PHYSICS

BOOKS - RESNICK AND HALLIDAY PHYSICS (HINGLISH)

THE NUCLEUS

Sample Problem

1. An alpha particle with kinetic energy $K_i = 5.30$ MeV happens, by chance,to be headed directly toward he nucleus of a neutral gold atom (fig). What is its distance of closest approach d (least center to center separation) to the nucleus? Assume that the atom remains stationary.

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2. What is the binding energy per nucleon for ^{120}Sn?

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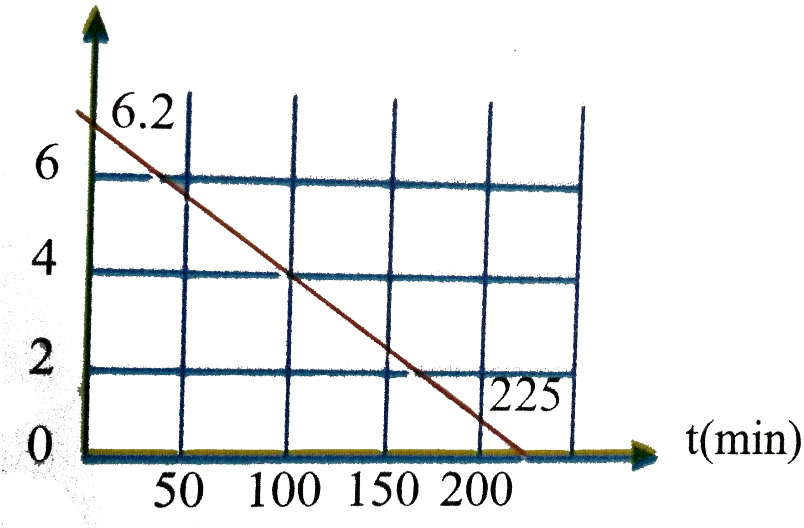
3. The table that follows shows some measurements of the decay rate of a sample of $.^{128}I$, a radio nuclide often used medically as a tracer to measure the rate at which iodine is absorbed by the thyroid gland.

Time(min)	$A(counts/s)$	Time(min)	$A(counts)/s$
4	392.2	132	10.9
36	161.4	164	4.56
68	65.5	196	1.86
10	26.8	218	1.00



The half life $t_{1/2}$ for this radio nuclide.

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4. Iiodine -131 is a radioactive isdotpe. If 1.0 mg of ^{131}I has an activity of 4.6×10^{12}Bq. What is the half-life of ^{131}I (in days)

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5. A sample contains large number of nuclei. The probability that a nucleus in sample will decay after four half lives is

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6. We are given the following atomic masses :

$._{92}^{238}U = 238.05079u$ $._{2}^{4}He = 4.00260u$

$._{90}^{234}Th = 234.04363u$ $._{1}^{1}H = 1.00783u$

$._{91}^{237}Pa = 237.05121u$

Here the symbol Pa is for the element protactinium (Z = 91) .

Calculate the energy released during the alpha decay of $._{92}^{238}U$.

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7. Calculate the disintegeration energy Q for the beta decay of ^{32}P, . The needed atomic masses are 31.973 u of ^{32}P and 31.972 u for ^{32}S

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8. In a Moon rock sample the ratio of number of (stable) ^{40}Ar atoms present to the number of (radioactive)^{40}K atoms is 10.3. Assume that all the argon atoms were produced by the decay of potassium atoms, with a half life of $1.25 \times 10^9 y$. How old is the rock?

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9. Consider the neutron capture reaction

$^{109}Ag + n \rightarrow {}^{110}A > o^{110}Ag + \gamma$ (40-34)

in which a compound nucleus $\left(^{110}Ag\right)$ is formed. Figure 40-18 shows the relative rate at which such events take place, plotted against the energy of the incoming neutron. Find the mean lifetime of this compound nucleus by using the uncertainty principle in the form

$\Delta E. \Delta t \approx \hat{h}$. (40-35)

here ΔE is a mesure of the uncertainty with which the energy of a state can be defined. The quantity Δt is a measure of the time available of measure this energy. In fact here Δt is just t_{avg}, the average life of the compound nucleus befoe it decays to its ground state.

Reasoning: We see that the relative reaction rate peaks sharply at a neutron energy of about 5.2 eV.This suggests that we are dealing with a single excited energy level of the compund nucleus ^{110}Ag. When the availabel energy(of the incoming neutron) just matches the energy of this level above the neutron) just matches the energy of this level above the ^{110}Ag ground state, we have resonance and the reaction of Eq. 40 -34 really goes.

However, the resonance peak is not infinitely sharp but has an approximate half peak is not infinitely shart but has an approximate half width (ΔE in the figue) of about 0.20 eV. We can account for this resonance peak width by saying that the excited level is not sharply defined in energy but has an energy uncertainty ΔE of about 0.20 eV.

Calculation : Subsitiuting that uncertainty of 0.20 2V into Eq. given us

$$\Delta = t_{avg} \approx \frac{h}{\Delta E} \approx \frac{\left(4.14 \times 10^{-15} eV. s\right) / 2\pi}{0.20 eV}$$

$\approx 3 \times 10^{-15} s.$

This is several hundraed times greater than the time a 5.2 eV neutron takes to cross the diameter of a ^{109}Ag nucleus . Therefore , the neutron is spending this time of 3×10^{-15} s as part of the nucleus.

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10. Consider the fission of $._{92}^{238}U$ by fast neutrons. In one fission event, no neutrons are emitted and the final end products, after the beta decay of the primay fragments, are $._{58}^{140}Ce$ and $._{44}^{99}Ru$. Calculate Q for this fission process. The relevant atomic and particle masses are

$m\left(._{92}^{238}U\right) = 238.05079u$

$m\left(._{58}^{140}Ce\right) = 139.90543u$

$m\left(._{44}^{99}Ru\right) = 98.90594u$

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11. Assume a proton is a sphere of radius $R \approx 1$ fm. Two protons are fired at each other with the same kinetic energy. K

a. What must K be if the paticles are brought to rest by their mutual Coulomb repulsion when they are just touching each other? We can take this value of K as a representative measure of the height of the Colulomb barrier.

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12. Temperature of an ideal 'gas whose molecules have average kinetic energy 1 e V is

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Checkpoint

1. For nuclide ${}_{Z}X^{A}$, which of the following changes snot take place in respective decay: a)Both (A) and (Z) decreases in α-decay b)Both (A) and (Z) do not change in γ-decay c)(A) does not change but (Z) decreases by one unitun positrondecay or k-electron capture d)Both (A) and (Z) increases in β-decay

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2. The nuclide $.^{131} I$ is radioactive, with a half-life of 8.04 days. At noon on January 1, the activity of a certain sample is 60089. The activity at noon on January 24 will be

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3. U^{238} decays into Th^{234} by the emission of an a-particle. There follows a chain of further radioactive decays, either by α-decay or by $\beta -$ decay. Eventually a stable nuclide is reached and after that, no further radioactive decay is possible. which of the following stable nuclides is the end product of the U^{238} radioactive decay chain ?

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4. A generic fission event is

$^{235}U+n \rightarrow X+Y+2n$

Which of the following pairs cannot represent X and Y: (a) ^{141}Xe and ^{93}Sr (b) ^{139}Cs and ^{94}Rb (c) ^{156}Nd and ^{79}Ge d. ^{121}In and ^{113}Ru?

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5. निम्न अभिक्रियाओं में x, y, z, a, b और c के मान बताइए :

(i) $\quad {}_{6}^{11}\text{C} \rightarrow {}_{y}^{z}\text{B}+x+v$

(ii) $\quad {}_{6}^{12}\text{C}+{}_{6}^{12}\text{C} \rightarrow {}_{a}^{20}\text{Ne}+{}_{b}^{c}\text{He}$

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Problems

1. A uranium 238 nucleus, originally at rest, emits and α particle. The α particle travels with a speed of v m/s. What is the recoil speed of the residual necleus?

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2. The half-life of a particular radioactive isotope is 6.5 h. If there are initially 65×10^{19} atoms of this isotope, how many remain at the end of 26 h?

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3. Consider the three formation processes shown for the compound nucleus ^{20}Ne in Fig. 40-14. Here are some of the atomic and particle masses:

What energy must (a) the alpha particle, (b) the proton, and (c) the γ ray photon have to provide 25.0 MeV of excitation energy to the compound nucleus?

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4. A certain radioactive isotope decay has α-emission,

$$._{Z_1}^{A_1}X \rightarrow ._{Z_1-2}^{A_1-4}Y$$

half life of X is 10 days. If 1 mol of X is taken initially in a sealed container, then what volume of helium will be collected at STP after 20 days?

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5. The activity of a sample of radioactive element $.^{100}A$ is 6.02 curie. Its decay constant is $3.7 \times 10^4 s^{-1}$. The initial mass of the sample will be:

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6. The half life of a given radioactive nuclide is 138.6 days. What is the mean life of this nuclide? After how much time will a given sample of this nuclide get reduced to only 12.5% of its initial value?

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7. What is the activity of a 20 ng sample of ^{92}Kr, which has a half life of 1.84 s?

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8. The half-life period of U^{234} is 2.5×10^5 years. In how much time is the quantity of the isotope reduce to 25% of the original amount?

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9. How much energy is released when a ^{238}U nucleus decays by emitting (a) an alpha particle and (b) a sequence of neutron, proton, neutron, proton? (c) Convince yourself both by reasoned argument and by direct calculation that the difference between these two numbers is just the total binding energy of the alpha particle. (d) Find that binding energy. Some needed atomic and particle masses are

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10. For a given sample, the count rate is 47.5α particle per minute. After 5 minutes, the count is reduced to 27α particles per minute. Find the decay constant and half life of the sample.

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11. A measurement of the energy ΔE of an intermediate nucleus must be made within the mean lifetime $\Delta t$of the nucleus and necessarily carries an uncertainty ΔEaccording to the uncertainty principle

$\Delta E. \Delta = h$

(a) What is the uncertainty ΔE in the energy for an intermediate nucleus if the nucleus has a mean lifetime of $10^{-22}s$? (b) Is the nucleus a compound nucleus?

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12. A free neutron decays into a proton, an electron and

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13. When aboveground nuclear tests were conducted, the explosions shot radioactive dust into the upper atmosphere. Global air circulations then spread the dust worldwide before it settled out on ground and water. One such test was conducted in October 1976. What fraction of the WSr produced by that explosion still existed in October 2006? The half-life of ^{90}Sr is 29 y.

