ when they touch each other at the surface.

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6. The most abundant isotope of helium has a $._{2}^{4}H$ nucleus whose mass is $6.6447 \times 10^{-27} kg$. For this nucleus, find (a) the mass defect and (b) the binding energy.

Given: Mass of the electron: $m_e = 5.485799 \times 10^{-4} u$, mass of the proton: $m_P = 1.007276u$ and mass of the neutron: $m_n = 1.008665u$.

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7. The atomic mass $._{2}^{4}He$ is $4.0026u$ and the atomic mass of $._{1}^{1}H$ is $1.0078u$. Using atomic mass units instead of kilograms, obtain the binding energy of $._{2}^{4}He$ nucleus.

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8. The nucleus of the deuterium atom, called the deuteron, consists of a proton and a neutron. Calculate the deuteron's binding energy, given atomic mass, i.e., the mass of a deuterium nucleus plus an electron is measured to be $2.014102u$.

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9. Calculate the binding energy for nucleon of $. \_ 6^{12} C$ nucleus, if mass of proton $m_p = 10078 u$, mass of neutron $m_n = 1.0087 u$, mass of $C_{12}, m_C = 12.0000 u$, and $1 u = 931.4 MeV$.

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10. The atomic mass of uranium $._{92}^{238} U$ is $23.058 u$, that of throium.$_{90}^{234} Th$ is $234.0436 u$ and that of an alpha particle $._{2}^{4} He$ is $4.006 u$, Determine the energy released when $\alpha - decay$ converts.$_{92}^{238} U$ into $._{92}^{238} U$. int $._{90}^{234} Th$.

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11. Refer to illustration 5.10, the energy released by the α - decay of $._{92}^{238} U$ is found to be$4.3 MeV$. Since this energy is carried away as kinetic energy of the recoiling $._{90}^{234} Th$. nucleus and the α- particles, it follows that $KE_{Th} + KE_{\alpha} = 4.3 MeV$. However, $KE_T h$ and KE_{α} are not equal.

Which particle carries away more kinetic energy, the $\overset{234}{90}Th$ nucleus or the α- particle? .

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12. The atomic mass of thorium $._{90}^{234}Th$ is $234.04359u$, while that of protactinium $._{91}^{234}Pa$ is $234.04330u$. Find the energy released when β decay changes $\overset{234}{90}Th$ into

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13. Consider the beta decay

$\hat{} 198Au \rightarrow^{198} Hg * + B\eta^{-1} + \vec{v}.$

where $\hat{} 198Hg^*$ represents a mercury nucleus in an excited state at energy $1.088MeV$ above the ground state. What can be the maximum kinetic energy of the electron emitted? The atomic mass of $\hat{} 198Au$ is $197.968233u$ and that of $\hat{} 198Hg$ is $197.966760u$.

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14. Find the energy liberated in the beta decay of $._{6}^{14}C$ to $._{7}^{14}N$ as represented by Eq.(iii). Equation (iii) refers to nuclei. Adding six electrons to both sides of Eq.(iii) gives

$. - 6^{14}C\text{atom} \rightarrow . - 7^{14}N.$

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15. What is the wavelenth of the $0.186MeV$ gamma- ray photon emitted by radium $._{88}^{226}Ra$?

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16. A radioactive sample has 6.0×10^{18} active nuclei at a certain instant. How many of these nuclei will still be in the same active state after two half-lives?

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17. The half-life of a radioactive nuclide is 20 hours. What fraction of original activity will remain after 40 hours?

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18. Suppose 3.0×10^7 radon atoms are trapped in a basement at a given time. The basement is sealed against further enetry of the gas. The half - life of radon is 3.83 days. How many radon atoms remain after31 days?

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19. In the above illustration, suppose there are 3.0×10^7 radon atoms $T_1/2 = 3.83$ days or $3.31 \times 10^5 s$ trapped in a basement. (a) How many radon atoms remain after 31 days ? Find the activity (b) just after the basement is sealed against further entry of radon and (c) days later.

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20. The decay constant for the radioactive nuclide $64Cu$ is $1.516 \times 10^{-5} s^{-1}$. Find the activity of a sample containing $1 \mu g$ of $\hat{} 64Cu$. Atomic weight of copper = $63.5 g(mol)^{-1}$. Neglect the mass difference between the given radioisotope and normal coper.

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21. The half-life of $\hat{} 198Au$ is $2.7 days$. Calculate (a) the decay constant, (b) the average-life and (C) the activity of $1.00 mg$ of $\hat{} 198Au$. Take atomic weight of $\hat{} 198Au$ to be $198 gmol^{-1}$.

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22. (a) Determine the number of carbon $._6^{14} C$ atoms present for every gram of carbon . _ $6^{12}C$ in a living organism. Find (b) The decay constant and (c) the activity of this sample.

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23. The number of $\hat{\ } 238U$ atoms in an ancient rock equals the number of $\hat{\ } 206Pb$ atoms. The half-life of decay of $\hat{\ } 238U$ is $4.5 \times 10^9 y$. Estimate the age of the rock assuming that all the $\hat{\ } 206Pb$ atoms are formed from the decay of $\hat{\ } 238U$.

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24. A bottle of red wine is thought to have been sealed about $5 years$ ago. The wine containa a number of different kinds of atoms, incluing carbon, oxygen,and hydrogen. Each of these has a radioactive isotope. The radiaoctive isotope of carbon is the familiar $._6^{14}C$ with a half-life of $5730 years$. The radioactive isotope of oxygen is. $._8^{15}O$ and has a half-life of $122.2 s$. The radioactive isotope of hydrogen $._1^3H$ and is called tritium, its half-life is $12.33 years$. The activity of each of these isotopes is known at the time the bottle was sealed. However, only one of the isotopes is useful for determining the age of the wine accurately. Which is it?

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25. A radioactive nucleus undergoes a series of decay according to the scheme

$$A \xrightarrow{\alpha} A_1 \xrightarrow{\beta^-} A_2 \xrightarrow{\alpha} A_3^{172} \xrightarrow{\gamma} A_4.$$

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26. Suppose, the daughter nucleus in a nuclear decay is itself radioactive. Let λ_p and λ_d be the decay constants of the parent and the daughter nuclei. Also, let N_p and N_d be the number of parent and daughter nuclei at time t. Find the condition for which the number of daughter nuclei becomes constant.

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27. A radioactive nucleus can decay by two different processes. The half-life for the first process is t_1 and that for the second process is t_2. Show that the effective half-life t of the nucleus is given by

$$\frac{1}{t} = \frac{1}{t_1} + \frac{1}{t_2}.$$

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28. A factory produces a radioactive substance A at a constant rate R which decays with a decay constant λ to form a stable substance. Find (a) the number of nuclei of A and (b) number of nuclei of B, at any time t assuming the production of A starts at $t=0$. (c) Also, find out the maximum number of nuclei of A present at any time during its formation.

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29. Nuclei of 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 time of A and also the limiting value of N at $t\to\infty$.

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30. The mean lives of an unstable nucleus in two different decay processes are $1620 yr$ and $405 yr$, respectively. Find out the time during which three-fourth of a sample will decay.

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31. Find the half-life of uranium, given that $3.32 \times 10^7 g$ radium is found per gram of uranium in old minerals. The atomic weights of uranium and radium are 238 and 226 and half-life of radium is 1600 years (Avogadro number is $6.023 \times 10^{23} / g - \text{atom}$).

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32. Find the Q value of the reaction $P + .^7 Li \rightarrow .^4 He + .^4 He$. Determine whether the reaction is exothermic or endothermic. The atomic masses of $.^1 H, .^4 He$ and $.^7 Li$ are $1.007825u$, $4.002603u$, and $7.016004u$, respectively.

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33. Consider a collision between two particles one of which is at rest and the other strikes it head on with momentum P_1. Calculate the energy of reaction Q in terms of the kinetic energy of the particles before and they collide.

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34. Two other possible ways by which $.^{235}U$ can undergo fission when bombarded with a neutron are (1) by the release of $.^{140}Xe$ and $.^{94}Sr$ as fission fragments and (2) by the release of $.^{132}Sn$ and $.^{101}Mo$ as fission fragments. In each case, neutrons are also released. Find the number of neutrons released in each of these events.

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35. Calculate the total energy released if $1.0kg$ of $.^{235}U$ undergoes fission, taking the disintergration energy per event to be $Q = 208MeV$ (a more accurate value than the estimate given previously).

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36. On disintegration of one atom of $.^{235}U$, the amount of energy obtained is $200MeV$. The power obtained in a reactor is 1000 kilo watt. How many atoms are disintegrated per second in the reactor? What is the decay in mass per hour?

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37. A deuterium reaction that occurs in an experimental fusion reactor is in two stage:

(a) Two deuterium $\left(.^2_1 D\right)$ nuclei fuse together to form a tritium nucleus, with a proton as a by product written as $D(D, p)T$.

(b) A tritium nucleus fuses with another deuterium nucleus to form a helium $._{2}^{4}He$ nucleus with neutron as a by - product, written as T (D,n) $._{2}^{4}He.$

Compute (a) the energy released in each of the two stages, (b) the energy released in the combined reaction per deutrium. (c) What percentage of the mass energy of the initial deuterium is released. Given,

$._{1}^{2}D = 2.014102amu$

$._{1}^{3}T = 3.016049$

$._{2}^{4}He = 4.002603amu$.

$._{1}^{1}H = 1.007825amu$

$._{0}^{1}n = 1.00665amu$

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38. In the process of nuclear fission of $1g$ uranium, the mass lost is $0.92mg$. The efficiency of power house run by the fission reactor is 10% .To obtain 400 megawatt power from the power house, how much uranium will be required per hour? $\left(c = 3 \times 10^{8}ms^{-1}\right)$.

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39. A nuclear reactor using $.^{235}U$ generates $250MW$ of electric power. The efficiency of the reactor (i.e., efficiency of conversion of thermal energy into electrical energy) is 25%. What is the amount of $.^{235}U$ used in the reactor per year? The thermal energy released per fission of $.^{235}U$ is $200MeV$.

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40. What is the power output of a $._{92}U^{235}$ reactor if it is takes 30 days to use up $2kg$ of fuel, and if each fission gives $185MeV$ of useable energy ?.

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41. A nuclear explosion is designed to deliver $1MW$ of heat energy, how many fission events must be required in a second to attain this power level. If this explosion is designed with a nuclear fuel consisting of uranium 235 to run a reactor at this power level for one year, then calculate the amount of fuel needed. You can assume that the calculate the amount of energy released per fission event is $200 MeV$.

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Solved Examples

1. The disintegration rate of a certain radioactive sample at any instant is 4750 disintegrations per minute. Five minutes later the rate becomes 2700 per minute. Calculate

(a) decay constant and (b) half-life of the sample

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2. There is a stream of neutrons with a kinetic energy of $0.0327 eV$. If the half-life of neutrons is $700 s$, what fraction of neutrons will decay before they travel is distance of $10 m$? Given mass of neutron $= 1.676 \times 10^{-27} kg$.

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3. The binding energies per nucleon for deuteron $(._1 H^2)$ and helium ($._2 He^4)$ are $1.1 MeV$ and $7.0 MeV$ respectively. The energy released when two deuterons fuse to form a helium nucleus $(._2 He^4)$ is........

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4. Some amount of a radioactive substance (half-life =10 days) is spread inside a room and consequently the level of radiation become 50 times the permissible level for normal occupancy of the room. After how many days will the room be safe for occupation?.

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5. A small quantity of solution containing Na^{24} radio nuclide $(half - l \text{ if } e = 15h)$ of activity $1.0 microcurie$ is injected into the blood of a person. A sample of the blood of volume $1 cm^3$ taken after $5h$

shows an activity of 296 disintegrations per minute. Determine the total volume of the blood in the body of the person. Assume that the radioactive solution mixes uniformly in the blood of person.

(1 curie $= 3.7 \times 10^{10}$ disintegrations per second)

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6. At a given instant there are 25% undecayed radioactive nuclei in a sample. After $10s$ the number of undecayed nuclei reduces to 12.5%. Calculate

(a) mean life of the nuclei,

(b) the time in which the number of undecayed nuclei will further reduce to6.25% of the reduced number.

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7. In an ore containing uranium, the ratio of $.^{238}U$ to $.^{206}Pb$ nuclei is 3. Calculate the age of the ore, assuming that all the lead present in the ore is the final stable product of $.^{238}U$. Take the half-life of $\hat{}\ 238U$ to be 4.5×10^9 years.

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8. 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. $(1u = 931MeV/c^2)$

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9. In a nuclear reactor $.^{235}U$ undergoes fission liberating $200MeV$ of energy. The reactor has a 10% efficiency and produces $1000MW$ power. If the reactor is to function for $10yr$, find the total mass of uranium required.

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10. A nucleus at rest undergoes a decay emitting an a particle of de - Broglie wavelength $\lambda = 5.76 \times 10^{-15} m$ if the mass of the daughter nucleus is 223.610 amu and that of alpha particle is $4.002 a\mu$, determine the total kinetic energy in the final state Hence , obtain the mass of the parent nucleus in amu (1 amu = 931.470 MeV / e^2)

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11. A radioactive element decays by $\beta - emission$. A detector records n beta particles in $2s$ and in next $2s$ it records $0.75n$ beta particles. Find mean life correct to nearest whole number. Given ln $|2| = 0.6931$, ln $|3| = 1.0986$.

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12. A rock is 1.5×10^9 years old. The rock contains $.^{238} U$ which disintegretes to form $.^{236} U$. Assume that there was no $.^{206} Pb$ in the rock initially and it is the only stable product fromed by the decay. Calculate the ratio of number of nuclei of $.^{238} U$ to that of $.^{206} Pb$ in the rock. Half-life of $.^{238} U$ is $4.5 \times 10^9. \, years.$ (2^(1//3)=1.259)` .

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13. What is the minimum photon energy required to remove the least bound neutron of $._{20}^{40} Ca$ and $._{18}^{40} Ar$. The nesessary atomic masses (in μ) are given below:

$$M(.^{40} Ca) = 39.962591u$$
$$M(.^{39} Ca) = 38.970719u$$
$$M(.^{40} Ar) = 39.962383$$
$$M(.^{39} Ar) = 38.964314u$$
$$m_n = 1.008665u$$

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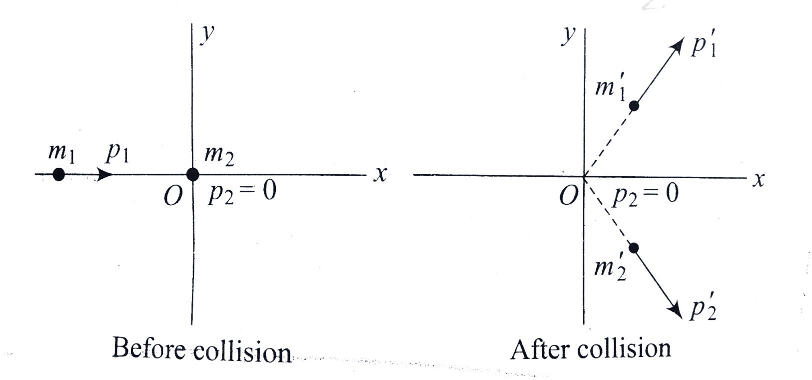
14. Consider a body at rest in the L-Frame, which explodes into fragments of masses m_1 and m_2. Calculate energies of the fragments of the body.



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15. (a) Find the energy needed to remove a neutron from the nucleus of the calcium isotope $._{20}^{42}Ca$.

(b) Find the energy needed to remove a proton from this nucleus.

(c) Why are these energies different? Mass of . $\_(20)^{40}Ca = 40.962278u$, mass of proton $= 1.007825u$.

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16. Write the decay equations and expression for the disintegration energy$Q$ of the following decay: $\beta -$ decay,electron capture.

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17. Find whether $\alpha -$ deacy or any of the $\beta -$ decay are allowed for $._{89}^{226} Ac.$

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Exercise 5.1

1. How many electron potons and mass number in a nucleus of atomic number 11 and mass 24?

(i) number of electron = (ii)number of proton = (iii)number of neutrons =

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2. Calculate the average binding energy per nucleon of $._{41}^{93}Nb$ having mass 9.2.906 u..

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3. Protons and neutrons exit together in an extermely small space within the nucleus. How is this possible when protons replel each other?

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4. A nucelus has binding energy of $100 MeV$. It further releases $10 MeV$ energy. Find the new binding energy of the nucleus.

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5. A nuclear reaction is given as

$A + B \rightarrow C + D$

Binding energies of $A, B, C,$ and D, are given as B_1, B_2, B_3 and B_4.

Find the energy released in the reaction.

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6. Calculate the binding energy of an alpha particle from the following data:

$massof_1^1 Ha \rightarrow m = 1.007825u$

mass of neutron $= 1.008665u$

mass of $\_ 4^2 Hea \rightarrow m = 4.00260u$.

Take $1u = 931 MeVc^{-2}$

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7. Find the binding energy of $\_ 26^{56} Fe$. Atomic mass of $\hat{} 56Fe$ is $55.9349u$ and that of $\hat{} 1H$ is $1.00783u$. Mass of neutron $= 1.00867u$.

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8. Use Avogadrs's number to show that the atomic mass unit is 1 u $= 1.66 \times 10^{-27} kg.$

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9. Take a sample of lead and oxygen. They contain different atoms and the density of solid lead is much greater than that of gaseosu oxygen. Decide whether the density of the nucleus in a lead atom is greater than, approximately equa to, or less than that in an oxygen atom.

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10. Show that the nuclide $.^8 Be$ has a positive binding energy but is unstable with respect to decay into two alpa particles, where masses of neutron, $.^1 H$, and $.^8 Be$ are 1.008665 u, $1.007825u$, and $8.005305u$, respectively.

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Exercise 5.2

1. A uranium nucleus (atomic number 92, mass number 231) emits an α-particle and the resultant nucleus emits a β-particles. What are the atomic and mass numbers of the final nucleus? .

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2. A radioactive nucleus undergoes a series of decay according to the scheme

If the mass number and atomic number of A are 180 and 72, respectively, what are these number A_4 ?.

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3. A nucleus, absorbing a neutron, emits an electron to go over to neptunium which on futher emitting an electron goes over to plutonium.

How would you represent the resulting plutonium?

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4. A uranium nucleus $U-238$ of atomic number92 emits two α- particles and two β-particles and trasnforms into a thorium nucleus. What is the mass number and atomic number of the thorium nucleus so produced?

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5. How many electrons protons, and neutrons are there in $12g$ of $._6 C^2$ and in $14g$ of $._6 C^{14}$?.

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6. Determine the product of the reaction:

$._3^7 Li + ._2^4 He \rightarrow \ ? + n$

What is the Q value of the reaction?

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7. 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 $(given \log e = 0.4343)$

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8. In the final Uranium radioactive series the initial nucleus is U_{92}^{238} and the final nucleus is Pb_{82}^{206} . When Uranium nucleus decays to lead , the number of a - particle is .... And the number of β - particles emitted is ......

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9. A radioactive sample has a mass m, decay cosntant λ, and molecular weight M. If the Avogadro number is N_A, then

(a) find the initial number of neclei present, (b) find the number of deacyed nuceli after a time t, (c) find the activity of the sample after a time t,

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10. Calculate the time taken to decay 100 percent of a radioactive sample in terms of (a) half- life T and

(b) mean-life T_{av}

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11. The activity of a sample of radioactive material is A_1 at time t_1 and A_2 at time $t_2(t_2 \leq t_1)$. Obtain an expression for its mean life.

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12. A $._{92}^{238}Th$ undergoes alpha decay. What is the resulting daughter nucleus?

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13. Is the sulphur isotope $._{16}^{38}S$ likely to be stable?

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14. Determine the average $.^{14}C$ activity in decays per minute per gram of natural carbon found in living organisms if the concentration of $.^{14}C$ relative to that of $.^{12}C$ is 1.4×10^{-12} and half -life of $.^{14}C$ is $T_{1/2} = 57.30$ years.

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15. Radium 226 is found to have a decay constant of 1.36×10^{-11} Bq. Determine its half-life in years. If a $200g$ sample of radium was taken in 1902, how much of it will remain a hundered years later?

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16. A bottle of red wine is thought to have been sealed about $5 years$ ago. The wine contain a number of different kinds of atoms, including carbon, oxygen,and hydrogen. Each of these has a radioactive isotope. The radioactive isotope of carbon is the familiar $._6^{14}C$ with a half-life of $5730 years$. The radioactive isotope of oxygen is. $._8^{15}O$ and has a half-life of $122.2 s$. The radioactive isotope of hydrogen $._1^3H$ and is called tritium, its half-life is $12.33 years$. The activity of each of these isotopes is known at the time the bottle was sealed. However, only one of the isotopes is useful for determining the age of the wine accurately. Which is it?

