PHYSICS

FOR IIT JEE ASPIRANTS OF CLASS 12 FOR PHYSICS

NUCLEAR PHYSICS

Solved Example

1. compare the radii of the nuclei of mass numbers 27 and 64.

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2. The radius of the oxygen nucleus $._{8}^{16}O$ is $2.8 \times 10^{-15} m$. Find the radius of lead nucleus $._{82}^{205}Pb$.

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3. Find the binding energy of $._{26}^{56} Fe$. Atomic mass of Fe is $55.93u$ and that of Hydrogen is $1.00783u$ and mass of neutron is $1.00876u$

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4. Find the energy required to split $._{8}^{16} O$ nucleus into for α - particles. The mass of α- particle is $4.002603u$ and that of oxygen is $15.994915u$.

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5. Calculate the binding energy per nucleon of $._{20}^{40} Ca$. Given that mass of $._{20}^{40} Ca$ nucleus $= 39.962589u$, mass of proton $= 1.007825u$. Mass of Neutron $= 1.008665u$ and $1u$ is equivalent to $931 MeV$.

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6. The binding energies per nucleon for deuterium and helium are $1.1 MeV$ and $7.0 MeV$ respectively. What energy in joules will be liberated when 2 deuterons take part in the reaction.

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7. The kinetic energy of α- particles emiited in the decay of $._{88} Ra^{226}$ into $._{86} Rn^{222}$ is measured to be $4.78 MeV$. What is the total disintegration energy or the $'Q'$-value of this process ?

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8. A nucleus X, initially at rest , undergoes alpha dacay according to the equation ,

$\_(92)^{A} X \rightarrow_{Z}^{228} Y + \alpha$

(a) Find the value of A and Z in the above process.

(b) The alpha particle produced in the above process is found to move in a circular track of radius $0.11 m$ in a uniform magnetic field of 3 Tesla find the energy (in MeV) released during the process and the binding energy of the parent nucleus X

Given that : $m(Y) = 228.03u$, $m\left(_(0)^1 n \right) = 1.0029u$.

$m\left(_(2)^4 He \right) = 4.003u$, $m\left(_(1)^1 H \right) = 1.008u$

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9. The nucleus $.^{23} Ne$ deacays 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,$\left(m\left(.^{23}_{11} Ne\right) = 22.994466amu\right.$ and $m\left(.^{23}_{11} Na = 22.989770amu\right.$. Ignore the mass of antineuttino $(\bar{v})$.

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10. Calculate the binding energy of an α-particles. Given that mass of proton $= 1.0073u$, mass of neutron $= 1.0087u$. And mass of α-particle $= 4.0015u$.

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11. How many α and β-particles are emitted when uranium nucleus $(._{92}U^{238})$ decay to $._{82}Pb^{214}$?

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12. A radioactive sample has an activity of $5.13 \times 10^7 Ci$. Express its activity in 'becqueral' and 'rutherford'.

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13. A radioactive substance has 6.0×10^{18} active nuclei initially. What time is required for the active nuclei of the same substance to become 1.0×10^{18} if its half-life is $40s$.

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14. 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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15. Plutonium decays with a half-life of 24000 years. If the plutonium is stored for 72000 years, then the fraction of plutonium that remains is.

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16. A certain substance decays to $1/32$ of its initial activity in 25 days. Calculate its half-life.

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17. The half-life period of a radioactive substance is 20 days. What is the time taken for $7/8th$ of its original mass to disintergrate?

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18. How many disintegrations per second will occur in one gram of $._{92}U^{238}$, if its half life against alpha decay is $1.42 \times 10^{17}s$?

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19. One gram of radium is reduced by 2 miligram in 5 yers by α-decay. Calculate the half-life of radium.

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20. The half life of a radioactive substance is 5×10^{3}yrs. In how many years will its activity decay to 0.2 times its initial activity? Take

$\log_{10} 5 = 0.6990.$

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21. Obtain the amount of $.^{60} Co$ necessary to provide a radioactive source of $8.0 Ci$ strength. The half-life of $.^{60} Co$ is 5.3 years?

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22. An explosion of atomic bomb releases an energy of $7.6 \times 10^{13} J$. If $200 MeV$ energy is released on fission of one $.^{235} U$ atom calculate (i) the number of uranium atoms undergoing fission. (ii) the mass of uranium used in the atom bomb

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23. Calculate the energy released by fission from $2g$ of $.^{235} ._{92} U$ in kWh. Given that the energy released per fission is $200 MeV$.