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14. The radionuclide $._6C^{11}$ decays according to $._6C^{11} \rightarrow ._5B^{11} + e^+ + v$: half life =20.3min. The maximum energy of the emitted positron is $0.960 MeV$. Given the mass values

$m(._6C^{11}) = 11.011434u, m(._6B^{11}) = 11.009305u$

Calculate Q and compare it with maximum energy of positron emitted.

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15. Read the following :

(i) 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 Y will decay at a faster rate the X.

(ii) The electron emitted in beta radiation originates from decays of a neutron in a nucleus

(iii) The half-life of ^{215} At is 100 ms. The time taken for the radioactivity of a sample of ^{215} At to decay to $1/16^{th}$ of its initial value is 400 ms.

(iv) The volume (V) and mass (m) of a nucleus are related a V $\propto$ m.

(v) Given a sample of Radium - 226 having halflife of 4 days. Find the probability, a nucleus disintegrates within 2 half lives is 3/4. Select the correct code for above.

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16. Radius of a nucleus is given by the relation $R = R_0 A^{1/3}$ where $R_0 = 1.3 \times 10^{-15} m$ and A is mass number. For a nucleon inside a nucleus, de-Broglie wavelength is given by diameter of the nucleus.

Average kinetic energy of a nucleon in the Te^{128} nucleus based on above information will be :

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17. Consider an initially pure Mgm sample of X, an isotope that has a half-life of T hour, what is its initial decay rate (N_A = Avogadro No, atomic weight of X is A)

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18. Under certain circumstances, a nucleus can decay by emitting a particle more massive than an α-particle. Consider the following decay processes:

$._{88}Ra^{223} \rightarrow ._{82}Pb^{209} + ._{6}C^{14}, ._{88}Ra^{223} \rightarrow ._{86}Rn^{219} + ._{2}He^{4}$

(a) Calculate the Q-values for these decays and determine that both are energetically allowed.

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19. A sample of uranium mineral was found to contain Pb^{208} and U^{238} in the ratio of 0.008 : 1. Estimate the age of the mineral (half life of U^{238} is 4.51×10^9 years).

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20. In the following list of nuclides, identify (a) those with filled nucleon shells, (b) those with one nucleon outside a filled shell, and (c) those with one vacancy in an otherwise filled shell:

$^{13}C, {}^{18}O, {}^{40}K, {}^{49}Ti, {}^{60}Ni, {}^{91}Zr, {}^{92}Mo, {}^{121}Sb, {}^{143}Nd, {}^{144}Sm, {}^{205}Tl$ and ^{207}pb

.

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21. A radioactive isotope has initial activity of 28 dpm Its activity is reduced to 14 dpm after half an hour. The initial number of nuclide in sample was:

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22. कुछ विशिष्ट परिस्थितियों में एक नाभिक α कण से अधिक द्रव्यमान वाला एक कण उत्सर्जित करके क्षयित होता है। निम्नलिखित क्षय-प्रक्रियाओं पर विचार कीजिए-

$._{88}^{223}Ra \rightarrow ._{82}^{209}Pb + ._{6}^{14}C$

$._{88}^{223}Ra \rightarrow ._{86}^{219}Rn + ._{2}^{4}He$

इन दोनों क्षय प्रक्रियाओं के लिए Q मान की गणना कीजिए और दर्शाइए कि दोनों प्रक्रियाएं ऊर्जा की दृष्टि से सम्भव है।

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23. The strong neutron excess (defined as N - Z) of high- mass nuclei is illustrated by noting that most high-mass nuclides could never fission into two stable nuclei without neutrons being left over. For example, consider the spontaneous fission of a ^{235}U nucleus into two stable daughter nuclei with atomic numbers 39 and 53. From Appendix F, determine the name of the (a) first and (b) second daughter nucleus.

From Fig. 40-6, approximately how many neutrons are in the (c) first and (d) second? (e) Approximately how many neutrons are left over?

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24. An isotope of Potassium $._{19}^{40}K$ has a half life of 1.4×10^9year and decays to Argon $._{18}^{40}Ar$which is stable.

(i) Write down the nuclear reaction representing this decay.

(ii) A sample of rock taken from the moon contains both potassium and argon in the ratio $1/3$. find age of rock

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25. In 1992, Swiss police arrested two men who were attempting to smuggle osmium out of Eastern Europe for a clan- destine sale. However, by error, the smugglers had picked up ^{137}Cs. Reportedly, each smuggler was carrying a 1.0 g sample of ^{137}Cs in a pocket! In (a) bequerels and (b) curies, what was the activity of each sample? The isotope ^{137}Cs has a half-life of 30.2 y. (The activities of radioisotopes commonly used in hospitals range up to a few millicuries.)

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26. A radiation detector records 9500 counts in 1.00 min. Assuming that the detector records all decays, what is the activity of the radiation source in (a) becquerels and (b) curies?

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27. In a nuclear reactor an element X decays to a radio active element Y at a constant rate 10^{15} atoms per sec. Each decay release $100MeV$ energy. Half life of Y equals T and decays to a stable product Z. Each decay of Y releases $50MeV$. All energy released inside the reactor is used to produce electricity at an efficiency of 25%. Calculate the electrical power in kw generated in the reactor in steady state.

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

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29. (a) Define atomic mass unit. What is its symbol ?

(b) Define atomic mass of an element.

(c) What is meant by saying that 'the atomic mass of oxygen is 16' ?

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30. 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 exicted state. Find the kinetic energy of nucleus C just after its fromation 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.

(1amu=$930 MeV / c^2$).

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31. A given coin has a mass of 3.0 g. Calculate the nuclear energy that would be required to separate all the neutrons and protons from each other. For simplicity assume that the coin is entirely made of $._{29}^{63} Cu$ atoms of mass 62.92960 u..

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32. 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 $2.5 h$ 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 $.^{56} Mn = 56 gmol^{-1}$).

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

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

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34. If the activation energies of the forward and backward reactions of a reversible reaction are $E_a(f)$ and $E_a(b)$, respectively. The ΔE of the reaction is ....

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35. The radionuclide ^{64}Cu has a half-life of 12.7 h. If a sample contains 5.50 g of initially pure ^{64}Cu at t = 0, how much of it will decay between $t = 14.0h$ and $t = 16.0h$?

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36. Calculate the nearest distance of approach of an α-particle of energy 2.5 Me V being scattered by a gold nucleus (Z=79).

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37. Cancer cells are more vulnerable to x and gamma radiation than are healthy cells. In the past, the standard source for radiation therapy was radioactive ^{60}Co, which decays, with a half-life of 5.27 y, into an excited nuclear state of ^{60}Ni. That nickel isotope then immediately emits two gamma-ray photons, each with an approximate energy of 1.2 MeV, How many radioactive ^{60}Co nuclei are present in a 6000 Ci source of the type used in hospitals? (Energetic particles from linear accelerators are now used in radiation therapy.)

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38. A source contains two phosphorus radionuclei $._{15}^{32}P(T_{1/2}=14.3d)$ and $._{15}^{33}P(T_{1/2}=25.3d)$. Initially, 10% of the decay come from $._{15}^{33}P$. How long one must wait until 90% comes from it?

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39. The half-life of a radioactive substance against $\alpha-$decay is $1.2\times10^{7}s$. What is the decay rate for 4×10^{15} atoms of the substance ?

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40. A stationary thoron nucleus (A = 220, z=90) emits an alpha particle with kinetic energy E_{α}. What is the kinetic energy of the recoiling nucleus?

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41. The binding energy per nucleon for C^{12} is 7.68 MeV and that for C^{13} is 7.5 MeV. The energy required to remove a neutron from C^{13} is

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42. In a Rutherford scattering experiment, assume that an incident alpha particle (radius 1.80 fm) is headed directly toward a target gold nucleus (radius 6.23 fm). What energy must the alpha particle have to just barely "touch" the gold nucleus?

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43. A deuterium nucleus at rest absorbs a Gamma ray photon of energy 2.21 MeV and splits into a proton and a neutron. The neutron was found to be at rest after the disintegration. Calculate the mass of proton if it is known that mass of deuterium and hydrogen atom is 2.014740u and 1.008145u respectively. $\left[1u = 931MeV / c^2\right]$

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44. What is the binding energy per nucleon of ^{262}Bh ? The mass of the atom is $262.1231u$.

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45. The nuclide ^{14}C contains (a) how many protons and (b) how many neutrons?

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46. For overcoming the Coulomb barrier for fusion, methods other than heating the fusible material have been suggested. For example, if you were to use two particle accelerators to accelerate two beams of deuterons directly toward each other so as to collide head-on, (a) what voltage would each accelerator require in order for the colliding deuterons to overcome the Coulomb barrier?

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47. Consider the fission of $._{92}^{238} U$ by fast neutrons. In one fission event, no neutrons are emitted and the final end products, after the beta decay of the primay fragments, are $._{58}^{140} Ce$ and $._{44}^{99} Ru$. Calculate Q for this fission process. The relevant atomic and particle masses are

$m\left(._{92}^{238} U\right) = 238.05079u$

$m\left(._{58}^{140} Ce\right) = 139.90543u$

$m\left(._{44}^{99} Ru\right) = 98.90594u$

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48. Assume that the protons in a hot ball of protons each have a kinetic energy equal to kT, where k is the Boltzmann constant and T is the absolute temperature. If $T = 1 \times 10^7 K$, what (approximately) is the least separation 98.905 94 u any two protons can have?

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49. The uranium ore mined today contains only 0.72% of fissionable ^{235}U, too little to make reactor fuel for thermal-neutron fission. For this reason, the mined ore must be enriched with ^{235}U. Both $^{235}U(T_{1/2} = 7.0 \times 10\% y)$ and $^{235}U(T_{1/2} = 4.5 \times 10^9 y)$ are radioactive. How far back in time would natural uranium ore have been a practical reactor fuel, with a $^{235}U/^{235}U$ ratio of 3.0% ?

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50. What is the Q of the following fusion process?

$._1^2 H + ._1^1 H \rightarrow ._2^3 He +$ photon

Here are some at atomic masses.

$_1^2H 2.014102u _1^1H 1.007825u$

$_2^3He 3.016029u$

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51. Calculate the Coulomb barrier height for two Li nuclei that are fired at each other with the same initial kinetic energy K.