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17. A radio nuclide A_1 with decay constant λ_1 transforms into a radio nuclide A_2 with decay constant λ_2. Assuming that at the initial moment, the preparation contained only the radio nuclide A_1

(a) Find the equation decribing accumulation of radio nuclide A_2 with time. (b) Find the time interval after which the activity of radio nuclide A_2 reaches its maximum value.

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18. Consider the beta decay of an unstable $._6^{14}C$ nuleus initially at rest: $._6^{14}C \rightarrow ._7^{14}N + ._{-1}^{0}e + v._e$.

Is it possible for the maximum kinetic energy of the emiited beta particle to be exactly equal to Q?

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19. The atomic mass of uranium $._{92}^{238}U$ is $23.058u$, that of throium.$_{90}^{234}Th$ is $234.0436u$ and that of an alpha particle $._2^4He$ is $4.006u$, Determine the energy released when $\alpha - decay$ converts.$_{92}^{238}U$ into $._{92}^{238}U$. int $._{90}^{234}Th$.

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20. Refer to illustration 5.10, the energy released by the α - decay of $._{92}^{238}U$ is found to be$4.3MeV$. Since this energy is carried away as kinetic energy of the recoiling $._{90}^{234}Th$. nucleus and the α- particles, it follows that $KE_{Th} + KE_{\alpha} = 4.3 MeV$. However, $KE_{T}h$ and KE_{α} are not equal. Which particle carries away more kinetic energy, the $\overset{234}{90} Th$ nucleus or the α- particle? .

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21. Estiamte the minium amount of $._{235}^{92} U$ that needs to undergo fission in order to run a $1000 MW$ power reactor per year of continuous operartion. Assume an efficiency of about 33 percent.

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22. The isotope $._{6}^{14} C$ is radioactive and has a half-life of 5730 years . If you starts with a sample of 1000 carbon -14 niclei, how many will still be around in $17, 190 years$?

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23. The half-life of the radioactive nucleus $._{86}^{226}Ra$ is $1.6 \times 10^3 yr$. If a sample contains3.0×10^{16} such nuclei, determine the activity at this time.

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24. Radon, $._{86}^{222}Rn$, is a radioactive gas that can be trapped in the basement of homes, and its presence in high concnetrations is a known health hazard. Radon has a half-life of $3.83 days$. A gas sample contains 4.0×10^8 radon atoms initially.

(a) How many atoms will remain after $12 days$ have passed if no more radon leaks in? (b) What is the initial activity of the radon sample?

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25. The $._{88}^{226}Ra$ nucleus undergoes α-decay to $._{88}^{226}Rn$. Calculate the amount of energy liberated in this decay. Take the mass of $._{88}^{226}Ra$ to be

$226.025402u$, that of $._{88}^{226}Rn$ to be $222.017571u$, and that of $._{2}^{4}He$ to be $4.002602u$.

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26. Calculate the energy released when three alpha particles combine to form a $\hat{\ } 12C$ nucleus. The atomic mass of $\_2^4He$ is $4.002603u$.

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27. (a) Find the energy needed to remove a neutron from the nucleus of the calcium isotope $._{20}^{42}Ca$.

(b) Find the energy needed to remove a proton from this nucleus.

(c) Why are these energies different? Mass of $._{20}^{40}Ca = 40.962278u$, mass of proton $= 1.007825u$.

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Subjective

1. In a certain hypothetical radioactive decay process, species A decays into spesies B and species B decays into$C$ according to the reactions

$A \rightarrow 2B + \text{particles } + \text{energy}$

$B \rightarrow 2C + \text{particles } + \text{energy}$

The decay constant for species B is $\lambda_2 = 100 s^{-1}$. Initially, 10^4 moles of species of A were present while there was no none of B and C. It was found that species B reaches its maximum number at a time $t_0 = 21n(10)s$. Calcualte the value of maximum number of moles of B.

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2. $'m_1'$ g of non-radioactive isotopes $._z X^A$ are mixed with $'M_2'$ g of the radioactive isotopes $._z X^{A'}$. How much will the specific activity decreases ? Half-life of $._z X^{A'} = T$ Take N_A as Avagardo number.

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3. C^{14} disintegrates by β-emission with a reaction eneregy (Qvalue) of $0.155 MeV$ .A β-particle with an energy of $0.025 MeV$ is emitted in a direction at 135° to the direction of motion of the recoil nucleus. Determine the momneta of the three particles $(\beta^{-} = \overline{V}, {}^{14}N)$ involved in this disintegration in MeV/c units (where c is speed of light in vaccum)

$(M_0 = 0.511 MeV/c^2)$.

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4. A radio nuclide with disintegration constant λ is produced in a reactor at a constant rate α nuclei per second. During each decay energy E_0 is released. 20% of this energy is utilized in increasing the temperature of water. Find the increase in temperature of m mass of water in time t. Specific heat of water is s. Assume that there is no loss of energy through water surface.

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5. A stable nuclei C is formed from two radioactive nuclei A and B with decay constant of λ_1 and λ_2 respectively. Initially, the number of nuclei of A is N_0 and that of B is zero. Nuclei B are produced at a constant rate of P. Find the number of the nuclei of C after time t.

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6. Suppose a nucleus initally at rest undergoes α decay according to equation

$\cdot_{92}^{235} X \rightarrow Y + \alpha$

At $t = 0$, the emitted α-partilces enter a region of space where a uniform magnetic field $\overrightarrow{B} = B_0 \hat{j}$ and elcertis field $\overrightarrow{E} = E_0 \hat{i}$ exist. The α-prticles enters in the region with velocity $\overrightarrow{V} = v_0 \hat{j}$ from $x = 0$. At time $t = \sqrt{3} \times 10^6 \frac{m_0}{q_0 E_0} s$, the particle was observed to have speed twice the initial velocity v_0. Then, find (a) the velocity v_0 of the α-particles, (b) the initial velocity v_0 of the α-particle, (c) the binding energy per nucleon of the α-particle.

[Given that$m(Y) = 221.03u, m(\alpha) = 4.003u, m(n) = 1.09u, m(P) = 1.0$

.

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7. Natural uranium is a mixture of three isotopes $._{92}^{234}U$, $._{92}^{235}U$ and $._{92}^{238}U$ with mass percentage 0.01%, 0.71% and 99.28% respectively. The half-life of three isotopes are $2.5 \times 10^5 yr$, $7.1 \times 10^8 yr$ and $4.5 \times 10^9 yr$ respectively.

Determine the share of radioactivity of each isotope into the total activity of the natural uranium.

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8. A nuclear reaction is given us

$P +^{15} N \rightarrow_Z^A X + n$

(a). Find, A, Z and identity the nucleus X. (b) Find the Q value of the reaction . (c) If the proton were to collide with the $.^{15} N$ at rest, find the minimum KE needed by the proton to initiate the above reaction. (d) If the proton has twice energy in (c) and the outgoing neutron emerges at an angle of 90° with the direction of the incident proton, find the momentum of the protons and neutrons. $\left[\text{Given}, m(p) = 1.007825u, m\left(.^{15} C\right) = 15.0106u, m\left(.^{16} N\right) = 16.0061u, m\left(.^{15} N\right) = 15.000u\right), m\left(.^{16} O\right) = 15.9949u, m(u) = 1.0086665u, m\left(.^{15} O\right) = 15.0031u, \text{ and } 1u \approx 931.5 MeV.\right]$

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9. $._{235}^{239} Pu._{94}$ is undergoing $\alpha - decay$ according to the equation $._{94}^{235} Pu \rightarrow \left(._{97}^{235} U\right) + ._{2}^{4} He$. The energy released in the process is mostly kinetic energy of the α-particle. However, a part of the energy is released as γ rays. What is the speed of the emitted α-particle if the γ rays radiated out have energy of $0.90 MeV$? Given: Mass of $._{94}^{239} Pu = 239.05122u$, mass of $\left(._{97}^{235} U\right) = 235.04299u$ and mass of $._{1}^{4} He = 4.002602u (1u = 931 MeV)$.

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10. A tritrium gas target is bombared with a beam of monoenergetic protons of kinetic energy $K_1 = 3MeV$ The KE of the neutron emiited at 30° to the inicdent beam is K_2 ? Find the value of K_1 / K_2 (approximately in whole number). Atomic masses are $H^1 = 1.007276 a\mu$, $n^1 = 1.008665 a\mu, ._1 H^3 = 3.016050 a\mu, ._2 He^3 = 3.016030 a\mu$.

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11. Consider a nuclear reaction $A + B \rightarrow C$. A nucleus A moving with kinetic energy of $5MeV$ collides with a nucleus B moving with kinetic energy of $3MeV$ and forms a nucleus C in excited state. Find the kinetic energy of nucleus C just after its formation if it is formed in a state with excitation energy $10MeV$. Take masses of nuclei of A, B and C as $25.0, 10.0, 34.995 a\mu$, respectively.

$(1 a\mu = 930 MeV / c^2)$.

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12. Find the Q value of the reaction

$N^{14} + \alpha \rightarrow O^{17} + P$

The mass of are, respectively, $14.00307u$, $4.00260u$, and $16.99913u$. Find the total kinetic energy of the products if the striking α particles has the minimum kinetic energy required to initiate the reaction .

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13. A sample has two isotopes A^{150+} and B having masses $50g$ and $30g$, respectively. A is radioactive and B is stable.A decays to A' by emitting α-particles. The half-life of A is $2h$. Find the mass of the sample after $4h$ and number of α-particles emitted.

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14. The nucleus $.^{23}Ne$ decays by β-emission into the nucleus $.^{23}Na$. Write down the β-decay equation and determine the maximum kinetic energy of the electrons emitted. Given,$\left(m\left(._{11}^{23}Ne\right) = 22.994466amu\right.$ and $m\left(._{11}^{23}Na = 22.989770amu\right.$. Ignore the mass of antineutrino $(\bar{v})$.

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15. A radioavtive source in the form of a metal sphere of daimeter 10^{-3} m emits β-particles at a constant rate of 6.25×10^{10} particles per second. If the source is electrically insulated, how long will it take for its potential to rise by $1.0V$, assuming that 80% of the emitted β-particles escape the socurce?

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16. Find whether $\alpha -$ deacy or any of the $\beta -$ decay are allowed for $._{89}^{226}Ac$.

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17. Show that $\left(._{26}^{55}Fe\right)$ may electron capture, but not β^{+} decay.

Masses given are $M\left(._{26}^{55}Fe\right)=54.938298amu$,

$M\left(._{25}^{55}Mn\right)=54.938050amu, m(e)=0.000549amu.$

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18. A sample of $.^{18}F$ is used internally as a medical diagnostic tool to look for the effects of the positron decay $\left(T_{1/2}=110\text{ min }\right)$. How long does it take for 99% of the $.^{18}F$ to decay?

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19. Find the binding energy of an α-particle from the following data.

Mass of helium nucleus $=4.001235amu$

Mass of proton $=1.007277amu$

Mass of neutron $=1.00866amu$

(take $1amu=931.4813MeV$).

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20. Assume that a neutron breaks into a proton and an electron . The energy released during this process is (mass of neutron $= 1.6725 \times 10^{-27} kg$ mass of proton $= 1.6725 \times 10^{-27} kg$ mass of electron $= 9 \times 10^{-31} kg)$

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21. The binding energy of $._{17}^{35} Cl$ nncleus. Take atomic mass of $._{6}^{12} C$ as $12.000 anu$ Take $R_0 = 1.2 \times 10 -^{15} m$.

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22. Find the density of $._{6}^{12} C$ nucleus. Take atomic mass of $._{6}^{12} C$ as $12.00 amu$ Take $R_0 = 1.2 \times 10^{-15} m$.

Watch Video Solution

23. Calculate the binding energy per nucleon for $._{10}^{20}Ne$, $._{26}^{56}Fe$ and $._{98}^{238}U$. Given that mass of neutron is $1.008665amu$, mass of proton is $1.007825amu$, mass of $._{10}^{20}Ne$ is $19.9924amu$, mass of $._{26}^{56}Fe$ is $55.93492amu$ and mass of $._{92}^{238}U$ is $238.050783amu$.

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24. One gram of a radiactive material having a half-life period of 2 years is kept in store for a duration of 4 years. Calculate how much of the material ramins uncahnged.

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25. One gram of a radiactive substance takes 50 to lose 1 centigram. Find its half-life period.

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26. One gram ofo a radioactive substance disintegrates at the rate of 3.7×10^{10} disintegarations per second. The atomic mass of the subsatnce is 226. Calculate its mean life.

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27. There is a stream of neutrons with a kinetic energy of $0.0327eV$. If the half-life of neutrons is $700s$, what fraction of neutrons will decay before they travel is distance of $10m$? Given mass of neutron $= 1.676 \times 10^{-27} kg$.

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28. Nuclei of 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 time of A and also the limiting value of N at $t \rightarrow \infty$.

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29. The fission type of warhead of some guided missiles is estimated to be equivalent to 30000 tons of TNT. If $3.5 \times 10^8 J$ of energy is released by one tone of expolining TNT, how many fissions occur in the explosions of warhead? An energy of $200 MeV$ is released by fission of one atom of $.^{235}U$.

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30. IN a nuclear reactor, fission is produced in 1 g of $.^{235}U$ $(235.0349 amu)$. In assuming that $.^{92}_{53}Kr(91.8673 amu)$ and $.^{141}_{36}Ba(140.9139 amu)$ are produced in all reactions and no energy is lost, calculate the total energy produced in killowatt. Given: $1 amu = 931 MeV$.

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31. In the fission of $._{94}^{239} Pu$ by a thermal neutron, two fission fragmnets of equal masses and sizes are produced and four neutrosn are emitted. Find the force between the two fission fragments at the moment they are produced.

Given : $R_0 = 1.1$ fermi.

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32. Calcualte the excitation energy of the compound nuclei produced when

Given:

$$M(.^{235}U) = 235.0439\text{amu}, \quad M(n) = 1.0087\text{amu},$$
$$M(.^{238}U)238.0508\text{amu}, \quad M(.^{236}U) = 236.0456\text{amu}, .$$
$$M(.^{239}U) = 239.0543\text{amu}$$

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33. Calculate the ground state Q value of the induced fission reaction in the equation

$n + ._{92}^{235} U \rightarrow ._{92}^{236} U * \rightarrow ._{40}^{99} Zr + ._{52}^{134} Te + 2n$

If the neutron is thermal. A thermal neutron is in thermal equilibrium with its environment, it has an average kinetic energy given by $(3/2)kT$.

Given :

$m(n) = 1.0087amu, M\left(.^{235} U\right) = 235.0439\right) amu,$

$M\left(.^{99} Zr\right) = 98.916amu, M\left(.^{134} Te\right) = 133.9115amu.$

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34. Show that $._{92}^{230} U$ does not decay by emitting a neutron or proton.

Given:

$M\left(._{92}^{230} U\right) = 230.033927amu, M\left(._{92}^{230} U\right) = 229.033496amu,$

$M\left(._{92}^{229} Pa\right) = 229.032089amu, M(n) = 1.008665amu$

$m(p) = 1.007825amu.$

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35. The nuclear reaction $n + ._5^{10}B \rightarrow ._3^7Li + ._2^4He$ is observed to occur even when very slow-moving neutrons $(M_n = 1.0087amu)$ strike a boron atom at rest. For a particular reaction in which $K_n = 0$, the helium $(M_{He} = 4.0026amu)$ is observed to have a speed of $9.30 \times 10^6 ms^{-1}$. Determine (a) the kinetic energy of the lithium $(M_{Li} = 7.0160amu)$ and (b) the Q value of the reaction.

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Single Correct Option

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

$A \rightarrow B + ._2He^4$

$B \rightarrow C + 2e^-$

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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2. Consider two arbitaray decay equation and mark the correct alternative s given below. (i) $._{92}^{230} U \rightarrow n + ._{92}^{229} U$ (ii).$_{92}$ ^ $(230) U \rightarrow P + ._{91}^{229} Pa$

Given:

$M(._{92}^{230} U) = 230.033927u$, $M(._{92}^{229} U) = 229.03349u$, $m_n = 1.008665u$,

$M(._{91}^{229} Pa) = 229.032089$, m_p=1.007825, 1 am u =931.5 MeV`.

A. Only decay (i) is possible.

B. Only decay (ii) is possible.

C. Both decay are possible.

D. Neither of the two decay is possible.

Answer: d

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3. In a smaple of rock, the ration $.^{206} Pb$ to $.^{238} U$ nulei is found to be 0.5. The age of the rock is (given half-life of U^{238} is 4.5×10^9 years).

A. $2.25 \times 10^9 year$

B. $4.5x10^9$ In 3 year

C. $4.5x10^9 \frac{\frac{\ln(3)}{2}}{\ln 2} year$

D. $2.25 \times 10^9 \ln\left(\frac{3}{2}\right)$ year

Answer: c

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4. Let E_1 and E_2 be the binding energies of two nuclei A and B. it is observed that nuclei of A combine together to form a B nuclus. This observation is correct only if .

A. $E_1 > E_2$

B. $E_2 > E_1$

C. $E_2 > 2E_1$

D. nothing can be said

Answer: C

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5. A radioactive sample decays by 63% of its initial value in $10s$. It would have decayed by 50% of its initial value in .

A. $7s$

B. $14s$

C. $0.7s$

D. $1.4s$

Answer: A

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6. A nucleus moving with velocity $\bar{v}$ emits an α-particle. Let the velocities of the α-particle and the remaining nucleus be $\bar{v}_1$ and $\bar{v}_2$ and their masses be m_1 and (m_2) then,

A. $\underset{v}{\longrightarrow}$, $\underset{v_1}{\longrightarrow}$ and $\underset{v_2}{\longrightarrow}$ must be parallel to each other

B. none of the two of $\underset{v}{\longrightarrow}$, $\underset{v_1}{\longrightarrow}$ and $\underset{v_2}{\longrightarrow}$ should be paralle to each other

C. $\underset{v_1}{\longrightarrow} + \underset{v_2}{\longrightarrow}$ must be parallel to $\underset{v}{\longrightarrow}$.

D. $m_1 \underset{v_1}{\longrightarrow} + m_2 \underset{v_2}{\longrightarrow}$ must be parallel to $\underset{v}{\longrightarrow}$

Answer: D

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7. Which of the following statements is incorrect for nuclear forces?

A. These are strongest in magnitude.

B. They are charge dependent.

C. They are effective only for short ranges.

D. They are from interaction of every nucleon with the nearest limited number of nucleons.

Answer: d

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8. A certain radioactive material can undergo three constant λ, 2λ and 3λ. Then, the effective decay constant λ_{eff} is equal to $n\lambda$. What is the value of n?

A. 6

B. 4

C. 2

D. 3

Answer: A

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9. In an α -decay, the kinetic energy of α-particles is $48MeV$ and Q value of the reaction is $50MeV$. The mass number of the mother nucleus is (assume that daughter nucleus is in ground state)

A. 96

B. 100

C. 104

D. none of these

Answer: b

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10. A sample of radioactive material decays simultaneously by two processes A and B with half-lives $\frac{1}{2}$ and $\frac{1}{4}h$, respectively. For the first half hour it decays with the process A, next one hour with the process B, and for further half an hour with both A and B. If, originally, there were N_0 nuclei, find the number of nuclei after 2 h of such decay.

A. $\frac{N_0}{(2)^8}$

B. $\frac{N_0}{(2)^4}$

C. $\frac{N_0}{(2)^6}$

D. $\frac{N_0}{(2)^5}$

Answer: A

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11. In which of the following processes, the number of protons in the nuleus increase ?

A. α-decay

B. β^{-}-decay

C. β^{+}-decay

D. K - capture

Answer: b

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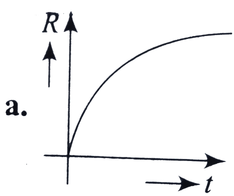
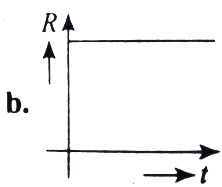
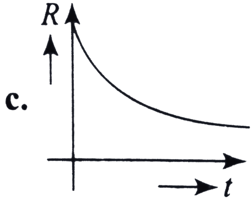
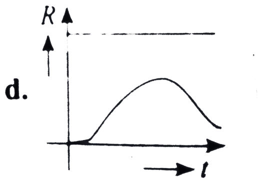
12. A radioactiev nuleus X deays to a stable nuleus Y. Then, time graph of rate of formation of Y against time t will be:

A. 

B. 

C. 

D. 