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24. 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 $1eV = 1.6 \times 10^{-19} J$).

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25. How much $.^{235} U$ is consumed in a day in an atomic powder house operating at $400MW$, provided the whole of mass $.^{235} U$ is converted into energy?

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

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27. Suppose India has a target of producing by $2020AD$, $200, 000MW$ of electric power, ten percent of which was to be obtained from nuclear power plants. Suppose we are given that, on an avedrage, the efficiency of utilization(i.e conversion to electric energy) of thermal energy produced in a reactor was 25% . How much amount of fissionable uranium would our country need per year by 2020? Take the heat energy per fission of $.^{235}U$ to be about $200MeV$.

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28. Calculate the energy released by the fission $1g$ of $.^{235}U$ in joule, given that the energy released per fission is $200MeV$.

(Avogadro's number $= 6.023 \times 10^{23}$)

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29. 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? $(c = 3 \times 10^8 ms^{-1})$.

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30. An electron-positron pair is produced when a γ-ray photon of energy $2.36MeV$ passes close to a heavy nucleus. Find the kinetic energy carried by each particle produced, as well as the total energy with each.

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31. A gamma ray photon of energy $1896MeV$ annihilates to produce a photon-antiproton pair. If the rest mass of each of the particles involved be $1.007276a.m.u$ aapproximately, find how much $K.E$ these will carry?

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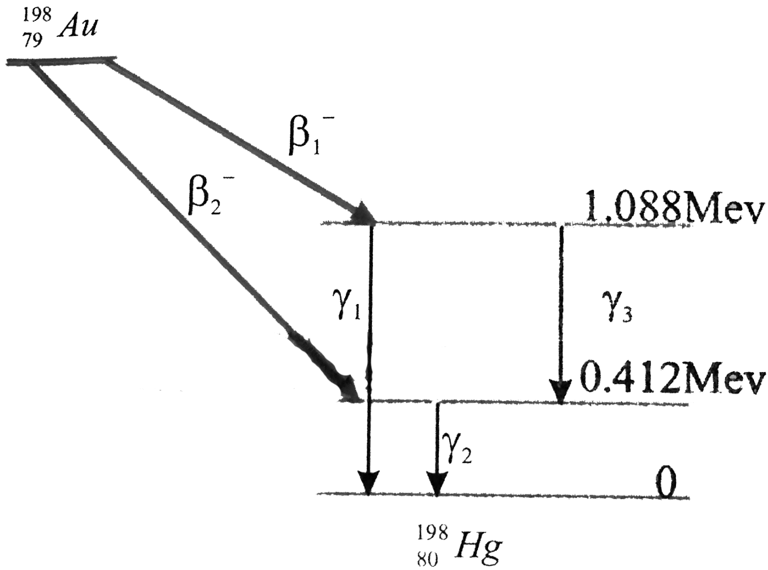
32. Obtain the maximum kinetic energy of β-particles, and the radiation frequencies of γ decays in the decay scheme shown in Fig. 14.6. You are given that $m(.^{198}Au) = 197.968233u$, $m(.^{198}Hg) = 197.966760u$



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C.U.Q

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

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

$B \to C + 2e^{-}$

Then.

A. A and C^2 are isomers

B. A and C are isotopes

C. A and B are isobars

D. A and B are isotopes

Answer: B

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2. The particles which can be added to the nucleus of an atom without changing its chemical properties are

A. electrons

B. protons

C. neutrons

D. positron

Answer: C

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3. The radius of the nuclues is proprtional to, (if A is the atomic mass number)

A. A

B. A^3

C. $A^{1/3}$

D. $A^{2/3}$

Answer: C

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4. The radius of a nucleus mainly depends on

A. Proton number

B. Electron Number

C. Mass number

D. Neutron number

Answer: C

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5. The nuclei $._6 C^{13} \& ._7 N^{14}$ can be described as

A. isotones

B. isobars

C. isomers

D. isotopes

Answer: A

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6. The graph of $1n\left(\frac{R}{R_0}\right)$ versus $1nA(R = radius$ of a nucleus and $A =$ its mass number) is

A. Straight line

B. Parabola

C. Ellipse

D. Circle

Answer: A

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7. The nucleus of $._{56}Ba^{141}$ contains

A. 85 protons, 56 neutrons

B. 55 protons, 86neutrons

C. 56 protons, 85 neutrons

D. 86 protons, 55 neutrons.

Answer: C

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8. The nuclear size is measured in units of