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52. Calculate and compare the energy released by (a) fusion of 1.0kg of hydrogen deep within the sun, and (b) the fission of 1.0kg of U^{235} in a fission reactor.

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53. Calculate the height of the Coulomb barrier for the head on collision of two deuterons, with effective radius 2.1 fm.

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54. Heavy water is the oxide of heavy hydrogen (deuterium) and is also called deuterium oxide. It is represented as D_2O. Heavy water is chemically similar to ordinary water heavy water is used for the neutron moderatory, as a trracer compound and for the preparation of deuterium. Reaction of heavy water with alkali metals liberates heavy hydrogen. heavy water can also be used for exchanging labile hydrogen with deuterium completely or partially. heavy water reacts slower than ordinary water but forms stronger bonds with other elements as compared to hydrogen.

Q. Reaction of N_2O_5 and D_2O produces

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55. Show that the energy released when three alpha particles fuse to form ^{12}C is 7.27 MeV. The atomic mass of ^{4}He is 4.0026u and that of ^{12}C is 12.0000u.

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56. The Sun has mass 2.0×10^{30} kg and radiates energy at the rate $3.9 \times 10^{26} W$ (A) At what rate is it mass changing? (b) What fraction of its original mass has it lost in this way since it began to burn hydrogen, about 4.5×10^{9} y ago?

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57. The fission properties of $._{84}Pu^{239}$ are very similar to those of $._{92}U^{235}$. The average energy released per fission is $180 MeV$. How much energy in MeV is released if all the atoms in 1kg of pure $._{94}Pu^{239}$ undergo fission.

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58. A thermal neutron (with approximately zero kinetic energy) is absrobed by a ^{238}U nucleus. How much energy is transferred from mass energy to the resulting oscillation of the nucleus? Here are some atomic masses and the neutron mass.

$^{237}U \quad 237.048723u \quad ^{238}U \quad 238.050782u$

^{239}U $239.054287u$ ^{240}U $240.056585u$

n $1.008664u$

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59. Calculate the disintegration energy Q for the fission of ^{52}Cr into two equal fragments. The masses you will need are

^{52}Cr $51.94051u$ ^{26}Mg $25.98259u$

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60. Calculate the energy released in the fissionn reaction

$^{235}U + n \rightarrow {}^{141}Cs + {}^{93}Rb + 2n$

Here are some atomic and particle masses.

^{235}U $235.04392u$ ^{93}Rb $92.92157u$

^{141}Cs $140.91963u$ n $1.00866u$

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61. a-d Complete the following table, which referes to the generalized fission reaction $^{235}U + n \rightarrow X + Y + bn$.

X	Y	b
^{140}Xe	(a)	1
^{139}I	(b)	2
(c)	^{100}Zr	2
^{141}Cs	^{92}Rb	(d)

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62. The isotope ^{235}U decays by alpha emission with a half life of $7.0 \times 10^{8} y$. It also decays (rarely) by spontaneous fission, and if the alpha decay did not occur, its half life due to spontaneous fission alone would be 3.0×10^{17}y. (a) At what rate do spontaneous fission decays occurs in 1.0 g of ^{235}U? (b) How many ^{235}U alpha decay events are there for every spontaneous fission event?

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63. The binding energy of the ^{14}N nucleus is 16.76 pJ and ^{14}C nucleus is 16.86 pJ. Which nucleus is the decay product of the other?

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64. For a radioactive sample, determine the ratio of the number of atoms decays of during the first half of its half- life to the number of atoms decays of during the second half of its half cycle.

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65. The half life of a substance A is 1 h. The half life of another substance B is 10 years. A mixture of the two substances has an activity of 1000 Bq. After 1 h, its activity drops to 900 Bq. What will be its acitivity after 20 years?

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66. Calculate the maximum possible energy of the γ rays emitted by an excited ^{11}B nuclues formed by the capture of a slow neutron by a ^{10}B nucleus. Take mass of $^{10}B = 10.012938u$ and $^{11}B = 11.009305u$

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Practice Questions Single Correct Choice Type

1. After how many days will 1/20th of the radioactive element remain, if the half life of the element is 6.931 days?

A. 23.03 days

B. 25.12days

C. 28.38 days

D. 29.96 days

Answer: D

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2. n number of α- particles are being emitted by N atoms of a radioactive elemtn. The half life of element will be

A. $\left(\frac{N}{n}\right)s$

B. $\left(\frac{n}{N}\right)s$

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

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

Answer: C

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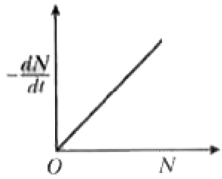
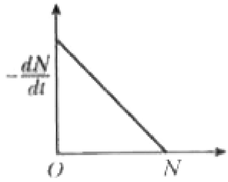
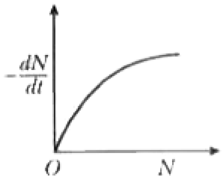
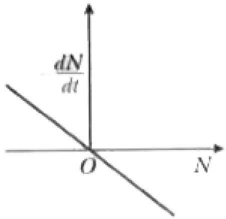
3. Which of the graphs shown in the figure below best represents the relationship between the radioactive decay rare $[-(dN/dt)]$ and population N?

A. 

B. 

C. 

D. 

Answer: A

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4. The fossil bone has a $.^{14}C : .^{12}C$ ratio, which is $\left[\frac{1}{16}\right]$ of that in a living animal bone. If the half -life of $.^{14}C$ is 5730 years, then the age of the fossil bone is :

A. 11460 years

B. 17190 years

C. 22920 years

D. 4584 years

Answer: C

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5. In a radioactive material the activity at time t_1 is R_1 and at a later time t_2, it is R_2. If the decay constant of the material is λ, then

A. $R_1 = (R_2(t_2 / t_1)$

B. $R_1 = R_2$

C. $R_1 = R_2 e^{-(t_1 - t_2)}$

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

Answer: C

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6. A nuclear reaction that uses one nucleus of $^{236}_{92}U$ generates 170 Mev. How much energy is released when 5.0 kg of this isotope is udeD?

A. $1.4x10^{10} J$

B. $3.5 \times 10^{14} J$

C. $6.9 \times 10^{13} J$

D. $8.9 \times 10^{14} J$

Answer: B

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7. Most suitable element for nuclear fission is the element with a atomic mass near

A. 11

B. 21

C. 52

D. 92

Answer: D

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8. A radioactive sample has half-life of 5 years. Probability of decay in 10 years will be.

A. 0.5

B. 0.75

C. 1

D. 0.6

Answer: B

Watch Video Solution

9. A sample of uranium is a mixture of three isotopes $._{92}U^{234}$, $._{92}U^{235}$ and $._{92}U^{238}$ present in the ratio 0.006%, 0.71% and 99.284% respectively. The half lives of then isotopes are 2.5×10^5 years, 7.1×10^8 years and 4.5×10^9 years respectively. The contribution to activity (in $\%$) of each isotope in the sample respectively

A. 10.4

B. 20.4

C. 21.4

D. 22.4

Answer: C

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10. At time $t = 0$, number of nuclei of a radioactive substance are 100. At $t = 1$ s these numbers become 90. Find the number of nuclei at $t = 2s$.

A. 50

B. 80

C. 70

D. nuclei will remain undecayed

Answer: A

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11. The decay constant of a radioactive sample is 1. The half life and mean life of the sample, respectively, are given by

A. $\frac{1}{\lambda}$ and $\frac{\log_e 2}{\lambda}$

B. $\frac{\log_e 2}{\lambda}$ and $\frac{1}{\lambda}$

C. $\lambda \log_e 2$ and $\frac{1}{\lambda}$

D. $\frac{\lambda}{\log_e 2}$ and $\frac{1}{\lambda}$

Answer: B

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12. A nucleus with Z=92 emits the following in a sequence $\alpha, \alpha, \beta^-, \beta^-, \alpha, \alpha, \alpha, \alpha, \beta^-, \beta^-, \alpha, \beta^+, \alpha$. The Z of the resulting nucleus is

A. 76

B. 79

C. 82

D. 74

Answer: B

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13. The atomic mass of B^{10} is 10.811 amu . Find the binding energy of B^{10} nucleus . The mass of electron is 0.0005498 amu. The mass of proton is m_p = 1.007276 amu . The mass of neutron is m_n = 1.008665 amu.

A. $-678.272 MeV$

B. $678.932 MeV$

C. $378.932 MeV$

D. None of these

Answer: A

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14. Four vessels A,B,C and D respectively, contains 20 g atom $(T_{1/2=5h}, 2g$ atom $(T_{1/2} = 1h)$, $5g$tom $(T_{1/2} = 2h)$, and 10 g atom $(T_{1/2} = 3h)$ of different radio nuclides in the beginning. The maximum activity would be exhibited by the vessel is

A. A

B. B

C. C

D. D

Answer: A

View Text Solution

15. In Rutherford's famous gold foil scatterig experiment he found that most alpha particles would pass throught the foil undeflected. Which of the following nuclear properties can be inferred from this obsevation?

A. Most of the space inside the atom is void

B. Most of the mass of an atom is in the nucleus

C. The nucleus contains both protons and neutrons

D. The diameter of the nucleus is small compared to the diameter of the atom.

Answer: A

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16. The electron, neutron, and proton, listed in descending order of mass are

A. Electron, neutron, proton

B. Electron, proton, neutron

C. Proton, neutron, electron

D. Neutron, proton, electron

Answer: D

Watch Video Solution

17. Which of the following is a wrong description of binding energy of a nucleus?

A. It is the energy required to break a nucleus into its consitituent nucleons

B. It is energy made available when free nucleous combine to form a nuceus

C. It is proportional to the sum of the rest mass energies of its nucleons minus the rest mass energy of the nucleus

D. It is the sum of the kinetic energy of all the nucleons in the nucleus.

Answer: A

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18. The binding energies of the atoms of elements A and B are E_a and E_b, respectively. Three atoms of the element B fuse to give one atom of element A. this fusion process is accompanied by release of energy e. then, E_a, E_b are e are related to each other as

A. $E_a + e = 3E_b$

B. $E_a = 3E_b$

C. $E_a - e = 3E_b$

D. $E_a + 3E_b + e = 0$

Answer: C

Watch Video Solution

19. How does the rest energy of a nucleus compare to the sum of the rest energies of the individual nucleons when they are apart from the nucleous?