Answer: c

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13. A heavy nuleus having mass number 200 gets disintegrated into two small fragmnets of mass numbers 80 and 120. If binding energy per nulceon for parent atom is $6.5MeV$ and for daughter nuceli is $7MeV$ and $8MeV$, respectivley , then the energy released in the decay will be.

A. 200 MeV

B. (-)220 MeV

C. 220 MeV

D. 180 MeV

Answer: c

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14. An element X decays , first by positron emission and then two α-particles are emitted in successive radiactive decay. If the product nucleus has a mass number 229 and atomic number 89, the mass number and atomic number of element X are.

A. $237, 93$

B. $237, 94$

C. $221, 84$

D. $237, 92$

Answer: b

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15. 90% of a radioactive sample is left undecayed after time t has elapsed. What percentage of the initial sample will decay in a total time $2t$?

A. 20%

B. 19%

C. 40%

D. 38%

Answer: B

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16. A radioactive element X converts into another stable element Y. Half-life of X is $2h$. Initially, only X is present. After time t, the ratio of atoms of X and Y is found to be $1:4$ Then t in hours is .

A. 2

B. 4

C. between4 and 6

D. 6

Answer: C

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17. $A \xrightarrow{\lambda} B \xrightarrow{2\lambda} C$

$T = 0, N_0, 0,$

$T N_1 N_2 N_3$

The ratio of $N_1 \text{ to } N_2$ is maximum I s

A. at no time this is possible

B. 2

C. $1/2$

D. $\frac{\ln 2}{2}$

Answer: b

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18. The binding energy of an electron in the ground state of He atom is equal to $E_0 = 24.6 eV$. Find the energy required to remove both electrons form the atom.

A. $24.6 eV$

B. $79.0 eV$

C. $54.4 eV$

D. none of these

Answer: b

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19. The mean life time of a radionuclide, if the activity decrease by 4% for every $1h$, would b e(product is non-radioactive, i.e., stable)

A. $25h$

B. $1.042h$

C. $2h$

D. $30h$

Answer: A

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20. On an average, a neutron loses half of its energy per collision with a quesi-free proton. To reduce a $2MeV$ neutron to a thermal neutron having energy $0.04eV$, the number of collisions requaired is nearly .

A. 50

B. 52

C. 26

D. 15

Answer: c

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21. Masses of two isobars $._{29}Cu^{64}$ and $._{30}Zn^{64}$ are $63.9298u$ and $63.9292u$, respectively. It can be concluded from these data that .

A. both the isobars are stable

B. $.^{64}Zn$ is radioactive, decaying to $.^{64}Cu$ through $\beta-$ decay

C. $.^{64}Cu$ is radioactive, decaying to $.^{64}Zn$ through β-decay

D. $.^{64}Cu$ is radioactive, decaying to $.^{64}Zn$ through γ-decay

Answer: c

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22. If a nucleus such as $.^{226}Ra$ that is initially at rest undergoes α- decay , then which of the following statemnets is true?

A. The alpha particles has more kinetic than the daughter nuclues.

B. The alpha particle has less kinetic energy than the daughter nucleus.

C. The alpha particle and daughter nucleus both have same kinetic energy

D. We cannot say anything about kinetic energy of alpha particle and daughter nucleus.

Answer: a

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23. If the$Q$ value of an endothermic reaction is $11.32MeV$, then the minimum energy of the reactant nuclei to carry out the reaction is (in laboratotry frame of reference)

A. $11.32 MeV$

B. less than $11.32 MeV$

C. greater than $11.32 MeV$

D. Data is insufficeint

Answer: c

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24. 1.00 kg of $.^{235} U$ undergoes fission process. If energy released per event is $200 MeV$, then the total energy released is

A. $5.12 \times 10^{24} MeV$

B. $6.02 \times 10^{23} MeV$

C. $5.12 \times 10^{16} MeV$

D. $6.02 \times 10^{6} MeV$

Answer: c

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25. Mark out the incoreect statemnet.

A. A free neutron can transfrom itself into photn.

B. A free neutron can transfrom itself into neutron.

C. In beta minus decay, the electron originates from nucleus.

D. All of the above

Answer: a

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26. $U-235$ can decay by many ways , let us here consider only two ways, A and B. In decay of $U-235$ by means of A, the energy released per fission is $210 MeV$ while in B it is $186 MeV$. Then , the uranium 235 sample is more likely to decay by .

A. scheme A

B. scheme B

C. equally likely for both schemes

D. it depends on half-life of schemes A and B

Answer: a

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27. $._{19}^{49} K$ isotope of potassium has a half-life of 1.4×10^{9} yr and decays to form stable argon, $._{18}^{40} Ar$. A sample of rock has been taken which contains both potassium and argon in the ratio $1:7$, i.e.,

$(Number of potassium$-14$a \rightarrow ms)/(Number of argon$-40

$a \rightarrow ms\Big) = \frac{1}{2}$

Assuming that when the rock was fromed no argon -40 was present in the sample and none has escaped subssequently, determine the age of the rock.

A. 4.2×10^9 years

B. 9.8×10^9 years

C. 1.4×10^9 years

D. 10×10^9 years

Answer: a

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28. What is the probability of a radioactive nucleus to survive one mean life?

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

B. $1 - \frac{1}{e}$

C. $\frac{\ln 2}{e}$

D. $1 - \frac{\ln 2}{e}$

Answer: a

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29. Consider one of fission reactions of $\hat{}\,(235)U$ by thermal neutrons $._{92}^{235}U + n \rightarrow ._{38}^{94}Sr + ._{54}^{140}Xe + 2n$. The fission fragments are however unstable and they undergo successive β-decay until $._{38}^{94}Sr$ becomes $._{40}^{94}Zr$ and $._{54}^{140}Xe$ becomes $._{58}^{140}Ce$. The energy released in this process is

Given:

$m(.^{235}U) = 235.439u, m(n) = 1.00866u, m(.^{94}Zr) = 93.9064u, m(.^{140}C$

.

A. $156 MeV$

B. $208 MeV$

C. $465 MeV$

D. cannot be computed

Answer: b

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30. A star initially has 10^{40} deuterons. It produces energy via the processes $._1^2 H +_1^2 H \rightarrow_1^3 H + p$ and $._1^2 H +_1^3 H \rightarrow_2^4 He + n$, where the masses of the nuclei are

$m(.^2 H) = 2.014$ amu, $m(p) = 1.007$ amu, $m(n) = 1.008$ amu and $m(.^4 He) = 4.001$ amu. If the average power radiated by the star is $10^{16} W$, the deuteron supply of the star is exhausted in a time of the order of

A. $10^6 s$

B. $10^8 s$

C. $10^{12} s$

D. $10^{16} s$

Answer: C

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31. Two radioactive X_1 and X_2 have decay constants 10λ and λ respectively . If initially they have the same number of nuclei, then the ratio of the number of nuclei of X_1 to that of X_2will be $1/e$ after a time .

A. $\frac{1}{10\lambda}$

B. $\frac{11}{10\lambda}$

C. $\frac{1}{11\lambda}$

D. $\frac{1}{9\lambda}$

Answer: D

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32. A radioactive substance is being consumed at a constant of $1s^{-1}$. After what time will the number of radioactive nuclei become 100. Initially, there were 200 nuclei present.

A. $1s$

B. $\frac{1}{1n(2)}s$

C. $\ln(2)s$

D. $2s$

Answer: C

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33. A radioactive isotope is being produced at a constant rate X. Half-life of the radioactive substance is Y. After some time, the number of radioactive nuclei become constant. The value of this constant is .

A. $\frac{XY}{\ln(2)}$

B. XY

C. $(XY)\ln(2)$

D. $\frac{X}{Y}$

Answer: A

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34. A radioactive substance X decays into another radioactive substance Y. Initially, only X was present . λ_x and λ_y are the disintegration constant of X and Y. N_y will be maximum when.

A. $\frac{N_y}{N_x - N_y = \frac{\lambda_y}{\lambda_x} - \lambda_y}$

B. $\frac{N_y}{N_x - N_y = \frac{\lambda_y}{\lambda_x} - \lambda_y}$

C. $\lambda_y N_y = \lambda_x N_x$

D. $\lambda_y N_x = \lambda_x N_y$

Answer: C

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35. There are two radio nuclei A and B. A is an α emitter and B a β emitter. Their disintegration constant are in the ratio of $1:2$ What should be the ratio of number of atoms of A and B at any time t so that probabilities of getting alpha and beta particles are same at that instant?

A. $2:1$

B. $1:2$

C. e

D. e^{-1}

Answer: A

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36. Half-life of a radioactive substance A is two times the half-life of another radioactive substance B. Initially, the number of A and B are N_A and N_B, respectively . After three half-lives of A, number of nuclei of both are equal. Then, the ratio N_A / N_B is .

A. $1/4$

B. $1/8$

C. `1//3

D. $1/6$

Answer: b

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37. There are two radioactive substance A and B. Decay constant of B is two times that of A. Initially, both have equal number of nuclei. After n half-lives of A, rates of disintegration of both are equal. The value of n is .

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38. A radioactive nucleus A finally transforms into a stable nuccelus B. Then, A and B may be

A. isobars

B. isotones

C. isotopes

D. none of these

Answer: c

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39. If $._{92}U^{238}$ changes to $._{85}At^{210}$ by a series of α-and β -decays, the number of α and β-decays undergone is .

A. $7 \text{ and } 5$

B. $7 \text{ and } 7$

C. $5 \text{ and } 7$

D. $7 \text{ and } 9$

Answer: b

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40. Number of nuclei of a radioactive substance are 1000 and 900 at times $t = 0$ and time $t = 2s$. Then, number of nuclei at time $t = 4s$ will be

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41. A radioacitve nucleus is being produced at a constant rate α per second. Its decay constant is λ. If N_0 are the number of nuclei at time $t = 0$, then maximum number of nuceli possible are .

A. $\frac{\alpha}{\lambda}$

B. $\frac{N_0\alpha}{\lambda}$

C. N_0

D. $\frac{\lambda}{\alpha + N_0}$

Answer: a

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42. In a sample of a radioactive substance, what fraction of the initial nuceli will remain undecayed after a time $t = T/2$, where T=half -life of radioactive substance?

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

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

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

D. $\frac{1}{\sqrt{2}-1}$

Answer: a

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43. The activity of a radioactive substance is R_1 at time t_1 and R_2 at time $t_2(\, > t_1)$. Its decay cosntant is λ. Then .

A. $R_1 t_1$

B. $R_2 = R_1 e^{\lambda(t_1 - t_2)}$

C. $\frac{R_1 - R_2}{t_2 - t_1 = cons \tan t}$

D. $R_2 = R_1 e^{\lambda(t_2 - t_1)}$

Answer: b

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44. In problem43, number of atoms decayed between time interval t_1 and t_2 are

A. $\frac{\ln(2)}{\lambda}(R_1 R_2)$

B. $R_1 e^{-\lambda t_2} - R_2 e^{-\lambda t_2}$

C. $\lambda(R_1 - R_2)$

D. $\frac{R_1 - R_2}{\lambda}\Big)$

Answer: d

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45. The ratio of molecular mass of two radioactive substances is $3/2$ and the ratio of their decay constant is $4/3$. Then. The ratio of their initial activity per mole will be

A. 2

B. $\frac{8}{9}$

C. $\frac{4}{3}$

D. $\frac{9}{8}$

Answer: C

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46. N_1 atoms of a radioactive element emit N_2 beta partilces per second. The decay cosntant of the element is (in s^{-1})

A. $\frac{N_1}{N_2}$

B. $\frac{N_2}{N_1}$

C. $N_1 \ln(2)$

D. $N_2 \ln(2)$

Answer: b

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47. The binding energy of nuclei X and Y are E_1 and E_2, respectively. Two atoms of X fuse to give one atom of Y and an energy Q is released. Then,

A. $Q = 2E_1 - E_2$

B. $Q = 2E_2 - 2E_1$

C. $Q < 2E_1 - E_2$

D. $Q > 2E_2 - 2E_1$

Answer: B

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48. The binding energy per nucleon number for deutron $H_1^2$and helium He_2^4 are $1.1 MeV$ and $7.0 MeV$ respectively . The energy released when two deuterons fase to form a belium nucleus He_2^4 is ....

A. 20.8 MeV

B. 16.6MeV

C. 25.2MeV

D. 23.6MeV

Answer: d

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49. $._{92}U^{238}$ absorbs a neutron. The product emits an electron. This product further emits an electron. The result is

A. $._{94}Pu^{239}$

B. $._{90}Pu^{239}$

C. $\cdot_{93} Pu^{237}$

D. . _ $(94) Pu^{237}$

Answer: a

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50. The activity of a radioative element decreases to one third of the original activity I_0 in a period of nine years. After a further 1apse of nine years, its activity will be

A. A_0

B. $\frac{2}{3} A_0$

C. $\frac{A_0}{9}$

D. $\frac{A_0}{6}$

Answer: c

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51. The half-life of a radioactive decay is x times its mean life. The value of zx is

A. 0.3010

B. 0.6930

C. 0.6020

D. $\frac{1}{0.6930}$

Answer: b

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52. Neutron decay in the free space is given follows:

$._{0}n^{1} \rightarrow ._{1}H^{1} + ._{-e}^{0} + []$

Then, the parenthesis represents

A. photon

B. graviton

C. neutrino

D. antineutrino

Answer: d

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53. A nucleus $._{Z}^{A}X$ emits an α-particel. The resultant nucleus emits a β^{+} particle. The respective atomic and mass numbers of the final nucleus will be

A. $Z-3, A-4$

B. $Z-1, A-4$

C. $Z-2, A-4$

D. $Z, A-2$

Answer: a

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54. Ceratain radioactive substance reduces to 25% of its value is $16 days$. Its half-life is

A. $32 days$

B. $8 days$

C. $64 days$

D. $28 days$

Answer: b

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55. What is the age of an ancient wooden piece if it is known that the specific activity of C^{14} nuclide in it amounts to $3/5$ of that in fresh trees? Given: the half of C nuclide is $5570 years$ and $\log_e(5/3) = 0.5$.

A. $1000 years$

B. $2000 years$

C. $3000 years$

D. $4000 years$

Answer: D

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56. A helium atom, a hydrogen atom and a neutron have mases of $4.003u, 1.008u$ and $1.009u$ (unified atomic mass units), respectively. Assuming that hydogen atoms and neutrons can be fuse to from helium, what is the binding energy of a helium nucleus?

A. $2.01u$

B. $3.031u$

C. $1.017u$

D. $0.031u$

Answer: d

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57. A certain radioactive element has half-life of 4 days. The fraction of material that decays in 2days is

A. $1/2$

B. $1/(\sqrt{2})$

C. $(\sqrt{2})$

D. $(\sqrt{2}) - 1/(\sqrt{2})$

Answer: d

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58. In the disintegration series

$._{92}^{238} U \overrightarrow{\alpha} X \overrightarrow{\beta^{-}} ._{Z}^{A} Y$ the values of Z and A, respectively, will be

A. 92326

B. 88230

C. 90234

D. 91234

Answer: d

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59. Atomic mass number of an element is 232 and its atomic number is 90. The end product of this radiaoctive element is an isotope of lead (atomic mass 208 and atomic number 82.) The number of α-and β -particles emitted are.

A. $6, 3$

B. $6, 4$

C. $5, 5$

D. $4, 6$

Answer: b

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60. The initial activity of a certain radioactive isotope was measured as 16000 counts $\min.^{-1}$. Given that the only activity measured was due to this isotope and that its activity after $12h$ was 2100 counts $\min.^{-1}$, its half-life, in hours, is nearest to [Given $\log_e(7.2) = 2$].

A. 9.0

B. 6.0

C. 4.0

D. 3.0

Answer: C

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61. The minimum frequency of a γ-ray that causes a deutron to disintegrate into a poton and a neutron is $(m_d = 2.0141amu, m_p = 1.0078amu, m_n = 1.0087amu.)$.

A. $2.7 \times 10^{20} Hz$

B. $5.4 \times 10^{20} Hz$

C. $10.8 \times 10^{20} Hz$

D. $21.6 \times 10^{20} Hz$

Answer: b

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62. The fission of a heavy nucleus gives, in general, two smaller nuclei, two or three neutrons, some $\beta -$ particles and some $\gamma -$ radiation. It is always true that the nuclei produced.

A. have a total rest-mass that is greater than that of the original nucleus

B. have large kinetic energies that carry off the greater part of the energy released

C. travel in exactly oppsite directions

D. have neutron-to-proton ratios that are too low for stabitity

Answer: B

Watch Video Solution

63. The activity of a radioactive sample is 1.6 curie, and its half-life is $2.5 days$. Its activity after $10 days$ will be

A. $0.8 curie$

B. $0.4 curie$

C. $0.1 curie$

D. $0.16 curie$

Answer: c

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64. The rest mass of a deuteron is equivalent to an energy of $1876 MeV$, that of a proton to $939 MeV$, and that of a neutron to` 940 MeV.

A. emits an X-ray photon of energy $2 MeV$

B. captures an X-ray photon of energy $2 MeV$

C. emits an X-ray photon of energy $3 MeV$

D. captures an X-ray photon of energy $3 MeV$

Answer: d

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65. A newly prepared radioactive nuclide has a decay constant λ of $10^{-6}s^{-1}$. What is the approximate half-life of the nuclide?

A. $1hour$

B. $1day$

C. $1week$

D. $1month$

Answer: c

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66. The half-life of a certain radioactive isotope is $32h$. What fraction of a sample would remain after $16h$?

A. 0.25

B. 0.71

C. 0.29

D. 0.75

Answer: B

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67. Samples of two radioactive nuclides, X and Y, each have equal activity A at time $t = 0$. X has a half-life of $24 years$ and Y a half-life of $16 years$. The samples are mixed together. What will be the total activity of the mixture at $t = 48$ years?

A. $\frac{1}{2}A_0$

B. $\frac{1}{4}A_0$

C. $\frac{3}{16}A_0$

D. $\frac{3}{8}A_0$

Answer: d

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

A. $1.35g$

B. $2.50g$

C. $3.70g$

D. $6.30g$

Answer: a

Watch Video Solution

69. Atomic mass number of an element is 232 and its atomic number is 90. The end product of this radioactive element is an isotope of lead (atomic mass 208 and atomic number 82.) The number of α-and β -particles emitted are.

A. $\alpha = 3, \beta = 3$

B. $\alpha = 6, \beta = 4$

C. $\alpha = 6, \beta = 0$

D. $\alpha = 4, \beta = 6$

Answer: b

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70. After an interval of one day , $1/16th$ initial amount of a radioactive material remains in a sample. Then, its half-life(in h) is .

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71. The half-life of $.^{215} At$ is $100\mu s$. The time taken for the activity of a sample of $.^{215} At$ to decay to $\frac{1}{16}th$ of its initial value is

A. $400\mu s$

B. $6.3\mu s$

C. $40\mu s$

D. $300\mu s$

Answer: a

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72. A stationery thorium nucleus $(A = 200, Z = 90)$ emits an alpha particle with kinetic energy E_α. What is the kinetic energy of the recoiling nucleus

A. $\frac{E_\alpha}{108}$

B. $\frac{E_\alpha}{110}$

C. $\frac{E_\alpha}{55}$

D. $\frac{E_\alpha}{54}$

Answer: D

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73. The fraction of a radioactive material which remains active after time t is $9/16$. The fraction which remains active after time $t/2$ will be .

A. $\frac{4}{5}$

B. $\frac{7}{8}$

C. $\frac{3}{5}$

D. $\frac{3}{4}$

Answer: D

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74. The radioactive decay rate of a radioactive element is found to be 10^3 disintegration per second at a cartain time . If the half life of the element is one second , the dacay rate after one second ..... And after three second is ......

A. $500s^{-1}$

B. $1000s^{-1}$

C. $250s^{-1}$

D. $2000s^{-1}$

Answer: a

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75. The percentage of quantity of a radioactive material that remains after 5 half-lives will be .

A. 31%

B. 3.125%

C. 0.3%

D. 1%

Answer: b

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76. $.^{238}U$ decays with a half-life of 4.5×10^9 years, the decay series eventually ending at $.^{206}Pb$, which is stable. A rock sample analysis shows that the ratio of the number of atoms of $.^{206}Pb$ to $.^{238}U$ is 0.0058. Assuming that all the $.^{206}Pb$ is prodduced by the decay of $.^{238}U$ and that all other half-lives on the chain are negligilbe, the age of the rock sample is $(1n1.0058 = 5.78 \times 10^{-3})$.