A. Angstrom

B. Fermi

C. Bar

D. Light-year

Answer: B

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9. Nuclides which have the same mass number are called

A. Isotopes

B. isobars

C. Isotones

D. Isomars

Answer: B

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10. Observe the following statements regarding isotones i) $.^{59}K_{19}$ and $.^{40}Ca_{20}$ are isotones

ii) Nuclides having different atomic numbers (z) and mass number (A) but same number of neutrons (n) are called Isotones iii) $.^{19}F_9$ and $.^{23}Na_{11}$ are isotones The correct answer is

A. i, ii and iii are correct

B. only i and ii are correct

C. only I and iii are correct

D. only ii and iii are correct

Answer: B

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11. A and B are isotopes. B and C are isobars. All three are radioactive. Which one of the following is true.

A. A, B and C must belong to the same number

B. A, B and C may belong to the same element

C. It is possible that A will change to B through a radioactive-decay process

D. It is possible that B will change to C through a radioactive decay process

Answer: D

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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. $M = ZM_n + (A - Z)M_p$

C. $M > (A - Z)M_n + ZM_p$

D. $M < (A - Z)M_n + ZM_p$

Answer: D

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13. The difference between the mass of a nucleus and the combined mass of its nucleons is

A. zero

B. positive

C. negative

D. zero,positive or negative

Answer: C

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14. The mass number of a nucleus is.

A. Always less than atomic number

B. Always more than atomic number

C. Equal to atomic number

D. Sometimes more or equal to atomic number

Answer: D

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15. If M is atomic weight, A is mass number then $(M-A)/A$ represents

A. Mass defect

B. Packing fraction

C. Binding Energy

D. Chain Reaction

Answer: B

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16. The difference between mass of the nucleus and total mass of its constituents is called

A. Packing fraction

B. Mass defect

C. Binding Energy

D. Binding energy per neucleon

Answer: B

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17. The parameter used to measure the stability of the nucleus is

A. Average binding energy

B. No of protons

C. No of neutrons

D. No of electrons

Answer: A

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18. When the number of nucleons in a nuclues increases the binding energy per nucleon

A. Increase continuously with mass number

B. Decreases continuosly with mass number

C. Remains constant with mass number

D. First increases and then decreases with increase in mass number

Answer: D

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19. Maximum value of binding energy per nucleon for most stable nuclei is

A. $8MeV$

B. $8.8MeV$

C. $7.6MeV$

D. $1.1MeV$

Answer: B

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20. The binding energy per nucleon is maximum at $A = 56$ and its value is around $\_ MeV / \text{Nculeon}$

A. 8.4

B. 8.7

C. 9

D. 7.8

Answer: B

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21. Average binding energy per nucleon over a wide range is

A. $8MeV$

B. $8.8MeV$

C. $7.6MeV$

D. $1.1MeV$

Answer: A

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22. The wrong statement about the binding energy is

A. It is the sum of the rest mass energies of nucleous minus the rest mass energy of the nucleus.

B. It is the energy released when the nucleons combine to form a nucleus.

C. It is the energy required to break a given nucleus into its constituent nucleons.

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

Answer: D

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23. The binding energies of a deutron and an α-particle are $1.125, 7.2 MeV / \text{nucleon}$ respectively. The more stable of the two, is

A. deutron

B. α-particle

C. both

D. sometimes deutron and sometimes α-particle

Answer: B

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24. Mass defect of an atom refers to

A. inaccurate measurment of mass of neutrons

B. mass annihilated to produce energy to bind the nucleous

C. packing fraction

D. difference in the number of neutrons and protons in the nucleus

Answer: B

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25. The stability of a nucleus can be measured by

A. Average binding energy

B. Packing fraction

C. Ratio of number of neutrons and protons

D. All the above.

Answer: D

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26. In a nuclear reaction some mass converts into energy. In this reaction total $B.E$ of reactants when compared with that of product is

A. always greater

B. always les

C. either greater or less

D. always equal

Answer: D

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27. The age of pottery is determind by archeologists using a radiosotope of

A. carbon

B. cobalt

C. iodine

D. phosphorus

Answer: A

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28. During an artificial transmutation the nucleus emits

A. β-particles

B. α-particle

C. always neutrons

D. may emit protons or neutrons

Answer: D

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29. When two deuterium nuclei fuse together to form a tritium nuclei, we get a