A. It is greater than the sum

B. It is less than the sum

C. It is equal to the sum

D. It is in the ratio of 1:1.25

Answer: B

View Text Solution

20. The binding energies of the nuclei of $._2^4He, ._3^7Li, ._6^{12}C$ and $._7^{14}N$ are 28, 52, 90, 98 MeV respectively. Which of these is most stable.

A. $_2^4He$

B. $_3^7Li$

C. $_6^{12}C$

D. $_7^{14}N$

Answer: C

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21. In the nuclear reaction descried by the equation below, an alpha particle reacts with a nucleus to form another nucleus and an additional particle X. $_2^4He + _6^{12}C \rightarrow _7^{13}N + X$.This additional particle X is a

A. Positron

B. Neutron

C. Proton

D. Tritium nucleus

Answer: D

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22. Nucleus A is converted into C through the following reactions,

$A \rightarrow B + \alpha$

$B \rightarrow C + 2\beta$

then,

A. A and B are isotopes

B. A and C are isobars

C. A and B are isobars

D. A and C are isotopes

Answer: D

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23. In one average life (assuming the decay to proceed according to radioactive law)

A. Half the active nuclei decay

B. Less than half the active nuclei decay

C. More than half the active nuclei decay

D. All the nuclei decay

Answer: C

Watch Video Solution

24. 90% of the active nuclei present in a radioactive sample are found to remain undecyayed after 1 day. The precentage of undecayed nuclei left after two days will be

A. 0.85

B. 0.81

C. 0.8

D. 0.79

Answer: B

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25. Let T be the mean life of a radioactive sample. 75% of the active nuclei present in th sample initially will deacy in time

A. 2T

B. 0.5T(In2)

C. 4T

D. 2(In 2) T

Answer: D

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26. 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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27. The half life of $.^{131}I$ is 8day. Given a sample of $.^{131}1$ at $t = 0$, we can assert that:

A. No nucleus will decay before t=4 days

B. No nucleus will decay 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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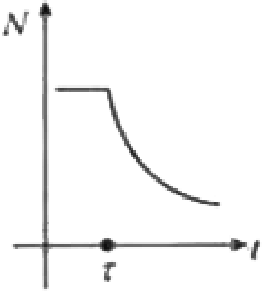
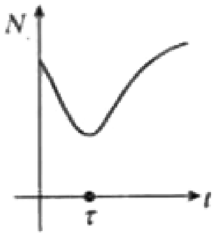
28. A radioactive sample consists of two distinct species having equal number of atoms initially. The mean life of one species is τ and that of the other is 5τ. The decay products in both cases are stable. A plot is made of the total number of radioactive nuclei as a function of time. Which of the following figure best represents the form of this plot?

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



A.



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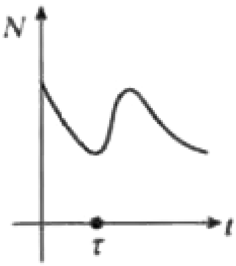
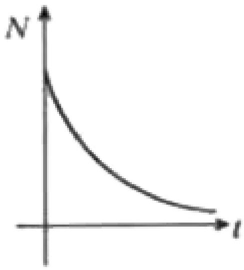


C.



D.

Answer: D

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29. Half-lives of two radioactive elements A and B are 20 minutes and 40 minutes respectively. Initially, the samples have equal number of nuclei. After 80 minutes, the ratio of decayed numbers of A and B nuclei will be

A. $1:16$

B. $4:1$

C. $1:4$

D. $5:4$

Answer: D

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30. The ratio of molecular mass of two radioactive substances is $3/2$ and the ratio of their decay cosntatnt 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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31. An unstable nucleus decays in three different modes, each mode having a different half life $T_1, T_2, T_3 (T_1 > > T_2 > > T_3)$. The overall half life of a sample will be given by

A. $T \approx T_1$

B. $T \approx T_3$

C. $T \approx (T_1 + T_2 + T_3)/3$

D. $T \approx T_2$

Answer: B

View Text Solution

32. The decay constant of a radioactive material represents the fraction of nuclei of a particular isotope that

A. will eventually decay if you wait long enough

B. Will decay per unit time

C. Are present in an element containing a mixture of isotopes

D. Are present in a chemical compounds containing elements of different atomic numbers

Answer: B

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33. Samples of two different isotopes, X and Y. Both contain the same number of radioactive atoms. Sample X has a half life twice than that of Y. How do their activities be compared?

A. X has a smaller activity than Y

B. X has a greater activity than Y

C. Activities of X and Y are equal

D. Need to know number of neutrons in nucleus

Answer: A

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34. A particle isotope has a half life of 10 min.What does that statement imply about a sample of this type of nucleus?

A. All of the nuclei will decay in 10 min

B. All of the nuclei wil decay in 20 min

C. Every time you start with 10 nuclei at the beginning of a 10 -min interval, 5 nuclei will be left at the end of the interval.

D. The expected number of nuclei to decay in 10 min will be one half the number at the beginning of the 10 min.

Answer: D

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35. A radioactive substance is dissolved in a liquid and the solution is heated.The activity of the solution

A. Is smaller than that of element

B. Is greater than that of element

C. Is equal to that of element

D. Will be smaller or greater depending upon whether the solution is weak or concentrated.

Answer: C

View Text Solution

36. Nuclear reactions can occur spontaneously when

A. Q is negative

B. Q is positive

C. Q is negative, positive, or imaginary

D. Q is either positive or negative, but not when Q is imaginary

Answer: B

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

(a) 4.4 MeV (b) 5.4 MeV (c) 5.6 MeV (d) 6.5 MeV

A. 4.4MeV

B. 5.4MeV

C. 5.6MeV

D. 6.5MeV

Answer: B

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38. During a negative 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 excitation energy of the nucleus is converted into an electron

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 and 5

B. 7 and 7

C. 5 and 7

D. 7 and 9

Answer: B

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40. Ten grams of $\hat{\ } 57Co$ kept in an open container beta-decays with a half-life of 270 days. The weight of the material inside the container after 540 days will be very nearly

A. 10 g

B. 5 g

C. 2.5 g

D. 1.25 g

Answer: A

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41. Which one of the following combinations of radioactive decay results in the formation of an isotope of the original nucleus?

A. One alpha and four beta

B. One alpha and two beta

C. One alpha and one beta

D. Two alpha and one beta

Answer: B

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42. If a beam consisiting of α, β and γ radiation is passed through an electric field perpendicular to the beam, the deflections suffered by the components, in decreasing ordre are,

A. α, β, γ

B. α, γ, β

C. β, α, γ

D. β, γ, α

Answer: C

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43. A γ- ray photon is emitted

A. After ionization of an atom

B. Due to conversion of a neutron into a proton in the nucleus

C. After de- excitation of a nucleus

D. Due to conversion of a proton into a neutron in the nucleus

Answer: C

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44. An archaeologist extracts a sample of carbon from an ancient ax handle and finds that it emits an average of 10 beta emissions per minute. She finds that the same mass of carbon from a living tree emits 40 beta per minute. Knowing that the half life of carbon -14 is 5730 years, she concludes that the age of the ax handle is about

A. 2865 years

B. 5730 years

C. 11460 years

D. 17190 years

Answer: C

View Text Solution

45. When a U-235 nucleus absorbs a neutron and underfoes nuclear fission, about 200 MeV of energy is released. But in what form? Intereting most of this energy initially appears in the form of

A. γ rays

B. Kinetic energy of emitted neutrons

C. Kinetic energy of the fission fragments

D. Heat

Answer: C

View Text Solution

46. A star initially has 10^{40} deuterons. It produces energy via the processes $._1 H^2 +_1 H^2 \rightarrow_1 H^3 + p$ and $._1 H^2 +_1 H^3 \rightarrow_2 He^4 + n$. 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. 106s

B. 108s

C. 1012s

D. 1016s

Answer: C

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47. Which of the following is a correct statement?

A. In fission process, two fragments are necessary but in fusion two products are not necessary.

B. In fission process, two fragments are not necessary but in fusion two products are necessary.

C. In fission process as well as fusion, two products are necessary.

D. In fission process or fusion, two products are not necessary.

Answer: C

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48. Which of the following statements are correct?

A. Nuclei with small mass number and atomic number are more likely to undergo fusion than fission.

B. Nuclei having a small binding energy per nucleon are more likely to undergo fusion than fision.

C. Nuclei having large binding energy per nucleon are more likey to undergo fusion than fission.

D. Nuclei with large atomic number are more likely to undergo fusion than fission.

Answer: A

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49. Osmium has atomic number 76. A particular isotopes of osmium has an atomic mass of 186.956u. Which symbol correctly represents this isotope?

A. $_{111}^{187}Os$

B. $^{76}_{187}Os$

C. $^{111}_{76}Os$

D. $^{187}_{76}Os$

Answer: D

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50. Which of the following is not an assumption involved in the expresssion: $r = \left(1.2 \times 10^{-15} m\right) A^{1/3}$?

A. Nuclei are incompressible.

B. The nucleus is spherical in shape.

C. All nucleons have roughtly the same mass.

D. Nuclear densities are proportional to the mass numbers.

Answer: D

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51. What is the approximate radius of a carbon nucleus that has six protons and six neutrons?

A. $1.2 \times 10^{-15} m$

B. $2.7 \times 10^{-15} m$

C. $2.2 \times 10^{-15} m$

D. $2.9 \times 10^{-15} m$

Answer: B

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52. Assuming the radius of a hydrogen atom is given by the Bohr radius $r_{\text{Bohr}} = 5.29 \times 10^{-1}$ m what is the ratio of the nuclear density of a hydrogen atom to its atomic density?

A. 1.2×10^{-14}

B. 8.6×10^{13}

C. 4.4×10^{4}

D. 3.9×10^{17}

Answer: B

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53. ${}^{207}_{82}Pb$ has a mass of $3.4368 \times 10^{-25} kg$. What is the approxiamte density of this lead nucleus?