A. $38 \times 10^8 years$

B. $38 \times 10^6 years$

C. $19 \times 10^8 years$

D. $19 \times 10^6 years$

Answer: b

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77. A radioactive nucleus a series of decays according to the scheme

$$A \underset{\rightarrow}{\alpha} A_1 \underset{\rightarrow}{\beta} A_2 \underset{\rightarrow}{\alpha} A_3 \underset{\rightarrow}{\gamma} A_4$$

If the mass number and atomic number of $A$are 180 and 72, respectively, then what are these number for A_4 ?

A. $172 \text{ and } 69$

B. $174 \text{ and } 70$

C. $176 \text{ and } 69$

D. $176 \text{ and } 70$

Answer: A

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78. If 10% of a radioactive substance decays in every 5 year, then the percentage of the substance that will have decaed in $20 years$ will be .

A. 40%

B. 50%

C. 65.6%

D. 34.4%

Answer: d

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79. Stationery nucleus $.^{238}U$ decays by a emission generaring a total kinetic energy T:

$._{92}^{238} \rightarrow ._{90}^{234}Th + ._{2}^{4}\alpha$

What is the kinetic energy of the α-particle?

A. Slightly less than $T/2$

B. $T/2$

C. Slightly less than T

D. Slightly greater than T

Answer: c

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80. The activity of a radioative element decreases to one third of the original activity I_0 in a period of nine years. After a further 1apse of nine years, its activity will be

A. I_0

B. $(2/3)I_0$

C. $(I_0/9)$

D. $(I_0/6)$

Answer: c

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81. The half-life period of RaB $\left(._{82}Pb^{214}\right)$ is 26.8 min . The mass of one curie of RaB is

A. $3.71 \times 10^{10} g$

B. $3.71 \times 10^{-10} g$

C. $8.61 \times 10^{10} g$

D. $3.064 \times 10^{-8} g$

Answer: d

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82. A 5×10^{-4}Å photon produces an electron-positron pair in the vincinity of a heavy nucleus. Rest energy of electron is $0.511 MeV$. sIf they have the same kinetic energies, the energy of each paricles is nearly

A. $1.2 MeV$

B. $12 MeV$

C. $120 MeV$

D. $1200 MeV$

Answer: b

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83. 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. $6h$

B. $12h$

C. $24h$

D. $128h$

Answer: b

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84. Uranium ores contain one radium -226atom for every 2.8×10^6 uranium -238 atoms. Calculate the half-life of $._{88} Ra^{226}$ is 1600 years $\left(._{88} Ra^{226}\right.$ is a decay product of $._{92} U^{238}\Big)$.

A. $1.75 \times 10^3 years$

B. $1600 \times \dfrac{238}{92} years$

C. $4.5 \times 10^9 years$

D. $1600 \times 238 years$

Answer: c

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85. Plutinium has atomic mass 210 and a decay constant equal to $5.8 \times 10^{-8} s^{-1}$. The number of α-particles emitted per second by $1 mg$ plutonium is

(Avagadro's constant =6.0×10^{23}).

A. 1.7×10^9

B. 1.7×10^{11}

C. 2.9×10^{11}

D. 3.4×10^9

Answer: b

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86. At any instant, the ratio of the amounts of two radioactive substance is $2:1$. If their half-lives be, respectively, $12h$ and $16h$, then after two days, what will be the ratio of the substances?

A. $1:01$

B. $2:01$

C. $1:2$

D. $1:4$

Answer: a

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87. The radioactivity of a sample is R_1 at a time T_1 and R_2 at time T_2. If the half-life of the specimen is T, the number of atoms that have disintegrated in the time $(T_2 - T_1)$ is proporational to

A. $R_1 T_1 = R_2 T_2$

B. $R_1 - R_2$

C. $\frac{R_1 - R_2}{T}$

D. $(R_1 - R_2)T$

Answer: d

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88. Half-life of a radioactive substance$A$ and B are, respectively, 20 min and 40 min . Initially, the samples of A and B have equal number of nuclei. After 80 min , the ratio of the ramaining number of A and B nuclei is

A. $1:16$

B. $4:1$

C. $1:4$

D. $1:1$

Answer: c

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89. A radioactive nucleus can decay by two differnet processess. The mean value period for the first process is t_1 and that the second process is t_2 .The effective mean value period for the two processes is .

A. $\frac{t_1 + t_2}{2}$

B. $t_1 + t_2$

C. $\sqrt{t_1 t_2}$

D. $\frac{t_1 + t_2}{t_1 + t_2}$

Answer: d

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90. The half-life of radium is $1620 years$ and its atomic weight is 226. The number of atoms that will decay from its $1g$ sample per second will be .

A. 3.6×10^{10}

B. 3.6×10^{12}

C. 3.1×10^{15}

D. 31.1×10^{15}

Answer: a

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91. The nuclear radius of a nucelus with nucleon number 16 is $3 \times 10^{-15} m$. Then, the nuclear radius of a nucleus with nucleon number 128 is .

A. $3 \times 10^{-15} m$

B. $1.5 \times 10^{-15} m$

C. $6 \times 10^{-15} m$

D. $4.5 \times 10^{-15} m$

Answer: c

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92. The nuclear radius of $._8 O^{16}$ is $3 \times 10^{-15} m$. If an atomic mass unit is $1.67 \times 10^{-27} kg$, then the nuclear density is approximately.

A. $2.35 \times 10^{17} gcm^{-3}$

B. $2.35 \times 10^{17} kgm^{-3}$

C. $2.35 \times 10^{17} gm^{-3}$

D. $2.35 \times 10^{17} kgmm^{-3}$

Answer: b

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93. What would be the energy required to dissociate completely $1g$ of $Ca - 40$ into its constituent, particles? Given: Mass of proton $= 1.00866 amu$,

Mass of neutron $= 1.00866 amu$,

Mass of $Ca - 40 = 39.97454 amu$, (Take $1 amu = 931 MeV$).

A. $4.813 \times 10^{24} MeV$

B. $4.813 \times 10^{24} eV$

C. $4.813 \times 10^{23} MeV$

D. none of these

Answer: a

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94. In fission,the percentage of mass converted into energy is about

A. 94%

B. 1%

C. 0.1%

D. 0.01%

Answer: c

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95. In the nuclear reaction $._1 H^2 + ._1 H^2 \rightarrow ._2 He^3 + ._0 n^1$ if the mass of the deuterium atom $= 2.014741 amu$, mass of $._2 He^3$ atom $= 3.016977 amu$, and mass of neutron $= 1.008987 amu$, then the Q value of the reaction is nearly .

A. $0.00352 MeV$

B. $3.27 MeV$

C. $0.82 MeV$

D. $2.45 MeV$

Answer: B

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96. Assuming that about $20 MeV$ of energy is released per fusion reaction $._1 H^2 + ._1 H^3 \rightarrow ._0 n^1 + ._2 He^4$, the mass of $._1 H^2$ consumed per day in a future fusion reactor of powder $1 MW$ would be approximately

A. $0.001g$

B. $0.1g$

C. $10.0g$

D. $1000g$

Answer: b

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97. Assuming that about $200MeV$ of energy is released per fission of $._{92}U^{235}$ nuceli, the mass of U^{235} consumed per day in a fission ractor of power 1 megawatt will be approximately .

A. $10^{-2}g$

B. $1g$

C. $100g$

D. $10,000g$

Answer: b

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98. If mass of $U^{235} = 235.12142 a. m. u.$, mass of $U^{236} = 236.1205 a. m. u$, and mass of neutron $= 1.008665 a. m. u$, then the energy required to remove one neutron from the nucleus of U^{236} is nearly about.

A. $75 MeV$

B. $6.5 MeV$

C. $1 eV$

D. zero

Answer: B

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99. The binding energies per nucleon for deuteron $\left(._1 H^2\right)$ and helium $\left(._2 He^4\right)$ are $1.1 MeV$ and $7.0 MeV$ respectively. The energy released when two deutrons fuse to form a helium nucleus $\left(._2 He^4\right)$ is

A. $13.9 MeV$

B. $26.9 MeV$

C. $23.6 MeV$

D. $19.2 MeV$

Answer: C

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100. In the fusion reaction $._1^2 H +_1^2 H \rightarrow_2^3 He +_0^1 n$, the masses of deuteron, helium and neutron expressed in amu are $2.015, 3.017$ and 1.009 respectively. If $1 kg$ of deuterium undergoes complete fusion, find the amount of total energy released. 1 amu $= 931.5 MeV / c^2$.

A. $\approx 6.02 \times 10^{13} J$

B. $\approx 5.6 \times 10^{13} J$

C. $\approx 9.0 \times 10^{13} J$

D. $\approx 0.9 \times 10^{13} J$

Answer: c

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101. The half-life of radium is $1500 years$. In how many years will $1g$ of pure radium be reduced to one centigram?

A. $3.927 \times 10^{2} years$

B. $9.927 \times 10^{2} years$

C. $99.927 \times 10^{2} years$

D. $0.927 \times 10^{2} years$

Answer: b

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102. The compound unstabel nucleus $._{92}^{236}U$ often decays in accordance with the following reaction

$._{92}^{236}U \rightarrow ._{54}^{140}Xe + ._{38}^{94}Sr$ + other particles

During the reaction, the uranium nucleus "fissions" (splits) into the two smaller nuceli have higher nuclear binding energy per nucleon (although the lighter nuclei have lower total nuclear binding energies, because they contain fewer nucleons).

Inside a nucleus, the nucleons (protonsa and neutrons)attract each other with a "strong nuclear" force. All neutrons exert approxiamtely the same strong nuclear force on each other. This force holds the nuclear are very close together at intranuclear distances.

A proton and a neutron are both shot at $100ms^{-1}$ toward a $._{6}^{12}C$ nuleus. Which partilce, if either, is more likely to be absorebed by the nucleus?

A. The proton

B. The neutron

C. Both particles are about equally likely to be absorbed,.

D. Neither particle will be absorbed.

Answer: b

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103. A container is filled with a radioactive substance for which the half-life is $2 days$. A week later, when the container is opened, it contains $5g$ of the substance. Approximately how many grams of the substance were initially placed in the container ?

A. 40

B. 60

C. 80

D. 100

Answer: C

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104. The half - life ofI ^ (131)$is8days. Givenasamp \le of$I^(131)$attime$t = 0` , we can assert that

A. no nucleus will decay before $t = 4days$

B. no nucleus will decay before $t = 8days$

C. all nucleus will decay before $t = 16days$

D. a given nucleus may decay at any tiem after $t = 0$.

Answer: d

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105. When an atom undergoes β^{-} decay

A. a neutron changes into a proton

B. a proton changes into a neutron

C. a neutron changes into an antiproton

D. a proton changes into an antineutron

Answer: b

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106. The nucleus of the deuterium atom, called the deuteron, consists of a proton and a neutron. Calculate the deutron's binding energy, given atomic mass, i.e., the mass of a deuterium nucleus plus an electron is measured to be $2.014102u$.

A. $0.002388MeV$

B. $2.014102MeV$

C. $2.16490MeV$

D. $2.224MeV$

Answer: d

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107. The compound unstabel nucleus $._{92}^{236}U$ often decays in accordance with the following reaction

$_(92)^{236}U \rightarrow ._{54}^{140}Xe +$ _(38)^(94)Sr ` + other particles

During the reaction, the uranium nucleus "fissions" (splits) into the two smaller nuceli have higher nuclear binding energy per nucleon (although the lighter nuclei have lower total nuclear binding energies, because they contain fewer nucleons).

Inside a nucleus, the nucleons (protonsa and neutrons)attract each other with a "strong nuclear" force. All neutrons exert approxiamtely the same strong nuclear force on each other. This force holds the nuclear are very close together at intranuclear distances.

In the nuclear reaction presented above, the "otter particles" might be .

A. An alpha particle, which consists of two protons and two neutrons

B. two protons

C. one proton and one neutron

D. two neutrons

Answer: d

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108. The compound unstabel nucleus $._{92}^{236}U$ often decays in accordance with the following reaction

$._{92}^{236}U \rightarrow ._{54}^{140}Xe + ._{38}^{94}Sr$ + other particles

During the reaction, the uranium nucleus "fissions" (splits) into the two smaller nuceli have higher nuclear binding energy per nucleon (although the lighter nuclei have lower total nuclear binding energies, because they contain fewer nucleons).

Inside a nucleus, the nucleons (protonsa and neutrons)attract each other with a "strong nuclear" force. All neutrons exert approxiamtely the same strong nuclear force on each other. This force holds the nuclear are very close together at intranuclear distances.

Why is a $._{2}^{4}He$ nucleus more stable than a $._{3}^{4}Li$ nulceus?

A. The strong nuclear force is larger when the neutron to proton ratio is higher.

B. The laws of nuclear physics forbid a nucleus from containing more protons than neutrons.

C. Forces other than the strong nuclear force make the lithium nulceus less stable.

D. none of these

Answer: c

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109. What is the power output of a $._{92}U^{235}$ reactor if it is takes 30 days to use up $2kg$ of fuel, and if each fission gives $185MeV$ of usable energy ?.

A. 45 megawatt

B. 58.46 megawatt

C. 72 megawatt

D. 92 megawatt

Answer: b

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110. Consider the following reaction :

$H_1^2 + H_1^2 = He_2^4 + Q$

Mass of the deuterium atom $= 2.0141u$

Mass of helium atom $= 4.0024u$

This is a nuclear .... reaction in which the energy Q released is .... MeV`.

A. 12

B. 6

C. 24

D. 48

Answer: C

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111. A radioactive nuclide is produced at the constant rate of n per second (say, by bombarding a target with neutrons). The expected number N of nuclei in existence t s after the number is N_0 is given by

A. $N = N_0 e^{-\lambda t}$

B. $N = N_0 e^{-\lambda t}$

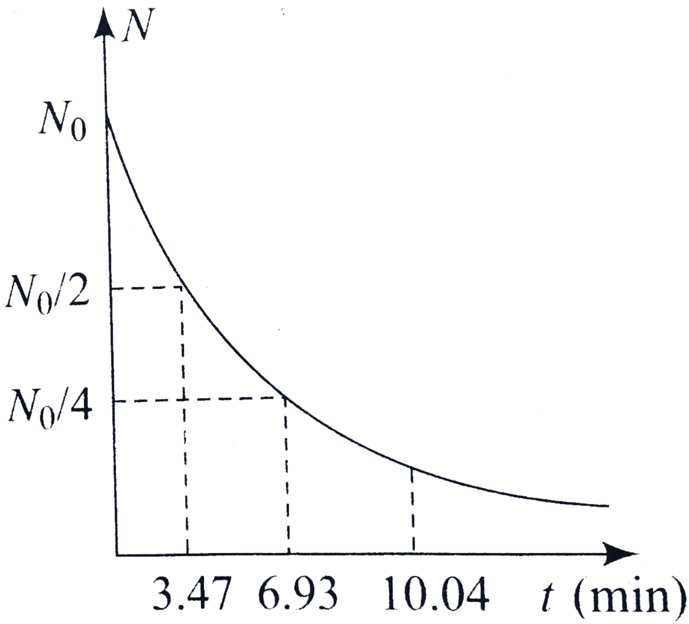
C. $N = \frac{n}{\lambda} + \left(N_0 + \frac{n}{\lambda}\right)e^{-\lambda t}$

D. $N = \frac{n}{\lambda} + \left(N_0 + \frac{n}{\lambda}\right)e^{-\lambda t}$

Answer: c

Watch Video Solution

112. A radioactive sample undergoes decay as per the following gragp. At time$t = 0$, the number of undecayed nuclei is N_0. Calculate the number of nuclei left after $1h$.



A. N_0 / e^8

B. N_0 / e^{10}

C. N_0 / e^{12}

D. N_0 / e^{14}

Answer: c

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113. Binding energy per nucleon for C^{12} is $7.68 MeV$ and for C^{13} is $7.74 MeV$. The energy required to remove a neutron from C^{13} is .

A. $5.49 MeV$

B. $8.46 MeV$

C. $9.45 MeV$

D. $15.49 MeV$

Answer: b

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114. A radio nuclide A_1 with decay constant λ_1 transforms into a radio nuclide A_2 with decay constant λ_2. Assuming that at the initial moment, the preparation contained only the radio nuclide A_1

(a) Find the equation describing accumulation of radio nuclide A_2 with time. (b) Find the time interval after which the activity of radio nuclide A_2 reaches its maximum value.

A. $\frac{\ln(\lambda_2 / \lambda_1)}{\lambda_2 - \lambda_1}$

B. $\frac{\ln(\lambda_2 / \lambda_1)}{\lambda_2 - \lambda_1}$

C. $\ln(\lambda_2 - \lambda_1)$

D. none of these

Answer: D

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115. A radioiostope X has a half-life of $10s$. Find the number of nuclei in the sample (if initially there are 1000 isotopes which are falling from rest from a height of $3000m$) when it is at a height of $1000m$ from refrence plane.

A. 50

B. 250

C. 29

D. 100

Answer: b

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116. In the nuclear raction given by $._2He^4 + ._7N^{14} \rightarrow ._1H^1 + X$ the nucleus X is

A. nitrogen of mass 16

B. nitrogen of mass 17

C. oxygen of mass 16

D. oxygen of mass 17

Answer: d

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117. A stationary nucleus of mass 24 amu emits a gamma photon. The energy of the emitted photon is $7MeV$. The recoil energy of the nucleus is

A. 2.2

B. 1.1

C. 3.1

D. 22

Answer: b

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118. There are n number of radioactive nuclei in a sample that undergoes beta decay. If from the sample, n' number of β-particels are emitted every $2s$, then half-life of nuclei is .

A. $n' / 2$

B. $0.693 \times (2n / n')$

C. $0.6931n(2n / n')$

D. $0.693 \times (n/n')$

Answer: b

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119. The luminous dials of watches are usually made by mixing a zinc sulphide phosphor with an α-particles emitter. The mass of radium (mass number $226, half-l \text{ if } e1620years$)that is needed to produce an average of 10 alpha`-particles per second for this purpose is

A. $2.77mg$

B. $2.77g$

C. $2.77 \times 10^{-23}g$

D. $2.77 \times 10^{-13}kg$

Answer: d

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120. The following deutruim reactions and corresponding raction energies are found to occur. S

A. $0.5eV$

B. $0.5MeV$

C. $0.05MeV$

D. $0.05eV$

Answer: c

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121. A neutron of energy 1 MeV and mass 1.6×10^{-27} kg passes a proton at such a distance that the angular momentum of the neutron relative to the proton approximately equals $10^{-33} Js$. The distance of closest approach neglecting the interaction between particles si

A. $0.44nm$

B. $0.44mm$

C. 0.44Å

D. $0.44fm$

Answer: d

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122. Rank the following nuclei in order from largest to smallest value of the binding energy per nucleon:

(i) $._2^4 H$, (ii) $_(24)^{52}Cr$, (iii) $._{62}^{152} Sm$, (iv) $._{80}^{100} Hg$, (v) $._{92}^{252} Cf$.

A. $E_v > E_{iv} > E_{iii} > E_{ii} > E_i$

B. $E_i > E_{ii} > E_{iii} > E_{iv} > E_v$

C. $E_{ii} > E_{iii} > E_{iv} > E_v > E_i$

D. $E_i = E_{ii} = E_{iii} = E_{iv} = E_v$

Answer: C

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123. A nucelus with atomic number Z and neutron number N undergoes two decay processes. The result is a nucleus with atomic number $Z-3$ and neutron $N-1$. Which decay processes took place?

A. Two β^{-} decays

B. Two β^{+} decays

C. An α decay and a β^{-} decays

D. Analpha$decay$ and $a$beta^(+)` decays

Answer: d

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124. Gold $._{79}^{198}Au$ undergoes β^{-} decay to an excited state of $._{80}^{198}Hg$. If the excited state decays by emission of a γ-photon with energy $0.412MeV$, the maximum kinetic energy of the electron emitted in the decay is (This maximum occurs when the antineutrino has negligible energy. The recoil energy of the $._{80}^{198}Hg$ nucleus can be ignored. The masses of the neutral atoms in their ground states are $197.968255u$ for $._{79}^{198}Hg$).

A. $0.412MeV$

B. $1.371MeV$

C. $0.959MeV$

D. $1.473MeV$

Answer: C

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125. For a certain radioactive substance, it is observed that after $4h$, only 6.25% of the original sample is left undeacyed. It follows that.

A. the half-life of the sample is $1h$

B. the mean life of the sample is $\frac{1}{1n2}h$

C. the decay constant of the sample is $1n(2)h^{-1}$

D. after a further $4h$, the amount of the substance left over would by only 0.39% of the original amount

Answer: a,b,c,d

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126. Mark out the coreect statemnet (s).