A. $2.3 \times 10^{17} kg/m^3$

B. $4.8 \times 10^{19} kg/m^3$

C. $3.5 \times 10^{18} kg/m^3$

D. $5.2 \times 10^{20} kg/m^3$

Answer: A

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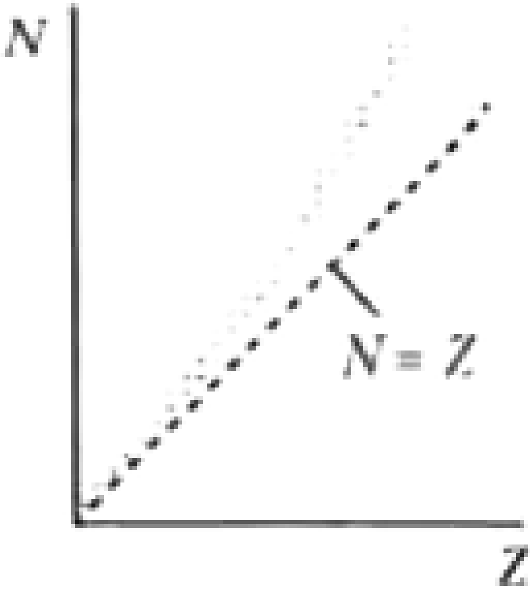
54. Which one of the following concepts explains why heavy nuclei do not follow the N=Z line (or trend) shown in the figure?



A. Transmutation

B. Coulomb repulsion

C. Particle wave duality

D. Pauli exclusion principle

Answer: B

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55. The binding energy of an isotope of chlorine is 298 MeV. What is the mass defect of this chlorine nucleus in atomic mass units?

A. 3.13u

B. 0.882u

C. 2.30u

D. 0.320u

Answer: D

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56. What is the mass defect of $_{50}^{120}Sn$ (atomic mass =119.902 200 u)? The hydrogen atom has a mass of 1.00783 u, and the neutron has a mass of 1.008 67 u.

A. $6.9175 \times 10^{-28} kg$

B. $1.8202 \times 10^{-27} kg$

C. $8.0024 \times 10^{-28} kg$

D. $1.0687 \times 10^{-27} kg$

Answer: B

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57. how much energy is required to remove a neuton $(m_n = 1.008665u)$ from ${}_{7}^{15}N$ that has an atomic mass of 15.000 108 to make ${}_{7}^{14}N$ that has an atomicmass of 14.003 074u?

A. 1.163MeV

B. 939.6MeV

C. 6.423MeV

D. 928.7MeV

Answer: B

Watch Video Solution

58. Which one of the following thickness of lead would be least effective in stopping β rays?

A. 0.04 m

B. 0.30 mm

C. 0.25 mm

D. 0.40 mm

Answer: A

View Text Solution

59. Consider the nuclear decay process: $^{90}_{39}Y \rightarrow ^{90}_{38}Sr +$? What is (are) the missing product (s)?

A. A photon

B. A positron and a neutrino

C. A proton

D. An electron and an alpha particle

Answer: B

Watch Video Solution

60. Which one of the following quantities is not a conserved quantity according to the laws of physics?

A. Electric charge

B. Angular momentum

C. Kinetic energy of the fission fragments

D. Nucleon number

Answer: C

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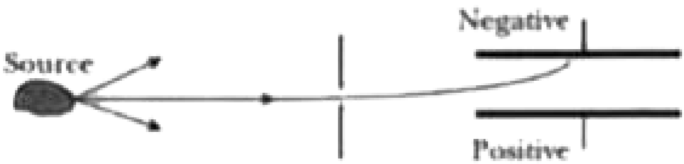
61. Radiation or (and) particles emerge(s) from a radioactive sample. These products from the sample are allowed to pass through a narrow slit and may be considered a beam.The beam is passed between two plates that carry opposite electrical charge. The experiment region contains no magnetic fields. It is observed that the beam is deflected toward the negatively charged plate.



Which one of the following statemetns is the best conclusion for this situation?

A. The beam is only α -rays

B. The beam could be either α rays or β^{+} rays

C. The beam is only β^{-} rays

D. The beam could be α rays, β^{+} rays, or γ rays

Answer: B

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62. The half life ofa particular isotope of iodine is 8.0 days. How much of a 10.0g sample of this isotope will remian after 30 days?

A. 0.37 g

B. 0.60 g

C. 0.45 g

D. 0.74 g

Answer: D

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63. The half life a particular isotope of barium is 12s. What is the activity of a $1.0 \times 10^{-6} kg$ sample of this isotope?

A. $1.2 \times 10^{15} Bq$

B. $2.5 \times 10^{17} Bq$

C. $1.8 \times 10^{16} Bq$

D. $3.6 \times 10^{18} Bq$

Answer: B

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64. The activity of carbon -14 in a sample of charcoal from an archaeological site is 0.04 Bq. Determine the age of the sample. The half life of carbon -14 is 5730 years.

A. 10500 y

B. 14500y

C. 12500y

D. 16500y

Answer: B

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65. Which one of the following statements is true concerning the radioisotope carbon -14 that is used in carbon dating?

A. Carbon-14 is produced by living cells

B. Carbon-14, is produced during β^- decay

C. Carbon -14 is produced by the decay of carbon-12

D. Carbon -14 is produced by cosmic rays striking the atmosphere.

Answer: D

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66. The ratio of the abundance of carbon -14 to carbon -12 in a sample of dead wood is one quarter the ratio for living wood.If the half life of carbon -14 is 5730 years, which one of the following expressions determines how many years ago the wood died?

A. 2×5730

B. 0.75×5730

C. 4×5730

D. 0.50×5730

Answer: A

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67. Consider the following reaction: ${}_{7}^{14}N(d, \alpha){}_{6}^{12}C$ where ${}_{7}^{14}N$ has a mass of 14.003u, ${}_{6}^{12}C$ has a mass of 12.000000u, d has a mass of 2.014 102 u and α has a mass of 4.002 603 u. How much energy is released in this reaction

A. 1.2 MeV

B. 13.6 MeV

C. 8.3 MeV

D. 27.4 MeV

Answer: B

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68. Consider the reaction ${}_{1}^{1}H + {}_{62}^{150}Sm \rightarrow {}_{61}^{147}Pm + {}_{2}^{4}He$ where the masses are ${}_{1}^{1}H = 1.007824u, {}_{2}^{4}He = 4.002603u, {}_{62}^{150}Sm = 149.917276u, {}_{61}^{147}Pm = 146.9$

. How much energy is released in the reaction?

A. 3.14MeV

B. 12.6MeV

C. 6.88MeV

D. 19.8MeV

Answer: C

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69. How many kilowatt hours of energy are released from 25 g deuterium $_1^2H$ fuel in the fusion reaction, $_1^2H + _1^2H \to _2^4He + \gamma$ where the masses are $_1^2H = 2.014102u$ and $_2^4He = 4.002603u$

A. $1 \times 10^6 kWh$

B. $3 \times 10^6 kWh$

C. $2 \times 10^6 kWh$

D. $4 \times 10^6 kWh$

Answer: D

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Practice Questions More Than One Correct Choice Type

1. For a stable nuclei the

A. Biding energy is large

B. Binding energy per nucleons is large

C. Packing fraction is very large

D. Packing fraction is very small

Answer: B::D

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2. The mass number of a nucleus of an element is

A. Always less than its atomic number

B. Always more 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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3. 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. Isotones have the same N but different A and Z

Answer: B::C::D

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

A. Nearly 63% of the radioactive substance 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 nearly 8 years

D. All the above statements are true

Answer: A::C

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5. Which of the following statements are correct?

A. Nuclei having an odd number of protons and an odd number of neutrons are generally unstable.

B. The mas number of a nucleus is equal to its atomic number only for the nucleus $_1^1H$.

C. A radioactive element of half life 1.5 years completely disintegrates in 4.5 years

D. The mass per nucleon in an oxygen atom is slightly less than ina hydrogen atom.

Answer: A::B::D

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6. 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 acvitiy (R) of the sample at any instant is directly proportional to the number of undecayed nuclei present in the sample at that time

C. The number of decayed nuclei grows linearly with time

D. The number of decayed nuclei grows exponentially with time

Answer: A::B::D

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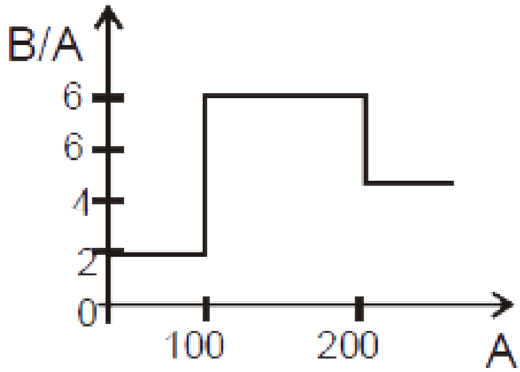
7. Assume that the nuclear binding energy per nucleon (B/A) versus mass number (A) is as shown in the figure. Use



this plot to choose the correct choice(s) given below. Figure

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

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

C. Fission of a nucleus lyging in the mass rnage of $100 < A < 200$ will release energy when broken into two equal fragments

D. Fission of a nucleus lying in the mass rang eof $200 < A < 260$ will release energy when broeken into two equal fragments.

Answer: B::D

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8. From the following equations, choose the possible nuclear reactions

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

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

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

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

Answer: A::B::C

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9. In the options given below, let E denote the mass energy of a nucleus and E(n) that of a neutron. The correct option is

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

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

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

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

Answer: A::D

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10. If m_p and m_n are masses of proton and neutron respectively and M_1 and M_2 are masses of $._{10}\,MeNe^{20}$ and $._{20}\,Ca^{40}$ nucleus repectively, 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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11. Which of the following are evidences for the existence of neutrons in an atom?

A. The ratio of the charge to the mas of atom's nucelus is smaller than that of a hydrogen nucleus

B. An atom is always electrically neutral

C. Isotopes are present

D. Some atoms are radioactive in nature

Answer: A::C

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12. The instability of the nucleus can be due to various causes. An unstable nucleus emits radiations if possible of transform into less unstable state. Then the cause and the result can be

A. A nucleus of excess nucleons is α -active

B. An excited nucleus of excess protons is β^{-} acitve

C. An excited nucleus of excess protons is β^{+} active

D. A nucleus of excess neutrons is β^{-} active

Answer: A::C::D

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13. A fraction f_1 of a radioactive sample decays in one mean lie and a fraction f_2 decays in one half-life

A. $f_1 > f_2$

B. $f_1 < f_2$

C. $f_1 = f_2$

D. $f_1 \neq f_2$

Answer: A::D

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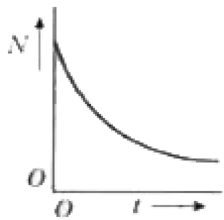
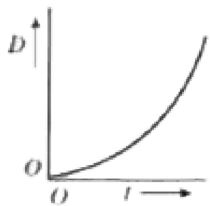
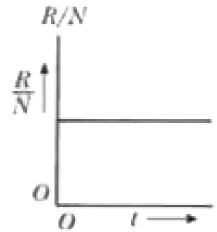
14. A large population of radioactive nucleus starts disintegrating at $t = 0$.At time t, if N= number of parent nuclei present, D= the number of daughter nuclei present and R= rate at which the daughter nuclei are produced , then the correct representation will be:

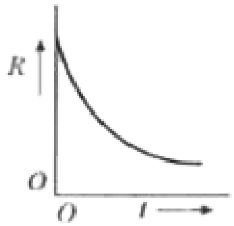


A.



B.

C. 

D. 

Answer: A::C::D

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15. In β-decay, the Q-value of the process is E. Then

A. Kinetic energy of a β-particle cannot exceed E

B. Kinetic energy of anti neutrino emitted lies between zero and E

C. N/Z ratio of the nucleus is altered

D. Mass number (A) of the nucleus is altered.

Answer: A::B::C

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16. Consider the following nuclear reactions and select the correct statemetns from the option given below .

Reaction I $n \rightarrow p + e^{-} + v$ Reaction II: $p \rightarrow n + e^{+} + v$

A. Free neutron is unstable, therefore reaction I is possible

B. Free proton is stable, therefore reactionII is not possible

C. Inside a nucleus, both decays (reactions I and II) are possible

D. Inside a nucleus, reaction I is not possible but reaction II is possible.

Answer: A::B::C

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17. The essential distinction between X - rays and γ - rays is that

A. γ rays have shorter wavelength than x rays

B. γ rays are extraterrestrial, x rays are man made

C. γ rays have less penetrating power than x rays

D. γ rays have greater ionizing powers than x rays

Answer: A::B::C

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18. When nucleus of an electrically neutral atom undergoes a radioactive decay process, it will remain neutral after the decay if the process is

(a) An α- decay (b) $A\beta^{\oplus}$-decay

(c) $A\gamma$-decay (d) AK- capture process

A. α decay

B. β decay

C. γ decay

D. K-capture

Answer: C::D

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19. Which of the following is an assumption in Carbon dating process?

A. The ratio of ^{14}C to ^{12}C is a constant in living organisms

B. The half life of a nuclide remains constant over the years

C. ^{14}C stops being absorbed when an organism dies

D. Fluctuation of ^{14}C and ^{12}C ratios occurs in well known periodic intervals

Answer: A::B::C

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20. Both under fission and nuclear fusion release enormus energy. When a uranium nucleus fission, the released energy is mainly kinetic energy of the repelling ragments. When a pair of hydrogen isotopes fues, the energy initially released is in the form of

A. Gamma radiation

B. Kinetic energy of colliding particles

C. Potential energy of the helium nucleus that is formed

D. Heat

Answer: A::B

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21. The total binding energy of an α particle $\left({}_{2}^{4}He\right)$ is 24.4 MeV whereas the total binding energy of a deutron $\left({}_{1}^{2}H\right)$ is merely 2.2MeV. When two deutrons are made to combine

A. An α particle will be obtained

B. An amount of 22.2 MeV energy will be released

C. An amount of 20.0 MeV energy will be released

D. An amount of 22.2 MeV energy will be consumed

Answer: A::C

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

A. The rest mass of a stable nucleus is less 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 separatd nucleons

C. In nuclear fusion, energy is released by fusion of two nuclei of medium mass (approximately 100 amu)

D. In nuclear fission, energy is released by fragmentation of a very heavy nuceus

Answer: A::D

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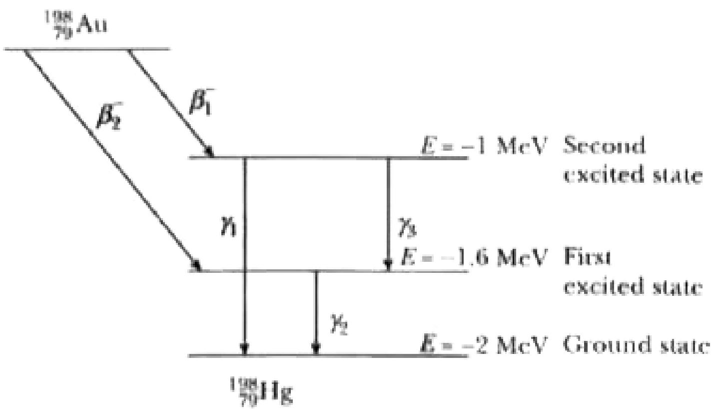
Practice Questions Linked Comprehension

1. Gold nucleus $\left({}^{198}_{79}Au\right)$ can decay into mercuyr nucleus $\left({}^{198}_{80}Hg^{8}\right)$ by two decay schemes shown in figure below (i) it can emit a β -particle (β_1) and come to ground state by either emiting one γ- ray (γ_1) or emitting two γ- rays (γ_3 and γ_4) (ii) It can emit one β- particle (β_2) and come to ground state by emitting γ_2 ray. Atomic masses: ${}^{198}Au = 197.9652$ amu and ${}^{198}Hg = 197.9662$ amu. Given that 1 amu= $930 MeV / c^2$. The energy levels of the nucleus are shown in figure below



Whatis the maximum kinetic energy of emitted β_2 particle?

A. 1.44 MeV

B. 0.59 MeV

C. 1.86 MeV

D. 1.46 MeV

Answer: D

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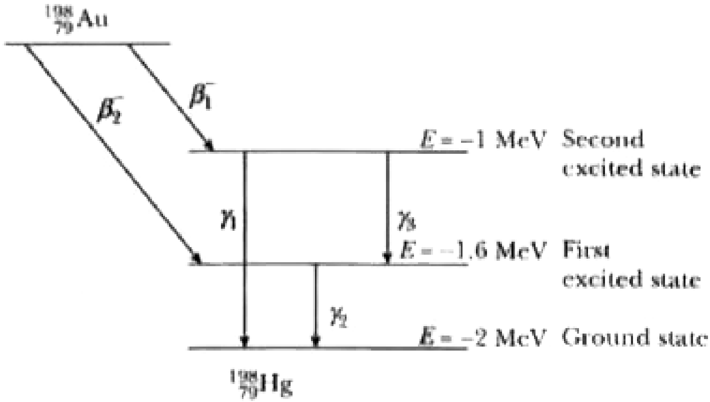
2. Gold nucleus $\left({}_{79}^{198}Au\right)$ can decay into mercuyr nucleus $\left({}_{80}^{198}Hg^{8}\right)$ by two decay schemes shown in figure below (i) it can emit a β -particle (β_1) and come to ground state by either emiting one γ- ray (γ_1) or emitting two γ- rays $(\gamma_3$ and $\gamma_4)$ (ii) It can emit one β- particle (β_2) and come to ground state by emitting γ_2 ray. Atomic masses: ${}^{198}Au = 197.9652$ amu and ${}^{198}Hg = 197.9662$ amu. Given that 1 amu= $930 MeV / c^2$. The energy levels of the nucleus are shown in figure below



What is the maximum kinetic energy of emitted β_1 parricle ?

A. 1.28 MeV

B. 0.77 MeV

C. 1.86 MeV

D. 0.86 MeV

Answer: D

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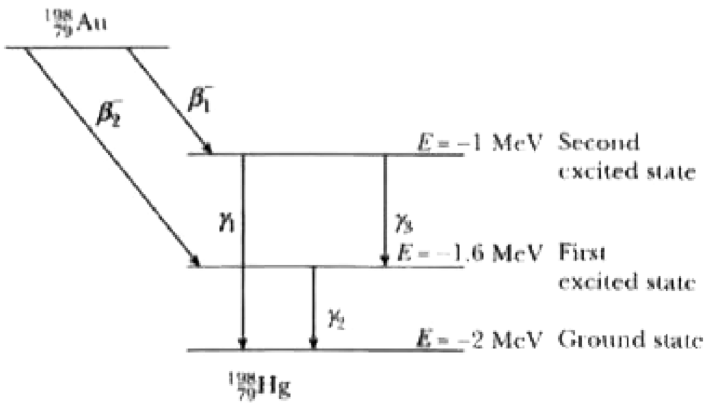
3. Gold nucleus $\left({}^{198}_{79}Au\right)$ can decay into mercuyr nucleus $\left({}^{198}_{80}Hg^8\right)$ by two decay schemes shown in figure below (i) it can emit a β -particle (β_1) and come to ground state by either emiting one γ- ray (γ_1) or emitting two γ- rays (γ_3 and γ_4) (ii) It can emit one β- particle (β_2) and come to ground state by emitting γ_2 ray. Atomic masses: $^{198}Au = 197.9652$ amu and $^{198}Hg = 197.9662$ amu. Given that 1 amu= $930 MeV / c^2$. The energy levels of the nucleus are shown in figure below



The wavelength of emitted γ - rays is the order

A. $\lambda_2 > \lambda_3 > \lambda_1$

B. $\lambda_3 > \lambda_2 > \lambda_1$

C. $\lambda_1 > \lambda_2 > \lambda_3$

D. $\lambda_3 = \lambda_2 = \lambda_1$

Answer: A

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4. We have two radioactive nuclei A and B. Both convert into a stable nucleus C. Nucleus A converts into C after emitting two two α-particles and three β-particles. Nucleus B converts into C after emitting one.

α-particle anf five β-particles. A time $t = 0$, nuclei of A are $4N_0$ and that of B are N_0. Half-life of A(into the conversion of C) is 1 min and that of B is 2 min . Initially number of nuclei of C are zero.

If atomic numbers and mass numbers of A and B are Z_1, Z_2, A_1 and A_2 respectively. Then

A. $Z_1 - Z = 6$

B. $A_1 = A_2 = 4$

C. both b and d are correct.

D. both a and c are wrong

Answer: B

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5. We have two radioactive nuclei A and B. Both convert into a stable nucleus C. Nucleus A converts into C after emitting two two α-particles and three β-particles. Nucleus B converts into C after emitting one. α-particle anf five β-particles. A time $t = 0$, nuclei of A are $4N_0$ and that of B are N_0. Half-life of A(into the conversion of C) is 1 min and that of B is 2 min. Initially number of nuclei of C are zero.