A. Higher binding energy per nucleon means the nucleus is more stable.

B. If the binding energy of nucleus can be negative.

C. Binding energy of a nucleus can be negative.

D. Binding energy of a nucleus is always positive.

Answer: a,b,d

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127. Mark out the coreect statemnet (s).

A. In alpha decay,the energy released is shared between alpha particle and daughter nulceus in the form of kinetic energy and share of alpha particle is more than that of the daughter nucleus.

B. In beta decay,the energy released is in the form of kinetic energy of beta particles.

C. In beta minus decay,the energy released is shared between electron and antineutrino

D. In gamma decay,the energy released is in the form of energy carried by photons termed as gamma rays.

Answer: a,c,d

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128. Mark out the coreect statemnet (s).

A. For an exothermic reaction, if Q value is$+12.56MeV$ and theKE of incident particcle is $2.44MeV$, then the totla KE of products of reaction is $15.00MeV$.

B. For an exothermic reaction, if Q value is $+12.56MeV$ and the KE of incident particcle is $2.44MeV$, then the totla KE of products of reaction is $12.56MeV$.

C. For an endothermic reaction, if we give the energy equal $|Q|$ value of reaction, then the reaction will be carried out.

D. For an exothermic reaction, the BE per nucleon of products should be greater than the BE per nucleon of reactants.

Answer: a,d

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129. Mark out the coreect statemnet (s).

A. In fission and fusion processes, the mass of reactant nuclide is greater than the mass of product nuclide.

B. In fission process, BE per nucleon of reactant nucleide is less than the binding energy per nucleon of product nucleide.

C. In fusion process, BE per nucleon of reactant nucleide is less than the binding energy per nucleon of product nucleide.

D. In fusion process, BE per nucleon of reactant nucleide is greater than the binding energy per nucleon of product nucleide.

Answer: a,b,c,

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130. During β-decay (beta minus), the emission of antineutrino particle is supported by which of the following statement (s)?

A. Angular momnetum conservation holds good in any nuclear raction

B. Linear momnetum conservation holds good in any nuclear raction

C. The KE of emitted β-particel is varying conitnuously to a maximum value.

D. none of these

Answer: a,b,c

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131. Two samples A and B of same radioactive nuclide are prepared. Sample A has twice the initial activity of sample B. For this situation, mark out the correct statement (s).

A. The half-lives of both the samples would be same.

B. The half-lives of the samples are different.

C. After each has passed through 5 half-lives, ratio of activity of A to B is $2:1$.

D. After each has passed through 5 half-lives, ratio of activity of A to B is $64 : 1$.

Answer: a,c

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132. The decay constant of a radioactive substance is $0.173 year^{-1}$. Therefore,

A. nearly 63% of the radioactive substnce will decay in $(1/0.173)$ year.

B. half-life of the radioactive substance is $(1/0.173)$ year

C. One-fourth of the radioactive substance will be left after 8 years

D. All of the above

Answer: a,c

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133. A nuclide A undergoes α-decay and another nuclide B undergoed β-decay. Then,

A. All the α-paricles emitted by A will have almost the same speed.

B. the α-particles emitted by B will have widely different speed.

C. the β-particles emitted by B will have almost the same speed.

D. the β-particles emitted by B may have almost the same speed.

Answer: a,d

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134. If A, Z and N denote the mass number, the atomic number, and the neutron number for a given nucleus, we can say that.

A. $N = Z + A$

B. isobars have the same A but different Z and `N.

C. isotopes have the same Z but different N and A.

D. isotopes have the same N but different A and Z.

Answer: b,c,d

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135. It has been found that nuclides with $2, 8, 20, 50, 82,$ and 126 protons or neutrons are exceptionally stable. These numbers are refferd to as the magic numbers and their existance has led to.

A. the idea of periodictiy in nuclear properties similar to the periodicity of chemical elements in periodic table

B. the so-called "liquid drop model of the nucleus"

C. the so-called "shell model of the nuclus"

D. have a conveninet exploanation of "nuclear fission"

Answer: a,c

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136. The phenomenon of nuclear fission can be carried out both in a controlled and in an incontrolled way. Out of the following, the correct statements vis-à-vis these phenomens are:

A. The fission energy released per reaction is much more than conventional nuclear reactions and one of the products of the reaction is that very particle which initiates the reaction.

B. It is the "surface to valume" ratio of the sample of nuclear fuel used which determines whether or not the reaction would sustain itself as a 'chain reaction".

C. The "control rods" in a nuclear reactor must be made of a material that absorbs neutorns effectively.

D. The energy released per fission as well as energy released per unit mass of the fuel in nuclear fission are both greater than the corresponding quantities for nuclear fusion.

Answer: a,b,c

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137. Choose the correct statements from the following:

A. Like other light nuclei, the $._2He^4$ nuclei also have a low value of the binding energy per nucleon .

B. The binding energy per nucleon decreases for nuclei with small as well as large atomic number.

C. The energy requuired to remove one neutron from $._3Li^7$ to transform it into the isotpes $._3Li^6$ is $5.6MeV$, which is the same as the binding energy per nucleon of $._3Li^6$

D. When two deuterium ncueli fuse together, they give rise to a tritrium nucleus accompained by a release of energy.

Answer: d,c

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138. It is observerd that only 0.39% of the original radioactive sample remains undecayed after eight hours. Hence,

A. the half-life of that substance is $1h$

B. the mean-life of the substance is $[1/(\log 2)]h$

C. decay constant of the substance is $(\log 2)h^{-1}$

D. if the number of radioactive nuclei of the this substance at a given instant is 10, then the number left after 30 min would be 7.5

Answer: a,b,c

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139. In a nuclear reactor.

A. the chain reaction is kept under control by rods of cadmium, which reduces the rate

B. the thick concrete shield is used to slow down the speed of fast neutrons

C. heavy water (or graphite)moderate the activity of the reactor

D. out of U^{238} and U^{235} natural uranium has less than 1% of U^{235}

Answer: a,d

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140. A radioactive sample has initial concentration N_0 of nuclei. Then,

A. the number of undecayed nuclei present in the sample decays exponentially with time

B. the activity (R) of the sample at any instant is directly proportional to the number of undecayed nuclei present in the sample at that tiem

C. the number of decayed nuclei grows exponentially with time

D. the number of decayed nuclei grows lineraly with time

Answer: a,b

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141. An O^{16} nucleus is spherical and has a radius R and a volume $V=\frac{4}{3}\pi R^3$.According to the empirical observation, the volume of the $._{54}X^{128}$ nucleus assumed to be sphericla is V' and radius is R'. Then

A. $V'=8V$

B. $V'=2V$

C. $R'=2R$

D. $R'=8R$

Answer: a,c

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142. Statement I:Heavy nuclides tend to have more number of neutrons than protons.

Staements II: In hevay nuclei, as there is coloumbic repulsion between protons, so excess of neutrons are preferable:

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143. Staements I: $._z X^4$ undergoes 2α-decays, 2β-decays (negative β) and 2γ-decays. As a result, the daughter product is $._z - 2X^{A-B}$.

Staements II: In β-decay, the mass number decreases by 4 unit and atomic number decreases by 2 unit. In β-decay (negative β), the mass number remains unchanged and atomic number increases by 1 unit. In γ-decay, mass number and atomic number remain unchanged.

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144. Staements I: The nucleus $._{Z}^{A}X$ is having atomic mass as well as its mass number as A.

Staements II: Mass number of an element is an integer that specifies an isotopes and has no units, while atomic mass is generally not an integer.

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145. Staements I: Light nuclei are most stable if N =Z, while heavy nuclei are more stable if N gtZ. (N $\rightarrow$ number of neutrons, Z $\rightarrow$ number of protons)

Staements II: As the number of protons increases in a nucleus, the Coulomb's repulsive forece increases, which tends to break the nucleus apart. So, to keep the nucleus apart. So, to keep the nucleus stable, more number of neutrons are needed which are neutral in nature.

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146. Staements I: In alpha decay of different radioactive nuclides, the energy of alpha particles has been compared. It is found that as the energy of alpha particle increases the half-life of the decay goes on decreasing.

Staements II: More is the energy in any decay process, more is the probability of decaying the nuclide which leads to faster rate of decay.

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147. Staements I: To determine the age of certain very old oragnic samples, dating of the sample with radioactive isotpes having larger half-life is a better choice than with radioactive isotopes having smaller half-lives.

Staements II: The activity of a radioactive sample having smaller half-life is negligibly small after a very long time and hence makes it next to impossible to get dtected.

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148. Staements I: The amount of energy required to remove an average nucleon from different nuclei having different mass numbers is approximately the same, while to remove an average electron from atoms having different mass numbers widely varying amounts of energies are required.

Staements II: Nucleon in a nucleus are bounded by short-range nuclear force while elecrtons in an atom are bounded by lond-range Coulomb' force.

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149. Staements I: The fission of a heavy nucleus is always accompanied with the neutrons along with two product nuclei.

Staements II: For a lighter stble nuclide, the $\frac{N}{Z}$ ratio has to be slightly greater than 1.

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150. Nuclei of a radioactive element X are being produced at a constant rate K and this element decays to a stable nucleus Y with a decay constant λ and half-life $T_{1/2}$. At the time $t = 0$, there are N_0nuclei of the element X.

The number N_X of nuclei of X at time $t = T_{1/2}$ is:

A. $\dfrac{K + \lambda N_0}{2\lambda}$

B. $\dfrac{(2\lambda N_0 - K)1}{\lambda}$

C. $\left[\lambda N_0 + \dfrac{K}{2}\right]\dfrac{1}{\lambda}$

D. Data insufficient

Answer: A

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151. Nuclei of a radioactive element X are being produced at a constant rate K and this element decays to a stable nucleus Y with a decay constant λ and half-life $T_{1/3}$. At the time $t = 0$, there are N_0nuclei of the element X.

The number N_Y of nuclei of Y at time t is .

A. $Kt-\frac{K-\lambda N_0}{\lambda}e^{-\lambda t}+K-\lambda\frac{N_0}{\lambda}$

B. $Kt-\frac{K-\lambda N_0}{\lambda}e^{-\lambda t}+K-\lambda\frac{N_0}{\lambda}$

C. $Kt+\frac{K-\lambda N_0}{\lambda}e^{-\lambda t}$

D. $Kt+\frac{K-\lambda N_0}{\lambda}e^{-\lambda t}$

Answer: B

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152. Nuclei of a radioactive element X are being produced at a constant rate K and this element decays to a stable nucleus Y with a decay constant λ and half-life $T_{1/3}$. At the time $t=0$, there are N_0nuclei of the element X.

The number N_Y of nuclei of Y at $t=T_{1/2}$ is.

A. $K\frac{\ln 2}{\lambda}+\frac{3}{2}\left(\frac{K-\lambda N_0}{\lambda}\right)$

B. $K\frac{\ln 2}{\lambda} + \frac{1}{2}\left(\frac{K - \lambda N_0}{\lambda}\right)$

C.

D. $K\frac{\ln 2}{\lambda} - 2\left(\frac{K - \lambda N_0}{\lambda}\right)$

Answer: c

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153. A radioactive with decay constant λ is being produced in a nuclear reactor at a rate q_0 per second, where q_0 is a positive constant and t is the time. During each decay, E_0 energy is released. The production of radionuclide starts at time $t = 0$.

Which differential equation correctly represents the above process?.

A. $\frac{dN}{dt} + \lambda N = q_0 t$

B. $\frac{dN}{dt} - \lambda N = q_0 t$

C. $\frac{dN}{dt} + q_0 t = \lambda N$

D. $\frac{dN}{dt} + q_0 t = -\lambda N$

Answer: A

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154. 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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155. Beta rays emitted by a radicactive material are

A. electromagnetic radiations

B. the electrons orbiting around the nucleus

C. charged particles emitted by the nucleus

D. neutral particles

Answer: c

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156. The equation

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

A. β-deacy

B. γ-decay

C. fusion

D. Fission

Answer: C

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157. During a beta decay

A. an atomic electron is ejected

B. an electron which is already present within the nucleus is ejected

C. a neutron in the nucleus decays emitting an electron

D. a part of the binding energy of the nucleus is converted into an electron

Answer: C

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158. During a nuclear fusion reaction

A. a heavy nucleus breaks into two fragments by itself

B. a heavy nucleus breaks into two fragments by itself

C. a light nucleus bombarded by thermal neutrons breaks up

D. two light nuclei combine to give a heavier nucleus and possibly other products

Answer: d

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159. 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. $6h$

B. $12h$

C. $24h$

D. $28h$

Answer: b

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160. The decay constant of a radioactive sample is λ. The half-life and the average-life of the sample are respectively

A. $1/\lambda$ and $(\ln 2)/\lambda$

B. $(\ln 2)\lambda$ and $1/\lambda$

C. $\lambda(\ln 2)$ and $1/\lambda$

D. $\lambda/(\ln 2)$ and $1/\lambda$

Answer: b

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161. A star initially has 10^{40} deuterons. It produces energy via the processes $._1H^2 +_1 H^2 \rightarrow_1 H^3 + p$ and $._1H^2 +_1 H^3 \rightarrow_2 He^4 + n$. If the average power radiated by the star is 10^{16} W, the deuteron supply of the star is exhausted in a time of the order of

(a) $10^6 s$ (b) $10^8 s$ (c) $10^{12} s$

The masses of the nuclei are as follows

$M(H^2) = 2.014$ amu, $M(n) = 1.008$ amu,

$M(p) = 1.007$ amu,$M(He^4) = 4.001$amu

A. $10^6 s$

B. $10^8 s$

C. $10^{12} s$

D. $10^{16} s$

Answer: c

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162. Fast neutrons can easily be slowed down by

A. the use of lead shielding

B. passing them through water

C. elastic collision with heavy nuclei

D. applying a strong electric field

Answer: b

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163. Consider a particle , β particle and $\gamma - rays$, each having an energy of $0.5 MeV$. In increase order of panetrating power , the radiation are .

A. α, β, γ

B. α, γ, β

C. β, γ, α

D. γ, β, α

Answer: c

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164. Masses of two isobars $._{29}Cu^{64}$ and $._{30}Zn^{64}$ are $63.9298u$ and $63.9292u$, respectively. It can be concluded from these data that .

A. both the isobars are stable

B. Zn^{64} is radioactive , decaying to Cu^{64} through β-decay

C. $Cu^{64}$is radioactive , decaying to Zn^{64} through γ-decay

D. $Cu^{64}$is radioactive , decaying to Zn^{64} through β-decay

Answer: d

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165. The half - life ofI ^ (131)$is8days. Givenasamp \leq of$I^(131)$attime$t = 0` , we can assert that

A. no nucleus will decay before $t = 4days$

B. no nucleus will decay before` t=8days

C. all nucleus will decay before$t = 16days$

D. a given nucleus may decay at any tiem after $t = 0$.

Answer: d

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166. In hydrogen spectrum the wavelength of H_a line is $656nm$, where in the spectrum of a distance galaxy H_a line wavelength is $706nm$. Estimated speed of the galaxy with respect to earth is ,

A. $2 \times 10^8 ms^{-1}$

B. $2 \times 10^7 ms^{-1}$

C. $2 \times 10^6 ms^{-1}$

D. $2 \times 10^5 ms^{-1}$

Answer: b

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

A. $10^{20} kgm^{-3}$

B. $10^{17} kgm^{-3}$

C. $10^{14} kgm^{-3}$

D. $10^{11} kgm^{-3}$

Answer: b

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168. Ne nucleus , the after absorbing energy , decays into two α particle and an unknown nucleus . The unknown nucleus is

A. nitrogen

B. carbon

C. boron

D. oxygen

Answer: b

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169. 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,

(a) x and y have the same decay rate initially

(b) x and y decay at the same rate always

(c) y will decay at a faster rate than x

(d) x will decay at a faster rate than y

A. X and Y have the same decay rate initially

B. X and$Y$ decay at the same rate always

C. Y will decay at a faster rate than `X

D. X will decay at a faster rate than Y

Answer: c

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170. Which of the following is a correct statement?

A. Beta rays are same as cathode rays.

B. Gamma rays are high-energy neutrons.

C. Alpha particles are singly ionized helium atoms.

D. Protons and neutrons have exactly the same mass

Answer: a

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171. Two radioactive X_1 and X_2 have decay constants 10λ and λ respectively . If initially they have the same number of nuclei, then the ratio of the number of nuclei of X_1 to that of X_2will be $1/e$ after a time .

A. $\frac{1}{10\lambda}s$

B. $\frac{1}{11\lambda}$

C. $\frac{11}{10\lambda}$

D. $\frac{1}{9\lambda}$

Answer: d

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172. The electron emitted in beta radiation originates from

A. inner orbits of atoms

B. free electrons existing in nuclei

C. decay of a neutron in a nuclues

D. photon escaping from the nucleus

Answer: c

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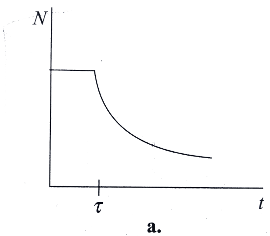
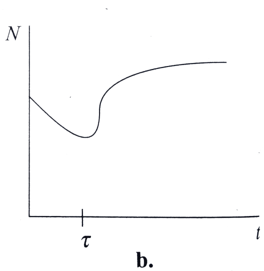
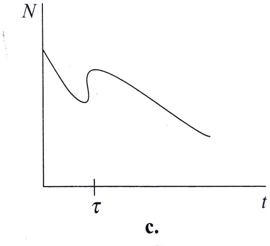
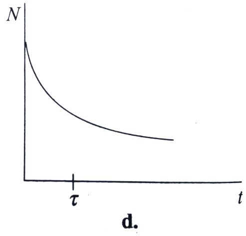
173. A radioactive sample consists of two distinct species having equal number of atoms initially. The mean life of one species is τ and that of the other is 5τ. The decay products in both cases are stable. A plot is made of the total number of radioactive nuclei as a function of time. Which of the following figure best represents the form of this plot?

(a), (b), (c), (d)

A. 

B. 

C. 

D. 

Answer: d

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174. The half - life of $\hat{}(215)At$ is $100\mu, s$. The time taken for the radioactivity of a sample of $\hat{}(215)At$ to decay to $1/16^{th}$ of its initially value is

A. $400\mu s$

B. $6.3\mu s$

C. $40\mu s$

D. $300\mu s$

Answer: A

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175. Which of the following process represents a $\gamma - decay$?

A. $\hat{} (A)X_Z + \gamma \rightarrow^A X_{Z-1} + a + b$

B. $\hat{} (A)X_Z +^1 n_0 \rightarrow^{A-3} X_{Z-2} + ac$

C. $\hat{} (A)X_Z \rightarrow^A X_Z + f$

D. $\hat{} (A)X_Z + e_{-1} \rightarrow^A X_{Z-1} + g$

Answer: c

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176. For uranium nucleus how does its mass vary with volume?

A. $m \propto V$

B. $m \propto 1/V$

C. $m \propto (\sqrt{V})$

D. $m \propto V^2$

Answer: a

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177. A nucleus with mass number 220 initially at rest emits an α-particle. If the Q-value of the reaction is $5.5 MeV$, calculate the kinetic energy of the α-particle.

A. $4.4 MeV$

B. $5.4 MeV$

C. $5.6 MeV$

D. $6.5 MeV$

Answer: B

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178. A 280days old radioactive substance shown an activity of 6000 dps, 100 days later its activity between 3000 dps ,what was its initial activity ?

A. $20000dps$

B. $24000dps$

C. $120000dps$

D. 6000 dps`

Answer: b

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179. If a star can convert all the He nuclei completely into oxygen nuclei. The energy released per oxygen nuclei is (Mass of the helium nucleus is

4.0026 amu and mass of oxygen nucleus is 15.9994 amu)

A. $7.6 MeV$

B. $56.12 MeV$

C. $10.24 MeV$

D. $23.9 MeV$

Answer: c

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180. $_(87)^{221}$Ra is a radioactive substance having half life of 4 days .Find the probability that a nucleus undergoes decay after two half lives

A. 1

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

C. $\frac{3}{4}$

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

Answer: b

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181. In the option given below , let E denote the rest mass energy of a nucleas and n a neutron .The correct option is

A. $E\left(._{92}^{236}U\right) > E\left(._{53}^{137}I\right) + E\left(._{39}^{97}Y\right) + 2E(n)$

B. $E\left(._{92}^{236}U\right) < E\left(._{53}^{137}I\right) + E\left(._{39}^{97}Y\right) + 2E(n)$

C. $E\left(._{92}^{236}U\right) < E\left(._{56}^{140}Ba\right) + E\left(._{36}^{94}Kr\right) + 2E(n)$

D. $E\left(._{92}^{236}U\right) = E\left(._{56}^{140}Ba\right) + E\left(._{36}^{94}Kr\right) + 2E(n)$

Answer: a

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182. A radioactive sample S_1 having an activity $5\mu Ci$ has twice the number of nuclei as another sample S_2 which has as activity of $10\mu Ci$.