What are number of nuclei of C, when number of nuclei of A and B are equal ?

A. $2N_0$

B. $3N_0$

C. $9N_0 / 2$

D. $5N_0 / 2$

Answer: C

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6. We have two radioactive nuclei A and B. Both convert into a stable nucleus C. Nucleus A converts into C after emitting two two α-particles and three β-particles. Nucleus B converts into C after emitting one. α-particle anf five β-particles. A time $t = 0$, nuclei of A are $4N_0$ and that of B are N_0. Half-life of A(into the conversion of C) is 1 min and that of B is 2 min . Initially number of nuclei of C are zero.

At what time rate of disintergrations of A and B are equal.

A. 4 minutes

B. 6 minutes

C. 8 minutes

D. 2 minutes

Answer: B

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7. In a nuclear fusion reactor, the reaction occurs in two stages (i) Two deuterium $\left({}_1^2D\right)$ nuclei fuse to form a tritium $\left({}_1^3T\right)$ nucleus with a proton as a byproduct. The reaction may be represented as D (D,p) T. (ii) A tritium nucleus fuses with another deuterium nucleus to form a helium $\left({}_2^4He\right)$ nucleus with a neutron as a byproduct. The reaction is represented as $T(D.\ n)\alpha$. Given that $m\left({}_1^2d\right) = 2.014104u$ (atom)

$m\left({}_1^3T\right) = 3.01609u$ (atom)

The energy released in 1st stage of fusion reaction is

A. 4.033 MeV

B. 17.587 MeV

C. 40.33 MeV

D. 1.7587 MeV

Answer: A

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8. In a nuclear fusion reactor, the reaction occurs in two stages (i) Two deuterium $\left({}_{1}^{2}D\right)$ nuclei fuse to form a tritium $\left({}_{1}^{3}T\right)$ nucleus with a proton as a byproduct. The reaction may be represented as D (D,p) T. (ii) A tritium nucleus fuses with another deuterium nucleus to form a helium $\left({}_{2}^{4}He\right)$ nucleus with a neutron as a byproduct. The reaction is represented as $T(D.\ n)\alpha$. Given that $m\left({}_{1}^{2}d\right) = 2.014104u$ (atom)

$m\left({}_{1}^{3}T\right) = 3.01609u$ (atom)

The energy released in the second stage of fusion reaction

A. 4.033 MeV

B. 17.587 MeV

C. 40.33 MeV

D. 1.7587 MeV

Answer: B

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9. In a nuclear fusion reactor, the reaction occurs in two stages (i) Two deuterium $\left({}_1^2D\right)$ nuclei fuse to form a tritium $\left({}_1^3T\right)$ nucleus with a proton as a byproduct. The reaction may be represented as D (D,p) T. (ii) A tritium nucleus fuses with another deuterium nucleus to form a helium $\left({}_2^4He\right)$ nucleus with a neutron as a byproduct. The reaction is represented as $T(D. n)\alpha$. Given that $m\left({}_1^2d\right) = 2.014104u$ (atom)

$m\left({}_1^3T\right) = 3.01609u$ (atom)

What percentage of the mass energy of the initial deuterium is released?

A. $0.184\ \%$

B. $0.284\ \%$

C. $0.384\ \%$

D. $0.484\ \%$

Answer: D

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10. Consider the following nuclear decay: ${}^{236}_{92}U \rightarrow {}^{232}_{90}Th + X$

What is X?

A. α decay

B. p

C. β^+

D. β^-

Answer: A

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11. Consider the following nuclear decay: ${}^{236}_{92}U \rightarrow {}^{234}_{90}Th + X$

Determine the amount of energy released in this decay. Use the following atomic masses.

${}^{236}_{92} = 236.045562u, {}^{232}_{90}Th = 232.038054u$

${}^{4}_{2}He = 4.002603u, {}^{1}_{0}n = 1.008665u$ and ${}^{1}_{1}p = 1.007277h$

Conversion factors $1u = 931.5meV, 1eV = 1.602 \times 10^{-19}J$

A. 3.5×10^{-8J}

B. $4.6 \times 10^{-12} J$

C. $6.0 \times 10^{-10} J$

D. $7.3 \times 10^{-13} J$

Answer: D

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12. Consider the following nuclear decay: $^{236}_{92}U \rightarrow {}^{234}_{90}Th + X$

If the uranium is at rest before its decay, which one of the following statements is true concerning the final nuclei?

A. They have equal kinetic energies, but he thorium nucleus has much more momentum.

B. They have momenta of equal magnitudes, but the thorium nucleus has much more kinetic energy.

C. They have equal kinetic energies and momenta of equal magnitudes

D. They have momenta of equal magnitudes, but X has much more kinetic energy

Answer: D

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Practice Questions Matrix Match

1. Match the statements in Column I labelled as a,b,c, and d with those in Column II labelled as p,q,r, and s. Any given statement in column I can have correct matching with one or more statements in Column II

Column I	Column II
(a) α-ray	(p) lowest ionizing power
(b) β-ray	(q) lowest ionizing power
(c) β plus ray	(r) high ionizing power
(d) γ-ray	(s) low penetrating power

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2. Symbol Q stands for energy released

Column I	Column II
(a) α-decay	(p) ${}^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + ({}^{1}_{0}n) + Q$
(b) β-decay	(q) ${}^{3}_{1}H + {}^{2}_{1}H \rightarrow {}^{4}_{2}He + Q$
(c) Nuclear fission	(r) ${}^{230}_{90}Th \rightarrow {}^{226}_{88}Ra + {}^{4}_{2}He + Q$
(d) Nuclear fusion	(s) ${}^{137}_{55}Cs \rightarrow {}^{137}_{56}Ba + e^{-} + \bar{v} + Q$

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3. In each question, there is a table having 3 columns and 4 rows. Based on the table, there are 3 questions. Each question has 4 options a,b,c and d ONLY ONE of these four options is correct.

In the given table, Column I shows different types of nuclei, Column II shows their characteristics and Column III shows the example of different types of nuclei.

Column I	Column II	Column III
(I) Atoms of element having same atomic number but different mass number	(i) Atomic number differ by 1	(J) ${}^{1}_{1}H, {}^{2}_{1}H$
(II) Nuclei having equal number of neutrons	(ii) Both the atomic number Z and mass number A are different	(K) ${}^{3}_{1}H, {}^{3}_{2}He$

Column I	Column II	Column III
(III) Nuclei which have the same mass number A but different atomic number Z	(iii) Have the same chemical properties.	(L) ${}^{9}_{4}Be, {}^{10}_{5}B$
(IV) Nuclei having the same mass number A but with the proton number Z and neutron number interchanged	(iv) Have different chemical properties	(M) ${}^{7}_{3}Li, {}^{7}_{4}Be$

Determine the characteristics of isobars.

A. (III) (ii) (L)

B. (III)(iv)(K)

C. (II)(i)(K)

D. (II)(i)(K)

Answer: A::B::C::D

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4. In each question, there is a table having 3 columns and 4 rows. Based on the table, there are 3 questions. Each question has 4 options a,b,c and d ONLY ONE of these four options is correct.

In the given table, Column I shows different types of nuclei, Column II shows their characteristics and Column III shows the example of different types of nuclei.

Column I	Column II	Column III
(I) Atoms of element having same atomic number but different mass number	(i) Atomic number differ by 1	(J) ${}^1_1H, {}^2_1H$
(II) Nuclei having equal number of neutrons	(ii) Both the atomic number Z and mass number A are different	(K) ${}^3_1H, {}^3_2He$

Column I	Column II	Column III
(III) Nuclei which have the same mass number A but different atomic number Z	(iii) Have the same chemical properties	(L) ${}^{9}_{4}Be, {}^{10}_{5}B$
(IV) Nuclei having the same mass number A but with the proton number Z and neutron number interchanged	(iv) Have different chemical properties	(M) ${}^{7}_{3}Li, {}^{7}_{4}Be$

Determine the characteristics of mirror nuclei.

A. (I)(iii)(K)

B. (IV)(iii)(J)

C. (I)(ii)(M)

D. (IV)(i)(M)

Answer: A::B::C::D

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5. In each question, there is a table having 3 columns and 4 rows. Based on the table, there are 3 questions. Each question has 4 options a,b,c and d ONLY ONE of these four options is correct.

In the given table, Column I shows different types of nuclei, Column II shows their characteristics and Column III shows the example of different types of nuclei.

Column I	Column II	Column III
(I) Atoms of element having same atomic number but different mass number	(i) Atomic number differ by 1	(J) ${}^1_1H, {}^2_1H$
(II) Nuclei having equal number of neutrons	(ii) Both the atomic number Z and mass number A are different	(K) ${}^3_1H, {}^3_2He$

Column I	Column II	Column III
(III) Nuclei which have the same mass number *A* but different atomic number *Z*	(iii) Have the same chemical properties.	(L) $^{9}_{4}Be, ^{10}_{5}B$
(IV) Nuclei having the same mass number *A* but with the proton number *Z* and neutron number interchanged	(iv) Have different chemical properties	(M) $^{7}_{3}Li, ^{7}_{4}Be$

Determine the characteristics of isotones.

A. (III)(i)(K)

B. (I)(i)(L)

C. (II)(ii)(L)

D. (I)(ii)(M)

Answer: A::B::C::D

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6. In the given table, column I shows the different types of decays in nuclear fission, collumn II show the change in the element which undergoes decay and Column III shows properties of different types of decays.