The half lives of S_1 and S_2 can be

A. $20 years$ and $5 years$, respectively.

B. $20 years \text{ and } 10 years, respectively.$

C. $10 years each$

D. $5 years each$

Answer: a

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Linked Comprehension

1. A radioactive with decay constant λ is being produced in a nuclear ractor at a rate q_0 per second, where q_0 is a positive constant and t is the time. During each decay, E_0 energy is released. The production of radionuclide starts at time $t = 0$.

Instantaneous power developed at time t due to the decay of the radionuclide is .

A. (q_(0)t-q_(0)/(lambda)+q_(0)/(lambda)e^(-lambdat))E_(0)`

B. (q_(0)t+q_(0)/(lambda)-q_(0)/(lambda)e^(-lambdat))E_(0)`

C. (q_(0)t+q_(0)/(lambda)+q_(0)/(lambda)e^(-lambdat))E_(0)`

D. (q_(0)t+q_(0)/(lambda)-q_(0)/(lambda)e^(-lambdat))E_(0)`

Answer: a

Watch Video Solution

2. A radioactive with decay constant λ is being produced in a nuclear ractor at a rate q_0 per second, where q_0 is a positive constant and t is the time. During each decay, E_0 energy is released. The production of radionuclide starts at time$t = 0$.

Average power developed in time t due to the decay of the radionuclide is

A. $\left(\frac{q_0 t}{2} - \frac{q_0}{\lambda} + \frac{q_0}{\lambda^2 t} - \frac{q_0}{\lambda^2 t} e^{-\lambda t} E_0\right)$

B. $\left(\frac{q_0 t}{2} + \frac{q_0}{\lambda} + \frac{q_0}{\lambda^2 t} - \frac{q_0}{\lambda^2 t} e^{-\lambda t} E_0\right)$

C. $\left(\frac{q_0 t}{2} - \frac{q_0}{\lambda} + \frac{q_0}{\lambda^2 t} + \frac{q_0}{\lambda^2 t} e^{-\lambda t} E_0\right)$

D. $\left(\frac{q_0 t}{2} + \frac{q_0}{\lambda} + \frac{q_0}{\lambda^2 t} + \frac{q_0}{\lambda^2 t} e^{-\lambda t} E_0\right)$

Answer: a

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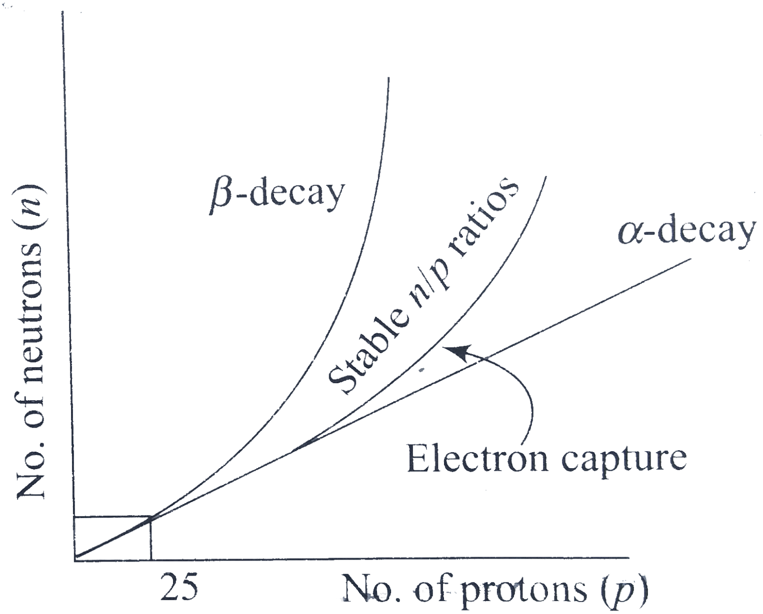
3. Various rules of thumb have seen proposed by the scientific community to expalin the mode of radioactive decay by various radioisotopes. One of the major rules is called the n/p ratio. If all the known isotopes of the elemnts are plotted on a graph of number of neutrons (n) versus number of protons (p), it is observed that all isotopes lying outside of a "stable" n/p ratio region are radioactive as shown fig. The graph exhibits straight line behaviour with unit slope up to $p = 25$. Above $p = 25$, tgose isotopes with n/p ratios lying above the stable region usually undergo beta decay. Very heavy isotopes $(p > 83)$ are unstable because of their relativley large nuclei and they undergo alpha decay. Gamma ray emission does not involve the release of a particle. It represnts a change in an atom from a higher energy level to a lower energy level.



How would the radioisotope of magnesium with atomic mass 27 undergo radioactive decay?.

A. electron capture

B. alpha decay

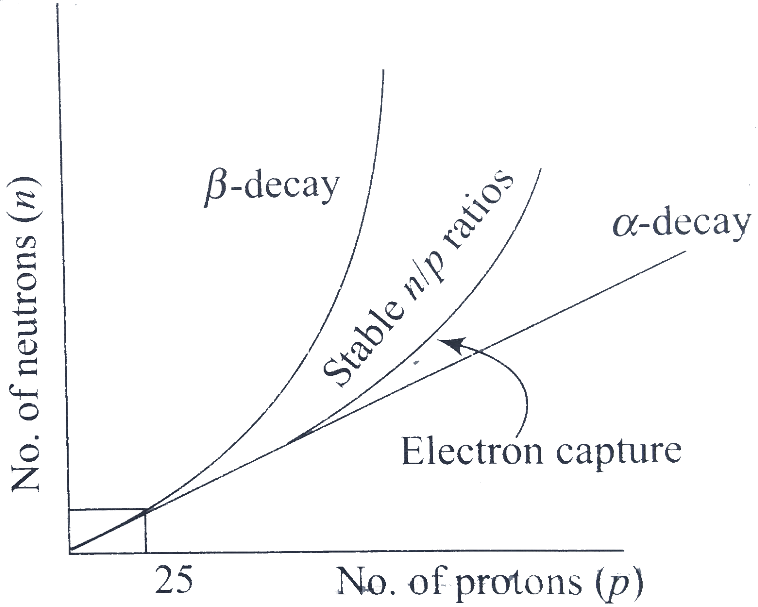
C. beta decay

D. gamma ray emission

Answer: c

Watch Video Solution

4. Various rules of thumb have seen proposed by the scientific community to expalin the mode of radioactive decay by various radioisotopes. One of the major rules is called the n/p ratio. If all the known isotopes of the elemnts are plotted on a graph of number of neutrons (n) versus number of protons (p), it is observed that all isotopes lying outside of a "stable" n/p ratio region are radioactive as shown f The graph exhibits straight line behaviour with unit slope up to $p = 25$. Above $p = 25$, tgose isotopes with n/p ratios lying above the stable region usually undergo beta decay. Very heavy isotopes $(p > 83)$ are unstable because of their relativley large nuclei and they undergo alpha decay. Gamma ray emission does not involve the release of a particle. It represnts a change in an atom from a higher energy level to a lower energy level.



$Th - 230$ undergoes a series of radioactive decay processes resulting in $Bi - 214$ being the final product. What was the sequence of the processes that occured?

A. $\alpha, \alpha, \alpha, g, \beta$

B. $\alpha, \alpha, \alpha, \alpha, \beta$

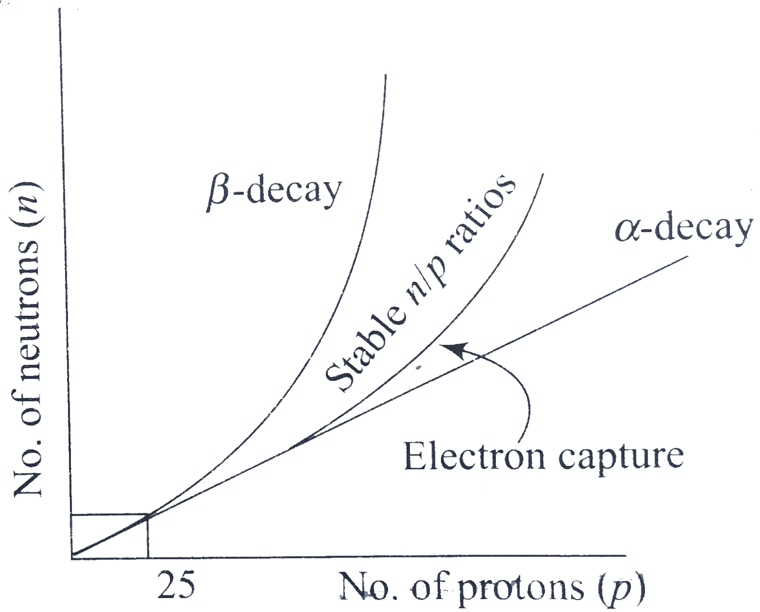
C. $\alpha, \alpha, \beta, \beta$

D. $\alpha, \beta, \beta, \beta, \gamma$

Answer: b

Watch Video Solution

5. Various rules of thumb have seen proposed by the scientific community to expalin the mode of radioactive decay by various radioisotopes. One of the major rules is called the n / p ratio. If all the known isotopes of the elemnts are plotted on a graph of number of neutrons (n) versus number of protons (p), it is observed that all isotopes lying outside of a "stable" n / p ratio region are radioactive as shown fig.5.28. The graph exhibits straight line behaviour with unit slope up to $p=25$. Above $p=25$, tgose isotopes with n / p ratios lying above the stable region usually undergo beta decay. Very heavy isotopes $(p>83)$ are unstable because of their relativley large nuclei and they undergo alpha decay. Gamma ray emission does not involve the release of a particle. It represnts a change in an atom from a higher energy level to a lower energy level.



Which of the following represents the relative penetrating power of the three types of radioactive emission in decreasing order?

A. $\beta > \alpha > \gamma$

B. $\beta > \gamma > \alpha$

C. $\gamma > \alpha > \beta$

D. $\gamma > \beta > \alpha$

Answer: d

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6. The radionuclide $.^{56}Mn$ is being produced in a cyclontron at a constant rate P by bombarding a manganese target with deutrons. $.^{56}Mn$ has a half-life of $2.5h$ and the target contains large numbers of only the stable manganese isotopes $.^{56}Mn$. The reaction that produces $.^{56}Mn$ is

$.^{56}Mn + d \rightarrow .^{56}Mn + p$

After being bombarded for a long time, the activity of $.^{56}Mn$ becomes constant, equal to $13.86 \times 10^{10} s^{-1}$. (Use $1n2 = 0.693$, Avagardo number $= 6 \times 10^{2}$, atomic weight of $.^{56}Mn = 56 gmol^{-1}$).

At what constant rate P, $.^{56}Mn$ nuclei are being produced in the cyclontron during the bombardment?

A. $2 \times 10^{11} \nu c \leq is^{-1}$

B. $13.86 \times 10^{10} \nu c \leq is^{-1}$

C. $9.6 \times 10^{10} \nu c \leq is^{-1}$

D. $6.93 \times 10^{10} \nu c \leq is^{-1}$

Answer: b

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7. The radionuclide $.^{56}Mn$ is being produced in a cyclontron at a constant rate P by bombarding a manganese target with deutrons. $.^{56}Mn$ has a half-life of $2.5h$ and the target contains large numbers of only the stable manganese isotopes $.^{56}Mn$. The reaction that produces $\hat{}(56)Mn$ is

$.^{56}Mn + d \rightarrow .^{56}Mn + p$

After being bombarded for a long time, the activity of $.^{56}Mn$ becomes constant, equal to $13.86 \times 10^{10} s^{-1}$. (Use $1n2 = 0.693$, Avagardo number $= 6 \times 10^{2}, a \rightarrow micweightof$.^(56)Mn=56 g mol^(-1) $). Aftertheactivityof$.^(56)Mn$becomescons\tan t, \nu mberof$.^(56)Mn` nuclei present in the target is equal to .

A. 5×10^{11}

B. 20×10^{11}

C. 1.2×10^{14}

D. 1.8×10^{15}

Answer: d

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8. The radionuclide $.^{56} Mn$ is being produced in a cyclontron at a constant rate P by bombarding a manganese target with deutrons. $.^{56} Mn$ has a half-life of $2.5h$ and the target contains large numbers of only the stable manganese isotopes $.^{56} Mn$. The reaction that produces $.^{56} Mn$ is

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After a long time bombardment, number $.^{56} Mn$ nuclei present in the target depends upon.

A. All (i), (ii), and (iii) are correct.

B. Only (i) and (ii) are correct.

C. Only (ii) and (iii) are correct.

D. Only (i) and (iii) are correct.

Answer: c

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9. Many unstable nuclie can decay spontaneously to a nucleus of lower mass but differnet combination of nucleons. The process of spontaneous emission of radiation is called radioactivity substance.

Radioactive decay is a statistical process. Radiaactivity is independent of all external conditions. The number of decays per unit time or decay rate is called activity. Activity exponentially decrease with time. Mean lifetime is always greater than half-life time.

Choose the correct statemnet about radioactivity:

A. Radioactivity is a statistical process.

B. Radioactivity is independent of high temperature and high pressure

C. When a nucleus undergoes α- or - β-decay, its atomic number changes.

D. All of the these

Answer: d

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10. Many unstable nuclie can decay spontaneously to a nucleus of lower mass but differnet combination of nucleons. The process of spontaneous emission of radiation is called radioactivity substance.

Radioactive decay is a statistical process. Radiaactivity is independent of all external conditions. The number of decays per unit time or decay rate is called activity. Activity exponentially decrease with time. Mean lifetime is always greater than half-life time.

If T_H is the half-life and T_M is the mean life. Which of the following statement is correct.

A. $T_M > T_H$

B. $T_M < T_H$

C. Both ar directly proportional to square of the decay constant.

D. $T_M \propto \lambda_0$

Answer: a

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11. Many unstable nuclie can decay spontaneously to a nucleus of lower mass but differnet combination of nucleons. The process of spontaneous emission of radiation is called radioactivity substance.

Radioactive decay is a statistical process. Radiaactivity is independent of all external conditions. The number of decays per unit time or decay rate is called activity. Activity exponentially decrease with time. Mean lifetime is always greater than half-life time.

n number of α-particels per second are being emitted by B atoms of a radioactive element. The half-life of element will be

A. $\frac{n}{N}s$

B. $\frac{N}{n}s$

C. $0693\frac{N}{n}s$

D. $0.693\frac{n}{N}s$

Answer: c

Watch Video Solution

12. All nuclei consist of two types of particles- protaon and neutrons. Nuclear force is the strongest froce. Stability of nucleus is determined by the neutron - proton ratio or mass defect or binding energy per nucleus or packing fraction. Shape of nucleus is calculated by quadrupole moment. Spin of nucleus depends on even or odd mass number. Volume of nucleus depends on the mass number. Whole mass of the atom (nearly 99%) is centered at the nucleus. Magnetic moment of the nucleus is measured in terms of the nuclear magnetons.

The correct statements about nuclear force is/are

A. Charge independent

B. short-range force

C. non-conservation force

D. spin-dependent force

Answer: a,b,c,d

Watch Video Solution

13. All nuclei consist of two types of particles- protaon and neutrons. Nuclear force is the strongest froce. Stability of nucleus is determined by the neutron - proton ratio or mass defect or binding energy per nucleus or packing fraction. Shape of nucleus is calculated by quadrupole moment. Spin of nucleus depends on even or odd mass number. Volume of nucleus depends on the mass number. Whole mass of the atom (nearly 99%) is centered at the nucleus. Magnetic moment of the nucleus is measured in terms of the nuclear magnetons.

Binding energy per nucleon is maximum.

A. for lighter order element (lows mass number)

B. for heavier oreder elements (high mass number)

C. for middle order elements

D. equal for all order elements

Answer: c

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14. All nuclei consist of two types of particles- protaon and neutrons. Nuclear force is the strongest froce. Stability of nucleus is determined by the neutron - proton ratio or mass defect or binding energy per nucleus or packing fraction. Shape of nucleus is calculated by quadrupole moment. Spin of nucleus depends on even or odd mass number. Volume of nucleus depends on the mass number. Whole mass of the atom (nearly 99%) is centered at the nucleus. Magnetic moment of the nucleus is measured in terms of the nuclear magnetons.

Volume (V) of the nucleus is related to mass number (A) as

A. $V \propto A^2$

B. $V \propto A^{1/3}$

C. $V \propto A^{2/3}$

D. $V \propto A$

Answer: d

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15. The compound unstabel nucleus $._{92}^{236}U$ often decays in accordance with the following reaction

$\_(92)^{236}U \rightarrow ._{54}^{140}Xe +$ _(38)^(94)Sr ` + other particles

During the reaction, the uranium nucleus "fissions" (splits) into the two smaller nuceli have higher nuclear binding energy per nucleon (although the lighter nuclei have lower total nuclear binding energies, because they contain fewer nucleons).

Inside a nucleus, the nucleons (protonsa and neutrons)attract each other with a "strong nuclear" force. All neutrons exert approxiamtely the same strong nuclear force on each other. This force holds the nuclear are very close together at intranuclear distances.

In the nuclear reaction presented above, the "otter particles" might be .

A. An alpha particle, which consists of two protons and two neutrons

B. two protons

C. one proton and one neutron

D. two neutrons

Answer: d

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16. The compound unstabel nucleus $._{92}^{236}U$ often decays in accordance with the following reaction

$._{92}^{236}U \rightarrow ._{54}^{140}Xe + ._{38}^{94}Sr$ + other particles

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Inside a nucleus, the nucleons (protonsa and neutrons)attract each other with a "strong nuclear" force. All neutrons exert approxiamtely the same strong nuclear force on each other. This force holds the nuclear are very close together at intranuclear distances.

Why is a $._{2}^{4}He$ nucleus more stable than a $._{3}^{4}Li$ nulceus?

A. The strong nuclear force is larger when the neutron to proton ratio is higher.

B. The laws of nuclear physics forbid a nucleus from contaning more protons than neutrons.

C. Forces other than the strong nuclear force make the lithium nulceus less stable.

D. None of the above.

Answer: a

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17. The compound unstabel nucleus $._{92}^{236}U$ often decays in accordance with the following reaction

$._{92}^{236}U \rightarrow ._{54}^{140}Xe + ._{38}^{94}Sr$ + other particles

During the reaction, the uranium nucleus "fissions" (splits) into the two smaller nuceli have higher nuclear binding energy per nucleon (although the lighter nuclei have lower total nuclear binding energies, because they contain fewer nucleons).

Inside a nucleus, the nucleons (protonsa and neutrons)attract each other with a "strong nuclear" force. All neutrons exert approxiamtely the same strong nuclear force on each other. This force holds the nuclear are very close together at intranuclear distances.

A proton and a neutron are both shot at $100ms^{-1}$ toward a $._{6}^{12}C$ nuleus. Which partilce, if either, is more likely to be absorebed by the nucleus?

A. The proton

B. The neutron

C. Both particles are about equally likely to be absorbed,.

D. Neither particle will be absorbed.

Answer: b

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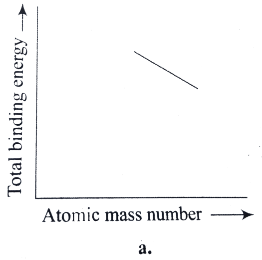
18. The compound unstabel nucleus $._{92}^{236}U$ often decays in accordance with the following reaction

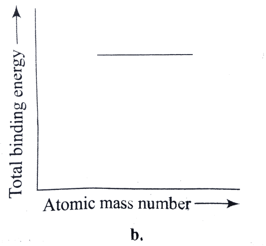
$._{92}^{236}U \rightarrow ._{54}^{140}Xe + ._{38}^{94}Sr$ + other particles

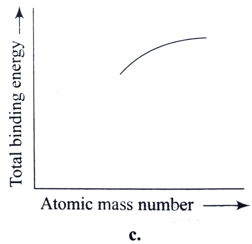
During the reaction, the uranium nucleus "fissions" (splits) into the two smaller nuceli have higher nuclear binding energy per nucleon (although the lighter nuclei have lower total nuclear binding energies, because they contain fewer nucleons).

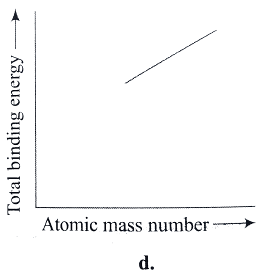
Inside a nucleus, the nucleons (protonsa and neutrons)attract each other with a "strong nuclear" force. All neutrons exert approxiamtely the same strong nuclear force on each other. This force holds the nuclear are very close together at intranuclear distances.

Which of the following graphs might represent the relationship between atomic number (i.e., "atomic weight") and the total binding energy of the nucleus, for nuclei heavier than $._{38}^{94}Sr$?

A. 

B. 

C. 

D. 

Answer: c

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19. A beam of alpha paricles is incident on a target of lead. A particular alpha paticles comes in 'head- on' to a particular lead nucleus and stops 6.50×10^{-14} m away from the center of the nucleus. (This point is well outside the nucleus.) Assume that the lead nucleus, which has 82 protons, remains at rest. The mass of alpha particle is $6.64 \times 10^{-27} kg$

Calculate the electrostatic potential energy at the instant when the alpha particle stops?

A. $36.3 MeV$

B. $45.0 MeV$

C. $3.63 MeV$

D. $40.0 MeV$

Answer: c

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20. A beam of alpha paricles is incident on a target of lead. A particular alpha paticles comes in 'head- on' to a particular lead nucleus and stops $6.50 \times 10^{-14} m$ away from the center of the nucleus. (This point is well outside the nucleus.) Assume that the lead nucleus, which has 82 protons, remains at rest. The mass of alpha particle is $6.64 \times 10^{-27} kg$

What initial kinetic energy (in joule and in MeV)did the alpha particle have?

A. 36.3

B. 0.36

C. 3.63

D. 2.63

Answer: c

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21. A beam of alpha paricles is incident on a target of lead. A particular alpha paticles comes in 'head- on' to a particular lead nucleus and stops 6.50×10^{-14} m away from the center of the nucleus. (This point is well outside the nucleus.) Assume that the lead nucleus, which has 82 protons, remains at rest. The mass of alpha particle is $6.64 \times 10^{-27} kg$

What was the initial speed of the alpha particle?

A. $132. \times 10^2 ms^{-1}$

B. $1.32. \times 10^7 ms^{-1}$

C. $13.2. \times 10^2 ms^{-1}$

D. $0.13. \times 10^7 ms^{-1}$

Answer: b

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22. A nucleus kept at rest in free space, brakes up into smaller nuclei of masses $'m'$ and $'2m'$. Total energy generated in this fission is E. The bigger part is radioactive, emits five gamma ray photons in the direction opposite to its velocity and finally comes torest. $[\text{Given} h = 6.6 \times 10^{-34} Js, m = 1 \times 10^{-26} Kg, E = 3.63 \times 10^{-8} mc^2, C =$

Fractional loss of mass in the fission is

A. 1.21×10^{-8}

B. 2.56×10^{-8}

C. 1.73xx10^(-8)`

D. 3.52×10^{-8}

Answer: a

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23. A nucleus kept at rest in free space, brakes up into smaller nuclei of masses $'m'$ and $'2m'$. Total energy generated in this fission is E. The bigger part is radioactive, emits five gamma ray photons in the direction opposite to its velocity and finally comes torest.

$\left[\text{Given} h = 6.6 \times 10^{-34} Js, m = 1 \times 10^{-26} Kg, E = 3.63 \times 10^{-8} mc^2, C =\right.$

Velocity of small daughter nucleus is

A. $5.6 \times 10^4 ms^{-1}$

B. $6.6 \times 10^4 ms^{-1}$

C. $7.6 \times 10^4 ms^{-1}$

D. $8.6 \times 10^4 ms^{-1}$

Answer: b

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24. A nucleus kept at rest in free space, brakes up into smaller nuclei of masses $'m'$ and $'2m'$. Total energy generated in this fission is E. The bigger part is radioactive, emits five gamma ray photons in the direction opposite to its velocity and finally comes torest. $\left[\text{Given} h = 6.6 \times 10^{-34} Js, m = 1 \times 10^{-26} Kg, E = 3.63 \times 10^{-8} mc^2, C =\right.$

The wavelength of the gamma ray is

A. 0.02Å

B. 0.03Å

C. 0.04Å

D. 0.05Å

Answer: b

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25. Nuceli A and B convert into a stable nucleus C. Nucleus A is converted into C by emitting 2αparticels and 3β-particles. Nucleus B is converted into C by emitting one α-particle and 5β-particles. At time $t=0$, nuclei of A are $4N_0$ and nuceli of B are N_0. Initially, number of nuclei of C are zero. Half-life of A (into conservation of C) is $1 \min$ and that of B is $2 \min$. Find the time (in minutes) at which rate of disintegration of A and B are equal.

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26. The half-life of a radioactive nuclide is 20 hours. What fraction of original activity will remain after 40 hours?

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27. A radioactive sample has 8.0×10^{18} active nuclei at a certain instant. How many of these nuclei will still be in the active state after two half-life $(\text{in} \times 10^{18})$?

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28. A radioactive sample decays with an average life of $20ms$. A capacitor of capacitance $100\mu F$ is charged to some potential and then the plates are connected through a resistance R. What should be the value of R so that the ratio of the charge on the capacitor to the activity of the radioactive sample remains constant in time?

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29. A radioactive sample decays through two different decay processes α-decay and β-decay is $6h$. What will be the ratio of number of radioactive nuclei present after $6h$?.

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Integer

1. $._{92}U^{238}$ changes to $._{85}At^{210}$ by a series of α-and β-decays. Find the number of α-decays undergone (an integer).

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2. A certain radioactive material can undergo three constant λ, 2λ and 3λ. Then, the effective decay constant λ_{eff} is equal to $n\lambda$. What is the value of n?

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3. The radioactive of a sample is R_1 at a time T_1 and R_2 at a time T_2. If the half-life of the specimen is T, the number of atoms that have disintegrated in the time $(T_2 - T_1)$ is equal to $\frac{n(R_1 - R_2)T}{\ln 4}$. Here n is some integral number. What is the value of n?

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4. The radioactive decay rate of a radioactive element is found to be 10^3 disintegration per second at a cartain time . If the half life of the element is one second , the dacay rate after one second ..... And after three second is ......

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5. In the final Uranium radioactive series the initial nucleus is U_{92}^{238} and the final nucleus is Pb_{82}^{206} . When Uranium neucleus decays to lead , the number of a - particle is .... And the number of β - particles emited is ......

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6. When Boron nucleus B_3^{10} is bombarded by neutrons , a- particle are emitted . The resulting nucleus is of the element .... and has the mass number....

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Fill In The Blanks

1. Atoms having the same ...... but different ..... are called isotopes .

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2. The binding energies per nucleon for deuteron $(._1 H^2)$ and helium $(._2 He^4)$ are $1.1 MeV$ and $7.0 MeV$ respectively. The energy released when two deutrons fuse to form a helium nucleus $(._2 He^4)$ is........

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Watch Video Solution

3. In the nuclear process , $C_6^{11} \rightarrow_2 B^{11} + \beta^+ + X, X$ stands for.......

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4. Consider the reaction $._1^2 H +_1^2 H =_2^4 He + Q$. Mass of the deuterium atom $= 2.0141u$. Mass of helium atom $= 4.0024u$. This is a nuclear......... reaction in which the energy Q released is............MeV.

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5. The order of magnitude of the density of nuclear matter is $10^4 kgm^{-3}$

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Multiple correct option

1. From the following equation pick out the possible nuclear fusion reactions

A. $._6 C^{13} + ._1 H^1 \rightarrow ._6 C^{14} + 4.3 MeV$

B. $._6 C^{13} + ._1 H^1 \rightarrow ._7 C^{13} + 2 MeV$

C. $._7 C^{14} + ._1 H^1 \rightarrow ._8 O^{15} + 7.3 MeV$

D. $._{92} U^{235} + ._0 n^1$

Answer: a,b,c

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2. Which of the following statement (s) is (are) correct ?

A. The rest mass of a stable nucleus is greater than the sum of the rest masses of its separated nucleons.

B. The rest mass of a stable nucleus is greater than the sum of the rest masses of its separated nucleons.

C. In nuclear fission, energy is released by fusing two nuclei of medium mass (approximately 100 a.m.u.)

D. In nuclear fission, energy is released by fragammentation of a very heavy nulceus.

Answer: a,d

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3. Let m_p be the mass of a poton , M_1 the mass of a $\_(10)^{20}Ne$ nucleus and M_2 the mass of a $\_(20)^{40}Ca$ nucleus . Then

A. $M_2 = 2M_1$

B. $M_2 > 2M_1$

C. $M_2 < 2M_1$

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

Answer: c,d

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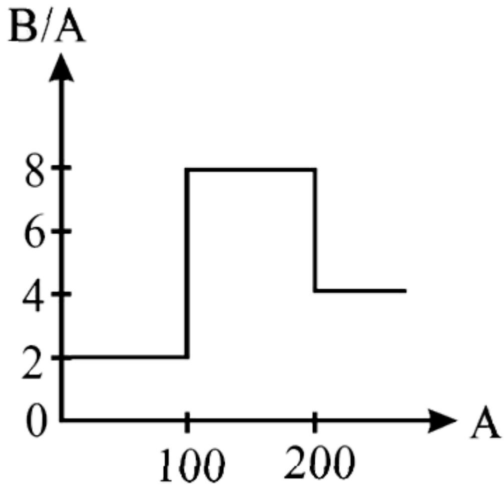
4. Assume that the nuclear binding energy per nucleus(B/A) versus mass number (A) is as shown in the figure Use this plot to choose the correct (s) choice given below



A. Fusion of nuclei with mass numbers lying in the range of $1 < A < 50$ will release energy.

B. Fusion of nuclei with mass numbers lying in the range of $51 < A < 100$ will release energy.

C. Fission of a nucleus lying in the mass range of $100 < A < 260$ will release energy when broken into equal fragments.

D. Fission of a nucleus lying in the mass range of $200 < A < 260$ will release energy when broken into equal fragments.

Answer: b,d

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Linked comprehension type

1. Scientists are working hard to develop nuclear fusion reactor Nuclei of heavy hydrogen, $\_(1)^2H$, known as deuteron and denoted by D, can be thought of as a candidate for fusion rector . The $D-D$ reaction is $\_(1)^2H +_1^2 H \rightarrow_2^1 He + n +$ energy. In the core of fusion reactor, a gas of heavy hydrogen of $\_(1)^2H$ is fully ionized into deuteron nuclei and electrons. This collection of $\_1^2H$ nuclei and electrons is known as plasma . The nuclei move randomly in the reactor core and occasionally come close enough for nuclear fusion to take place. Usually , the temperature in the reactor core are too high and no material will can be used to confine the to plasma for a time t_0 before the particles fly away from the core. If n is the density (number volume) of deuterons , the product$nt_0$is called Lawson number. In one of the criteria , a reactor is termed successful if Lawson number is greater then $5 \times 10^{14} s / cm^2$

it may be helpfull to use the following boltzmann constant

$$\lambda = 8.6 \times 10^{-5} eV / k, \frac{e^2}{4\pi s_0} = 1.44 \times 10^{-9} eVm$$

In the core of nucleus fusion reactor , the gas become plasma because of

A. strong nuclear force acting between the deutrons

B. Coulomb force acting between the deutrons

C. Coulomb force acting between deuteron-electron pairs

D. the high pairs temperature maintained inside the reactor core

Answer: D

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2. Scientists are working hard to develop nuclear fusion reactor Nuclei of heavy hydrogen, $\_\ (1)^2H$, known as deuteron and denoted by D, can be thought of as a candidate for fusion rector . The $D - D$ reaction is $\_\ (1)^2H +_1^2 H \rightarrow_2^1 He + n +$ energy. In the core of fusion reactor, a gas of heavy hydrogen of $\_\ (1)^2H$ is fully ionized into deuteron nuclei and electrons. This collection of $\_\ 1^2H$ nuclei and electrons is known as plasma . The nuclei move randomly in the reactor core and occasionally come close enough for nuclear fusion to take place. Usually , the temperature in the reactor core are too high and no material will can be used to confine the to plasma for a time t_0 before the particles fly away from the core. If n is the density (number volume) of deuterons , the product$nt_0$is called Lawson number. In one of the criteria , a reactor is termed successful if Lawson number is greater then $5 \times 10^{14} s / cm^2$

it may be helpfull to use the following boltzmann constant

$$\lambda = 8.6 \times 10^{-5} eV / k, \frac{e^2}{4\pi s_0} = 1.44 \times 10^{-9} eVm$$

Assume that two deuteron nuclei in the core of fusion reactor at temperature energy T are moving toward each other, each with kinectic energy $1.5kT$, when the seperation between them is large enough to neglect coulomb potential energy . Also neglate any interaction from other particle in the core . The minimum temperature T required for them to reach a separation of $4 \times 10^{-15} m$ is in the range

A. $1.0 \times 10^9 K < T2.0 \times 10^9 K$

B. $2.0 \times 10^9 K < T3.0 \times 10^9 K$

C. $3.0 \times 10^9 K < T4.0 \times 10^9 K$

D. $4.0 \times 10^9 K < T5.0 \times 10^9 K$

Answer: A

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3. Scientists are working hard to develop nuclear fusion reactor Nuclei of heavy hydrogen, $\_(1)^2 H$, known as deuteron and denoted by D, can be thought of as a candidate for fusion rector . The $D - D$ reaction is $\_(1)^2 H +_1^2 H \rightarrow_2^1 He + n +$ energy. In the core of fusion reactor, a gas of heavy hydrogen of $\_(1)^2 H$ is fully ionized into deuteron nuclei and electrons. This collection of $\_1^2 H$ nuclei and electrons is known as plasma . The nuclei move randomly in the reactor core and occasionally come close enough for nuclear fusion to take place. Usually , the temperature in the reactor core are too high and no material will can be used to confine the to plasma for a time t_0 before the particles fly away from the core. If n is the density (number volume) of deuterons , the product$nt_0$is called Lawson number. In one of the criteria , a reactor is termed successful if Lawson number is greater then $5 \times 10^{14} s / cm^2$

it may be helpfull to use the following boltzmann constant

$$\lambda = 8.6 \times 10^{-5} eV / k, \frac{e^2}{4\pi s_0} = 1.44 \times 10^{-9} eVm$$

Result of calculations for four different design of a fusion reactor using $D - D$ reaction are given below. which of these is most promising based on Lawson criterion ?

A. Deuteron density $= 2.0 \times 10^{12} cm^{-3}$, confinement tiem $= 5.0 \times 10^{-3} s$

B. Deuteron density $= 8.0 \times 10^{14} cm^{-3}$, confinement tiem $= 9.0 \times 10^{-1} s$

C. Deuteron density $= 4.0 \times 10^{23} cm^{-3}$, confinement tiem $= 1.0 \times 10^{-11} s$

D. Deuteron density $= 2.0 \times 10^{24} cm^{-3}$, confinement tiem $= 4.0 \times 10^{-12} s$

Answer: B

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4. The $\beta - decay$ process , discovered around 1900 , is basically the decay of a neutron n. In the laboratory , a proton p and an electron e^{-} are observed as the decay product of neutron. Therefore considering the decay of neutron as a two- body decay process, it was predicted theoretically that the kinetic energy of the electron should be a constant . But experimentally , it was observed that the electron kinetic energy has continuous spectrum Considering a three- body decay process , i.e. $n \rightarrow p + e^{-} + \bar{\nu}_e,$ around 1930 , Pauli explained the observed electron energy spectrum. Assuming the anti-neutrino $(\bar{\nu}_e)$ to be massaless and possessing negligible energy , and the neutrino to be at rest , momentum and energy conservation principle are applied. From this calculation , the maximum kinetic energy of the electron is $0.8 \times 10^6 eV$ The kinetic energy carried by the proton is only the recoil energy.

If the - neutrono had a mass of $3eV / c^2$ (where c is the speed of light) insend of zero mass , what should be the range of the kinectic energy K. of the electron ?

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5. The $\beta - decay$ process , discovered around 1900 , is basically the decay of a neutron n. In the laboratory , a proton p and an electron e^- are observed as the decay product of neutron. Therefore considering the decay of neutron as a two- body decay process, it was predicted theoretically that the kinetic energy of the electron should be a constant . But experimentally , it was observed that the electron kinetic energy has continuous spectrum Considering a three- body decay process , i.e. $n \rightarrow p + e^- + \bar{\nu}_e$, around 1930 , Pauli explained the observed electron energy spectrum. Assuming the anti-neutrino $(\bar{\nu}_e)$ to be massaless and possessing negligible energy , and the neutrino to be at rest , momentum and energy conservation principle are applied. From this calculation , the maximum kinetic energy of the electron is $0.8 \times 10^6 eV$ The kinetic energy carried by the proton is only the recoil energy.

What is the maximum energy of the anti-neutrino ?

A. The nucleus $._3^6 Li$ can emit an alpha particle

B. The nucleus $._{84}^{120} P0$ cam emit a proton.

C. Deuteron and alpha particle can undergo complete fusion.

D. The nuclei $._{30}^{70} Zn$ and $._{34}^{82} Se$ can undergo complete fusion.

Answer: C

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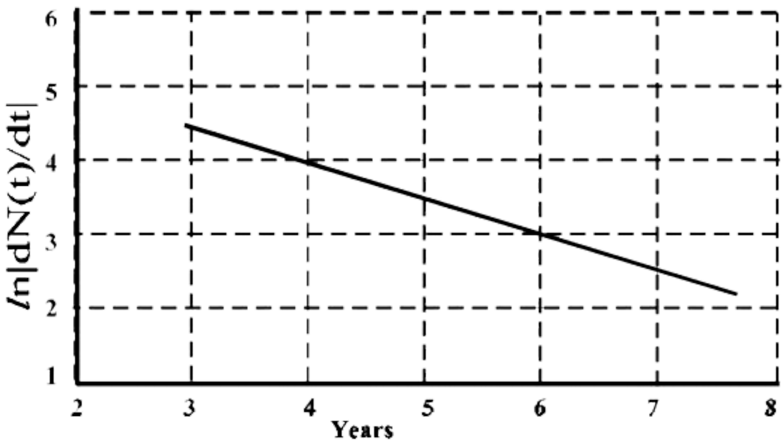
Integer type

1. To determine the half life of a radioactive element , a student plot a graph of in $\left|\frac{dN(t)}{dt}\right|$ versus t , Here $\left|\frac{dN(t)}{dt}\right|$ is the rate of radioactive decay at time t , if the number of radioactive nuclei of this element decreases by a factor of p after 4.16 year the value of p is



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2. The activity of a freshly prepared radioactive sample is 10^{10} disintegrations per second , whose mean life is $10^9 s$ The mass of an atom of this radioisotope is $10^{-25} kg$ The mass (in mg) of the radioactive sample is

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3. A freshly prepared sample of a radioisotope of half - life $1386s$ has activity 10^3 disintegrations per second Given that $\ln 2 = 0.693$ the fraction of the initial number of nuclei (expressed in nearest integer percentage) that will decay in the first $80s$ after preparation of the sample is

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ddp.5.1

1. The graph between log R and log A wher R is the nuclear radius and A is the mass of is.

A.

B.

C.

D.

Answer: A

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2. The ratio of radii of nuclei $._{13}A1^{27}$ and $._{52}X^{A}$ is $3:5$. The number of neutrons in the nuclei of X will be

A. 52

B. 73

C. 125

D. 13

Answer: B

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3. Radius of $._{2}^{4}He$ nucleus is 3 Fermi. The radius of $._{82}^{206}Pb$ nucleus will be.

A. 5 Fermi

B. 6 Fermi

C. 11.16 Fermi

D. 8 Fermi

Answer: C

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4. What is the radius of iodine atom (at no. 53, mass number 126)?

A. $2.5 \times 10^{-11}m$

B. $2.5 \times 10^{-9}m$

C. $7 \times 10^{-9}m$

D. $7 \times 10^{-6}m$

Answer: A

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5. A heavy nucleus at rest breaks into two fragments which fly off with velocities in the ratio $8:1$. The ratio of radii of the fragments is.

A. $1:2$

B. $1:4$

C. $4:1$

D. $2:1$

Answer: A

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6. Order of magnitude of density of uranium nucleus is , [m = 1.67 xx 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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7. α-particles of enegry $400 KeV$ are boumbardel on nucleus of $._{82} Pb$. In scattering of α-particles, it minimum distance from nucleus will be

A. 0.59 nm

B. 0.59 Å

C. 5.9 Å

D. 0.59 pm

Answer: D

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8. In nuclear reaction $._{2}He^{4}._{z}X^{A} \rightarrow ._{z+2}Y^{A+3}+A$, denotes.

A. electron

B. positron

C. proton

D. neutron

Answer: D

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9. For a nucleus to be stable, the correct relation between neutron number N and proton number Z is.

A. $N > Z$

B. $N = Z$

C. $N < Z$

D. $N \geq Z$

Answer: D

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10. Two nucleons are at a separation of $1 \times 10^{-15} m$. The net force between them is F_1, if both are neutrons, F_2 if both are protons and F_3 if one is a proton and other is a neutron. In such a case.