Column I	Column II	Column III
(I) Process in which a parent nucleus decays into the daughter nucleus by ejecting helium particle	**(i)** The original element becomes a new chemical element in a process known as nuclear transmutation.	**(J)** The most common form of cluster decay
(II) Process in which a parent nucleus decays into the daughter nucleus by ejecting an electron	**(ii)** It has a charge of + 2e and a mass of 4 u.	**(K)** An electron at the far right of the curve would have the maximum possible kinetic energy, leaving the energy of the neutrino to be only its small rest mass.
(III) The daughter nucleus is left in the excited state. It decays into any other lower state or ground state.	**(iii)** Conserves a quantum number known as the lepton number.	**(L)** Mode of relaxation of many excited states of atomic nuclei
(IV) Process in which a parent nucleus decays into the daughter nucleus by ejecting a neutron	**(iv)** Formation of fluorescent gamma rays	**(M)** The total energy of the decay process is divided between the electron, the antineutrino, and the recoiling nuclide

What are the characteristics of the below nuclear equation?

$$_{Z}^{A}X\text{(mother nucleus)} \rightarrow {}_{Z-2}^{A-4}Y\text{(daughter nucleus)} + {}_{2}^{4}He$$

A. (I)(ii)(J)

B. (IV)(ii)(M)

C. (II)(iv)(K)

D. (I)(ii)(J)

Answer: A::B::C::D

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7. In the given table, column I shows the different types of decays in nuclear fission, collumn II show the change in the element which undergoes decay and Column III shows properties of different types of decays.

Column I	Column II	Column III
(I) Process in which a parent nucleus decays into the daughter nucleus by ejecting helium particle	(i) The original element becomes a new chemical element in a process known as nuclear transmutation.	(J) The most common form of cluster decay
(II) Process in which a parent nucleus decays into the daughter nucleus by ejecting an electron	(ii) It has a charge of + 2e and a mass of 4 u.	(K) An electron at the far right of the curve would have the maximum possible kinetic energy, leaving the energy of the neutrino to be only its small rest mass.
(III) The daughter nucleus is left in the excited state. It decays into any other lower state or ground state.	(iii) Conserves a quantum number known as the lepton number.	(L) Mode of relaxation of many excited states of atomic nuclei
(IV) Process in which a parent nucleus decays into the daughter nucleus by ejecting a neutron	(iv) Formation of fluorescent gamma rays	(M) The total energy of the decay process is divided between the electron, the antineutrino, and the recoiling nuclide

What are the characteristics of the below nuclear equation?

${}_{z}^{A}X$ (mother nucleus) ${}_{Z+1}^{A}Y$ (daughter nucleus)$+{}_{-1}^{0}e$

A. (III)(ii)(J)

B. (II)(iii)(M)

C. (II)(iii)(M)

D. (I)(i)(M)

Answer: A::B::C::D

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8. In the given table, column I shows the different types of decays in nuclear fission, collumn II show the change in the element which undergoes decay and Column III shows properties of different types of decays.

Column I	Column II	Column III
(I) Process in which a parent nucleus decays into the daughter nucleus by ejecting helium particle	(i) The original element becomes a new chemical element in a process known as nuclear transmutation.	(J) The most common form of cluster decay
(II) Process in which a parent nucleus decays into the daughter nucleus by ejecting an electron	(ii) It has a charge of + 2e and a mass of 4 u.	(K) An electron at the far right of the curve would have the maximum possible kinetic energy, leaving the energy of the neutrino to be only its small rest mass.
(III) The daughter nucleus is left in the excited state. It decays into any other lower state or ground state.	(iii) Conserves a quantum number known as the lepton number.	(L) Mode of relaxation of many excited states of atomic nuclei
(IV) Process in which a parent nucleus decays into the daughter nucleus by ejecting a neutron	(iv) Formation of fluorescent gamma rays	(M) The total energy of the decay process is divided between the electron, the antineutrino, and the recoiling nuclide

What are the characteristics of the below nuclear equation?

$_{Z}^{A}X\cdot$ (mother nucleus) $\rightarrow\ _{Z}^{A}Y$ (daughter nucleus) $+hf$

A. (III) (iv)(L)

B. (I)(i)(K)

C. (III)(iii)(J)

D. (I)(ii)(M)

Answer: A::B::C::D

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9. There are different types of radioactive series that radioactivie decay follows. In the given table, Column I shows the end or stable nuclei which any one of the radioactive series produces, Column II shows the mass number of different tpes of ratioactive series and Column III shows different values of n different radioactive sereis.

Column I		Column II		Column III	
(I)	Stable end product ${}^{208}_{82}Pb$	(i)	Mass number $4n+1$	(J)	$n = 51$
(II)	Stable end product ${}^{209}_{83}Bi$	(ii)	Mass number $4n+3$	(K)	$n = 52$
(III)	Stable end product ${}^{206}_{82}Pb$	(iii)	Mass number $4n+2$	(L)	$n = 50$
(IV)	Stable end product ${}_{82}Pb$ ${}^{207}_{82}Pb$	(iv)	Mass number $4n$	(M)	$n = 53$

Determine the characteristics of thorium.

A. (III)(ii)(L)

B. (I)(iv)(K)

C. (II)(i)(M)

D. (II)(i)(K)

Answer: A::B::C::D

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10. There are different types of radioactive series that radioactivie decay follows. In the given table, Column I shows the end or stable nuclei which any one of the radioactive series produces, Column II shows the mass number of different tpes of ratioactive series and Column III shows different values of n different radioactive sereis.

Column I	Column II	Column III
(I) Stable end product $^{208}_{82}Pb$	(i) Mass number $4n+1$	(J) $n = 51$
(II) Stable end product $^{209}_{83}Bi$	(ii) Mass number $4n+3$	(K) $n = 52$
(III) Stable end product $^{206}_{82}Pb$	(iii) Mass number $4n+2$	(L) $n = 50$
(IV) Stable end product $_{82}Pb$ $^{207}_{82}Pb$	(iv) Mass number $4n$	(M) $n = 53$

Determine the characteristics of neptunium.

A. (I)(iii)(K)

B. (IV)(iii)(J)

C. (I)(ii)(M)

D. (II)(i)(K)

Answer: A::B::C::D

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11. There are different types of radioactive series that radioactivie decay follows. In the given table, Column I shows the end or stable nuclei which any one of the radioactive series produces, Column II shows the mass number of different tpes of ratioactive series and Column III shows different values of n different radioactive sereis.

Column I	Column II	Column III
(I) Stable end product $^{208}_{82}Pb$	(i) Mass number $4n + 1$	(J) $n = 51$
(II) Stable end product $^{209}_{83}Bi$	(ii) Mass number $4n + 3$	(K) $n = 52$
(III) Stable end product $^{206}_{82}Pb$	(iii) Mass number $4n + 2$	(L) $n = 50$
(IV) Stable end product $_{82}Pb$ $^{207}_{82}Pb$	(iv) Mass number $4n$	(M) $n = 53$

Determine the characteristics of actinium.

A. (III)(i)(K)

B. (I)(i)(L)

C. (IV)(ii)(J)

D. (I)(iv)(M)

Answer: A::B::C::D

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12. Many side particles are produced when radioactive decay takes place.In the given table, Column I shows the charge of the different side particles, Column II shows the mass and Column III shows the ionization power of these side particles.

Column I	Column II	Column III
(I) Charge: $+2e$	(i) Mass: $4m_p$	(J) Ionization power 100
(II) Charge: $-e$	(ii) Mass: m_e	(K) Ionization power 10000
(III) Charge: $-2e$	(iii) Massless	(L) Ionization power 1
(IV) Charge: 0	(iv) Mass: m_e	(M) Ionization power 1000

What are the characteristics of α- particle?

A. (I)(ii)(J)

B. (IV)(i)(M)

C. (II)(iv)(K)

D. (I)(i)(K)

Answer: A::B::C::D

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13. Many side particles are produced when radioactive decay takes place.In the given table, Column I shows the charge of the different side particles, Column II shows the mass and Column III shows the ionization power of these side particles.

Column I	Column II	Column III
(I) Charge: $+2e$	(i) Mass: $4m_p$	(J) Ionization power 100
(II) Charge: $-e$	(ii) Mass: m_e	(K) Ionization power 10000
(III) Charge: $-2e$	(iii) Massless	(L) Ionization power 1
(IV) Charge: 0	(iv) Mass: m_e	(M) Ionization power 1000

What the characteristics of β- particle?

A. (III)(ii)(J)

B. (II)(iv)(J)

C. (II)(iii)(K)

D. (I)(i)(M)

Answer: A::B::C::D

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14. Many side particles are produced when radioactive decay takes place.In the given table, Column I shows the charge of the different side particles, Column II shows the mass and Column III shows the ionization power of these side particles.

Column I	Column II	Column III
(I) Charge: $+2e$	(i) Mass: $4m_p$	(J) Ionization power 100
(II) Charge: $-e$	(ii) Mass: m_e	(K) Ionization power 10000
(III) Charge: $-2e$	(iii) Massless	(L) Ionization power 1
(IV) Charge: 0	(iv) Mass: m_e	(M) Ionization power 1000

What the characteristics of gamma` - particles?

A. (IV)(iii)(L)

B. (I)(i)(K)

C. (III)(iii)(J)

D. (I)(ii)(M)

Answer: A::B::C::D

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Practice Questions Integer Type

1. A neutron with kinetic energy $K = 10 MeV$ activates an endoergic nuclear reaction $n + {}_{6}^{12}C \rightarrow {}_{4}^{9}Be + {}_{2}^{4}He$. Initially ${}_{6}^{12}C$ was at rest. The threshold energy of this reaction is 6.5 MeV. Find the kinetic energy of the α- particle (in MeV) goingk at right to the direction of the incoming neutron.

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2. Two radioactive substances X and Y initially contain an equal number of atoms. Their half-lives are 1 hour and 2 hours respectively. Then the ratio of their rates of disintergration after two hours is

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3. There are two radioactive substance A and B. Decay consant of B is two times that of A. Initially, both have equal number of nuceli. After n half-lives of A,rates of disintegaration of both are equal. The value of n is

.

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4. 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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5. 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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6. A nuclear power supplying electrical power to a villages uses a radioactive material of half life T year as the fuel . The amount of fuel at the beginning is such that the total power requirement of the village is 12.5% of the electrical power available from the plant at that time. If the plant is able to meet the total power needs of the village for a maximum period of nT years , then the value of n is

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7. ^{131}I is an isotope of Iodine that β- decays to an isotope of xenon with a half life of 8 days. A small amount of a serum labeled with ^{131}I is injected into the blood of a person. The activity of the amount of ^{131}I injected was 2.4×10^5 Becquerel (Bq). It is known that the injected serum will get distributed uniformly in the blood stream in less than half an hour. After

115 hours, 2.5 ml of blood is drawn from the person's body, and gives an activity of 115 Bq. The total volume of blood in the person's body, in liters is approximately (you may use $e^{x} \approx 1 = x$ for $|x| < \; < 1$ and In $2 \approx 0.7$).

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