A. $F_2 > F_1 > F_3$

B. $F_1 = F_2 = F_3$

C. $F_1 = F_2 > F_3$

D. $F_1 = F_3 > F_2$

Answer: B

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11. M_n and M_p represent mass of neutron and proton respectively. If an element having atomic mass M has $N -$ neutron and Z-proton, then the correct relation will be :

A. $M < [NM_n + ZM_P]$

B. $M > [NM_n + ZM_P]$

C. $M = [NM_n + ZM_P]$

D. $M = N[M_n + M_P]$

Answer: A

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12. M, $M_n \& M_p$ denotes the masses of a nucleous of $._Z X^A$ a neutron, and a proton respectively. If the nucleus is separated in to its individual protons and neutrons then

A. $m < (A - Z)m_n + Zm_p$

B. $m = (A - Z)m_n + Zm_p$

C. $m = (A - Z)m_p + Zm_n$

D. $m > (A - Z)m_n + Zm_p$

Answer: A

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13. The rest energy of an electron is.

A. 510 KeV

B. 931 KeV

C. 510 MeV

D. 931 MeV

Answer: A

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14. Let m_p be the mass of a poton , M_1 the mass of a $_(10)^{20}Ne$ nucleus and M_2 the mass of a $_(20)^{40}Ca$ nucleus . Then

A. $M_2 = 2M_1$

B. $M_2 > 2M_1$

C. $M_2 < 2M_1$

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

Answer: C::D

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15. The mass number of a nucleus is.

A. always less than its atomic number

B. always greater than its atomic number

C. sometimes equal to its atomic number

D. sometimes more than and sometimes equal to its atomic number

Answer: C::D

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ddp.5.2

1. The mass defect in a particular nuclear reaction is 0.3 grams. The amont of energy liberated in kilowatt hours is.

(Velocity of light $= 3 \times 10^8 m/s$).

A. 1.5×10^6

B. 2.5×10^6

C. 3×10^6

D. 7.5×10^6

Answer: D

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2. If a proton and anti-proton come close to each other and annihilate, how much energy will be released ?

A. $1.5 \times 10^{-10} J$

B. $3 \times 10^{-10} J$

C. $4.5 \times 10^{-10} J$

D. None of these

Answer: B

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3. Binding energy of a nucleus is.

A. energy given to its nucleus during its formation

B. total mass of nucleus converted to energy units

C. loss of energy from the nucleus during its formation

D. total K.E. and P.E. of the nucleons in the nucleus

Answer: C

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4. The binding energies per nucleon for a deuteron and an $\alpha -$ particle are x_1 and x_2 respectively. What will be the energy Q released in the following reaction ?

$._1 H^2 + ._1 H^2 \rightarrow ._2 He^4 + Q.$

A. $4(x_1 + x_2)$

B. $4(x_2 = x_1)$

C. $2(x_1 + x_2)$

D. $2(x_2 = x_1)$

Answer: B

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5. The curve of blinding energy per nucleon as a function of atomic mass number has a sharp peak for helium nucleus. This implies that helium.

A. can easily be broken up

B. is very stable

C. can be used as fissionable material

D. is radioactive

Answer: B

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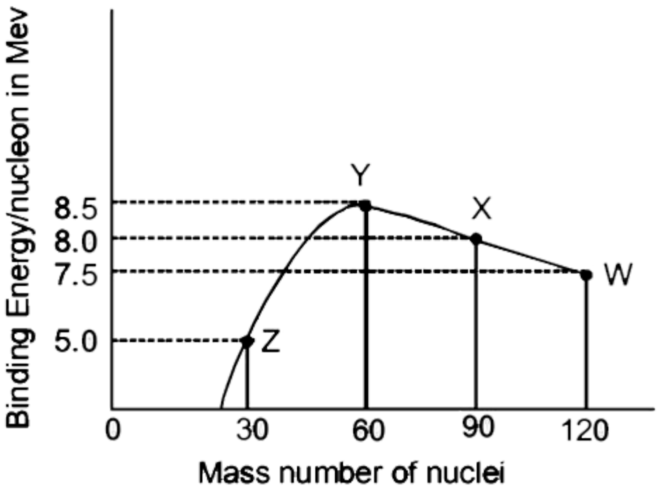
6. Binding energy per nucleons vs mass curve for nucleus is shown in the figure W, X, Y and Z are four nuclei indicated on the curve . The process that would release energy is



A. $Y \rightarrow 2Z$

B. $W \rightarrow X + Z$

C. $W \rightarrow 2Y$

D. $X \rightarrow Y + Z$

Answer: C

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7. The binding energy per nucleon is maximum in the case of.

A. $._{2}^{4}He$

B. $._{26}^{56}Fe$

C. $._{56}^{141}Ba$

D. $._{92}^{235}U$

Answer: B

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8. The masses of neutron and proton are 1.0087 a.m.u. and 1.0073 a.m.u. respectively. If the neutrons and protons combine to form a helium nucleus (alpha particle) of mass 4.0015a.m.u. The binding energy of the helium nucleus will be $(1a.m.u. = 931MeV)$.

A. $28.4MeV$

B. $20.8MeV$

C. $27.3MeV$

D. $14.2MeV$

Answer: A

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9. The mass defect for the nucleus of helium is 0.0303 a.m.u. What is the binding energy per nucleon for helium in MeV ?

A. 28

B. 7

C. 4

D. 1

Answer: B

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10. M_p denotes the mass of a proton and M_n that of a neutron. A given nucleus, of binding energy B, contains Z protons and N neutrons. The mass $M(N, Z)$ of the nucleus is given by.

A. $M(N, Z) = NM_n + ZM_P - Bc^2$

B. $M(N, Z) = NM_n + ZM_P + Bc^2$

C. $M(N, Z) = NM_n + ZM_P - B/c^2$

D. $M(N, Z) = NM_n + ZM_P + B/c^2$

Answer: C

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11. The binding energy of deuteron $._1^2 H$ is $1.112 MeV$ per nucleon and an $\alpha -$ particle $._2^4 He$ has a binding energy of $7.047 MeV$ per nucleon. Then in the fusion reaction $._1^2 H + ._1^2 h \rightarrow ._2^4 He + Q$, the energy Q released is.

A. $1 MeV$

B. $11.9 MeV$

C. $23, 8 MeV$

D. $931 MeV$

Answer: C

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12. If the binding energy per nucleon in $._3 Li^7$ and $._2 He^4$ nuclei are respectively 5.60 MeV and 7.06 MeV, then the ebergy of proton in the reaction $._3 Li^7 + p \rightarrow 2._2 He^4$ is

A. 19.6MeV

B. 2.4 MeV

C. 8.4MeV

D. 17.3 MeV

Answer: D

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13. The binding energy per nucleon of deuterium and helium atom is $1.1MeV$ and $7.0MeV$. If two deuterium nuclei fuse to form helium atom, the energy released is.

A. 19.2 MeV

B. 23.6 MeV

C. 26.9 MeV

D. 13.9MeV

Answer: B

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14. A nucleus of $._{84}^{210}Po$ originally at rest emits α particle with speed v. What will be the recoil speed of the daughter nucleus ?

A. $4v/206$

B. $4v/214$

C. $v/206$

D. $v/214$

Answer: A

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15. The binding energy per nucleon of O^{16} is $7.97 MeV$ and that of O^{17} is $7.75 MeV$. The energy (in MeV) required to remove a neutron from O^{17} is.

A. 3.52

B. 3.64

C. 4.23

D. 7.86

Answer: C

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1. In the disintegration series

$._{92}^{238} U \overrightarrow{\alpha} X \overrightarrow{\beta^{-}} ._{Z}^{A} Y$ the values of Z and A, respectively, will be

A. 92236

B. 88230

C. 90234

D. 91234

Answer: D

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2. In the given reaction

$._{z} X^{A} \rightarrow ._{z+1} Y^{A} \rightarrow ._{z-1} K^{A-4} \rightarrow ._{z-1} K^{A-4}$

Radioactive radiations are emitted in the sequence.

A. α, β, γ

B. β, α, γ

C. γ, α, β

D. β, γ, α

Answer: B

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3. A radioactive nucleus undergoes a series of deacy according to the scheme.

$$A \xrightarrow{\alpha} A_1 \xrightarrow{\beta^-} A_2 \xrightarrow{\alpha} A_3 \xrightarrow{\gamma} A_4$$

If the mass number and atomic number of A are 180 and 172 respectively, what are these numbers for A_4.

A. 172 and 69

B. 174 and 70

C. 176 and 69

D. 176 and 70

Answer: A

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4. 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. A and B are isotopes

D. A and B are isobars

Answer: A

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5. Half-lives of two radioactive substances A and B are respectively 20 minutes and 40 minutes. Initially, he sample of A and B have equal number of nuclei. After 80 minutes the ratio of the remaining number of A and B nuclei is :

A. 0.0527777777778

B. 0.16736111111111

C. 0.0444444444444444

D. 0.04236111111111

Answer: C

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6. The half - life ofI ^ (131)$is8days. Givenasamp \leq of$I^(131)$attime$t = 0` , we can assert that

A. No nucleus will decay before t= 4 days

B. No nucleus will decay before t= 8 days

C. All nuclei will decay before t=16 days

D. A given nucleus may decay at any time after t=0

Answer: D

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7. At any instant, the ratio of the amounts of two radioactive substance is $2:1$. If their half-lives be, respectively, $12h$ and $16h$, then after two days, what will be the ratio of the substances?

A. 0.0423611111111111

B. 0.0840277777777778

C. 0.0430555555555556

D. 0.0444444444444444

Answer: A

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8. During mean life of a radioactive element, the fraction that disintegrates is

A. e

B. $\frac{1}{e}$

C. $\frac{e-1}{e}$

D. $\frac{e}{e-1}$

Answer: C

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9. The activity of a sample of radioactive material A_1 at time t_1 and A_2 at time $t_2 (t_2 > t_1)$. Its mean life is T.

A. $A_1 t_1 = A_2 t_2$

B. $A_1 - A_2 = t_2 - t_1$

C. $A_2 = A_1 e^{(t_1 - t_2)} / T)$

D. $A_2 = A_1 e^{(t_1 / t_2)} / T)$

Answer: C

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10. The half-life of a sample of a radioactive substance is 1 hour. If 8×10^{10} atoms are present at $t = 0$, then the number of atoms decayed in the duration $t = 2$ hour to $t = 4$ hour will be

A. 2×10^{10}

B. 1.5×10^{10}

C. Zero

D. Infinity

Answer: B

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11. Atomic mass number of an element is 232 and its atomic number is 90. The end product of this radiaoctive element is an isotope of lead (atomic mass 208 and atomic number 82.) The number of α-and β -particles emitted are.

A. $\alpha = 3, \beta = 3$

B. $\alpha = 6, \beta = 4$

C. $\alpha = 6, \beta = 0$

D. $\alpha = 4, \beta = 6$

Answer: B

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12. A sample contains $16 gm$ of radioactive material, the half-life of which is two days. After 32 days, the amount of radioactive material left in the sample is

A. $< 1mg$

B. $\frac{1}{4}gm$

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

D. $1gm$

Answer: A

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13. A radio-isotope has a half-life of 5 yeard. The fraction of the atoms of this material that would decay in 15 years will be

A. $1/8$

B. $2/3$

C. $7/8$

D. $5/8$

Answer: C

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14. Three $\alpha -$ particle and one $\beta -$ particle decaying takes place in series from an isotope $._{88} Ra^{238}$. Finally the isotope obtained will be.

A. $._{84} X^{220}$

B. $._{86} X^{222}$

C. $._{83} X^{224}$

D. $._{83} X^{215}$

Answer: C

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15. Radon (Ra) decays into Polonium (P_0) by emitting an $\alpha -$ particle with half-life of 4 days. A sample contains 6.4×10^{10} atoms of R_n. After

12 days, the number of atoms of R_n left in the sample will be

A. 3.2×10^{10}

B. 0.53×10^{10}

C. 2.1×10^{10}

D. 0.8×10^{10}

Answer: D

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ddp.5.4

1. If 10% of a radioactive material decays in 5 days, then the amount of original material left after 20 days is approximately.

A. 0.6

B. 0.65

C. 0.7

D. 0.75

Answer: B

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2. A radioactive isotope X with a half-life of 1.37×109 years decays to Y which is stable. A sample of rock from the moon was found to contain both the elements X and Y which were in the ratio of $1:7$. The age of the rock is.

A. 1.96×10^{8}years

B. 3.85×10^{9}years

C. 4.11×10^{9}years

D. 9.59×10^{9}years

Answer: C

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3. The half-life of radium is $1620 years$ and its atomic weight is 226. The number of atoms that will decay from its $1g$ sample per second will be .

A. 3.61×10^{10}

B. 3.6×10^{12}

C. 3.11×10^{15}

D. 31.1×10^{15}

Answer: A

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4. A radioactive material decays by simulataneous emission of two particle from the with respective half - lives 1620 and 810 year . The time , in year , after which one - fourth of the material remains is

A. 1080

B. 2430

C. 3240

D. 4860

Answer: A

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5. For a substance the average life for $\alpha -$ emission is 1620 years and for $\beta -$ emission is 405 years. After how much time the $1/4$ of the material remains after α and β emission ?

A. 1500 years

B. 300 years

C. 449 years

D. 810 years

Answer: C

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6. A radioactive nucleus undergoes $\alpha-$ emission to form a stable element. What will be the recoil velocity of the daughter nucleus is V is the velocity of α-emission and A is the atomic mass of radioactive nucleus ?

A. $\frac{4V}{A-4}$

B. $\frac{2V}{A-4}$

C. $\frac{4V}{A+4}$

D. $\frac{2V}{A+4}$

Answer: A

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7. Half-life of a radioactive substance is 20 minutes. Difference between points of time when it is 33% disintegrated and 67% disintegrated is

approximate.

A. 10 min

B. 20 min

C. 30 min

D. 40 min

Answer: B

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8. A and B are two radioactive substances whose half lives are 1 and 2 years respectively. Initially $10gm$ of A and $1gm$ of B is taken. The time (approximate) after which they will have same quantity remaining is.

A. 6.62 years

B. 5 years

C. 3.2 years

D. 7 years

Answer: A

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9. Half life of a radio-active substance is 20 minutes. The time between 20% and 80% decay will be

A. 20 minutes

B. 40 minutes

C. 30 minutes

D. 25 minutes

Answer: B

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10. The excitation energy of a hydrogen -like ion in its first excited state is $40.8eV$ Find the energy needed to remain the electron from the ion

A. 54.4 eV

B. 13.6 eV

C. 40.8 eV

D. 27.2 eV

Answer: A

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11. The rate of disintegration was observed to be 1017 disintegrations per sec when its half life period is 1445 years. The original number of particles are.

A. 8.9×10^{27}

B. 6.6×10^{27}

C. 1.4×10^{16}

D. 1.2×10^{17}

Answer: B

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12. A small quantity of solution containing Na^{24} radio nuclide $(half - l \text{ if } e = 15h)$ of activity $1.0 microcurie$ is injected into the blood of a person. A sample of the blood of volume $1cm^3$ taken after $5h$ shows an activity of 296 disintegrations per minute. Determine the total volume of the blood in the body of the person. Assume that the radioactive solution mixes uniformly in the blood of person.

(1 curie $= 3.7 \times 10^{10}$ disintegrations per second)

A. 5.94 L

B. 2L

C. 317 L

D. 1 L

Answer: A

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13. A radioactive sample of $\hat{} (238)U$ decay to Pb through a process for which the half is 4.5×10^9 year. Find the ratio of number of nuclei of Pb to $\hat{} (238)U$after a time of 1.5×10^9 year Given $(2)^{1/3} = 1.26$

A. 0.12

B. 0.26

C. 1.2

D. 0.37

Answer: B

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14. A radioactive sample is $\alpha -$ emitter with half life 138.6 days is observed by a student to have 2000 disintegration/sec. The number of radioactive nuclei for given activity are.

A. 3.45×10^{10}

B. 1×10^{10}

C. $3.45XX10^{15}$

D. 2.75×10^{11}

Answer: A

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15. If one starts with one curie of radioactive substance $\left(T_{1/2} = 12hrs\right)$ the activity left after a period of 1 week will be about

A. 1 curie

B. 120 microcurie

C. 60 microcurie

D. 8 millicurie

Answer: C

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ddp.5.5

1. An antomic Power station has a generating capacity of $200MW$. The energy generated in a day by this station is.

A. 200 MW

B. 200 J

C. $4800 \times 10^6 J$

D. $1728 \times 10^6 J$

Answer: D

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2. $200MeV$ of energy may be obtained per fission of U^{235}. A reactor is generating $1000kW$ of power. The rate of nuclear fission in the reactor is.

A. 1000

B. 2×10^{8}

C. 3.125×10^{16}

D. 931

Answer: C

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3. 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. 3.125×10^{14}

C. 3.125×10^{15}

D. 3.125×10^{16}

Answer: A

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4. Energy released in the fission of a single $._{92}U^{235}$ nucleus is $200 MeV$. The fission rate of a $._{92}U^{235}$ fuelled reactor operating at a power level of $5W$ is.

A. $1.56 \times 10^{+10} s^{-1}$

B. $1.56 \times 10^{+11} s^{-1}$

C. $1.56 \times 10^{+16} s^{-1}$

D. $1.56 \times 10^{+17} s^{-1}$

Answer: B

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5. If a proton and anti-proton come close to each other and annihilate, how much energy will be released ?

A. $1.5 \times 10^{-10} J$

B. $3 \times 10^{-10} J$

C. $4.5 \times 10^{-10} J$

D. None of these

Answer: B

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6. Energy released in fusion of $1 kg$ of deuterium nuclei.

A. $8 \times 10^{13} J$

B. $3 \times 10^{27} J$

C. $2 \times 10^7 \mathrm{kWH}$

D. $8 \times 10^{23} \mathrm{MeV}$

Answer: A

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7. If the energy released in the fission of the nucleus is $200MeV$. Then the number of nuclei required per second in a power plant of $6kW$ will be.

A. 0.5×10^{14}

B. $0.5XX10^{12}$

C. 5×10^{12}

D. 5×10^{14}

Answer: D

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8. To generate a power of 3.2 mega watt, the number of fissions of U^{235} per minute is.

(Energy released per fission $= 200 MeV, 1eV = 1.6 \times 10^{-19} J$).

A. 6×10^{18}

B. 6×10^{17}

C. 10^{17}

D. $6XX10^{16}$

Answer: A

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9. The binding energy per nucleon of deuterium and helium atom is $1.1 MeV$ and $7.0 MeV$. If two deuterium nuclei fuse to form helium atom, the energy released is.

A. $19.2 MeV$

B. $23.6 MeV$

C. $26.9 MeV$

D. $13.9 MeV$

Answer: B

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10. The energy liberated on complete fission of $1kg$ of $._{92} U^{235}$ is (Assume $200 MeV$ energy is liberated on fission of 1 nucleus).

A. $8.2 \times 10^{10} J$

B. $8.2 \times 10^{9} J$

C. $8.2 \times 10^{13} J$

D. $8.2 \times 10^{16} J$

Answer: C

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11. The nuclear reaction $.^2 H + .^2 H \rightarrow .^4 He$ (mass of deuteron $= 2.0141 a.m.u$ and mass of $He = 4.0024 a.m.u$) is

A. fusion reaction releasing $24 MeV$ energy

B. fusion reaction absorbing $24 MeV$ energy

C. fission reaction releasing $0.0258 MeV$ energy

D. fission reaction absorbing $0.0258 MeV$ energy

Answer: A

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

A. increases with mass number at high mass numbers

B. decreases with mass number at low mass numbers

C. increases with mass number at low mass numbers

D. decreases with mass number at low mass numbers

Answer: B

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13. An atomic power nuclear reactor can deliver $300MW$. The energy released due to fission of each nucleus of uranium atom U^{238} is $170MeV$. The number of uranium atoms fissioned per hour will be.

A. 30×10^{25}

B. 4×10^{22}

C. 10×10^{20}

D. 5×10^{15}

Answer: B

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14. Which of the following statement (s) is / are correct (may have more than one option correct):

A. the rest mass of a stable nucleus is less than sum of the rest masses of its separated nucleons.

B. the rest mass of a stable nucleus is greater than the sum of the rest masses of its separated nucleons.

C. in nuclear fission energy is released by fusing two nuclei of medium mass (approximately 100 amu).

D. in nuclear fission energy is released by fragmentation of a very heavy nucleus.

Answer: A::D

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15. Match the statements of column I and column II

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