A. neutron

B. deuteron

C. alpha particle

D. proton

Answer: D

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30. Identify the correct statement / statements

a) Radiation causes genetic mutation

b)Restriction is blood circulation can be detected using radio-iodine

c)Hydrocarbon plastics are used as moderators in a nuclear reactor

d)The damage caused due to α-radiation is small due to its small penetrating power

A. a,b,c

B. a,c,d

C. b,c,d

D. a,b,d

Answer: B

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31. Identify the correct ascending order of α, β and γ with reference to their ioninzing power

(I) α-ray (II) γ-ray (III) β-ray

A. II,III,I

B. I,III,II

C. II,I,II

D. I,II,III

Answer: A

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32. Two identical nuclei A and B of the same radioactive element undergo β^- decay. A emits a β^- particle and changes to A'. B emits a β^- particle and then a γ-photon immediately afterwards, and changes to B.

A. A' and B' have the same atomic number and mass number

B. A' and B' have the same atomic number and different mass numbers

C. A' and B' have different atomic numbers but the same mass number

D. A' and B' are isotopes

Answer: A

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33. Identify the correct ascending order of α, β and γ with reference to their ioninzing power

(I) α-ray (II) γ-ray (III) β-ray

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34. 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, α, γ

Answer: C

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35. Decrease in atomic number is observed during

A) α-emission B) β-emission

C) Positron emission D) electron capture

A. B is correct

B. A and B are correct

C. A, C and D are correct

D. Only C

Answer: C

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36. When $._{15}P^{30}$ decays to become $._{14}Si^{30}$, the particle released is

A. electron

B. α-particle

C. neutron

D. positron

Answer: D

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37. During β^{-}-decay, a neutron inside nucleus converts into proton, electron and x. Then the paritcle x is

A. π^{+}-meson

B. neutrons

C. anti-neutrino

D. π^{-}-meson

Answer: C

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38. If a nucleus emits a gamma-ray, its atomic and mass number ____but there will be _____in the energy of the nucleus. Select suitable pair

A. Remain same, increase

B. Remain same,decrease

C. Decrease, increase

D. increase, decrease

Answer: B

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39. In the following nuclear reaction

$\cdot_{13} Al^{27} + \cdot_{2} He^{4} \rightarrow \cdot_{15} P^{30} + X, X$ will be

A. Proton

B. Electron

C. Neutron

D. α-particle

Answer: C

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40. In nuclear reaction $\cdot_{4} Be^{9} + \cdot_{2} He^{4} \rightarrow \cdot_{6} C^{12} + X, X$ will be

A. Proton

B. Electron

C. β-particle

D. α-particle

Answer: B

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41. In nuclear reaction $._4 Be^4 + ._z X^A \rightarrow ._{z+2} Y^{A+3} + R$, R denotes

A. electron

B. positron

C. proton

D. neutron

Answer: A

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42. A positron is emitted by radioactive nucleus of proton no 90. The product nucleus will have proton number

A. 91

B. 90

C. 89

D. 88

Answer: C

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43. $._{13} Al^{27} + \alpha -$ particle $\rightarrow$ neutron $+ 'X'$ then $'X'$ is

A. $._{15} p^{31}$

B. $._{14} Si^{30}$

C. $._{15} p^{30}$

D. $._{15} Si^{30}$

Answer: C

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44. The penentrating powder of beta particle compared to alpha particle is

A. Less

B. More

C. Equal

D. Can be more or less

Answer: B

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45. In a nuclear reactor, heavy water is used as a

A. Constrolling material

B. Moderator

C. Fuel

D. Heat exchanger

Answer: B

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46. The units of radioactivity is

A. Fermi

B. Farad

C. Curie

D. Hertz

Answer: C

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47. The half-life of a radioactive isotope is 3 hours. The value of its disintegration constant is

A. 0.3hour^{-1}

B. 0.693hour^{-1}

C. 0.231hour^{-1}

D. 0.231min^{-1}

Answer: C

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48. $._{92}U^{238} \rightarrow ._{82}Pb^{206} + 8._2^4He$. The number of β particles releaased in this reaction is

A. 6

B. 3

C. 1

D. 10

Answer: A

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49. The activity in any nucleus is measured in

A. Curie

B. Rutherford

C. Both 1 & 2

D. Newton

Answer: C

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50. The α-particle are

A. high energy electrons

B. positively charged hydrogen ions

C. high energy α-radiation

D. doubly positively charged helium nuclei

Answer: D

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51. α-particles carries

A. Mass 1

B. Mass 2

C. Mass 3

D. Mass 4

Answer: D

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52. At a specific instant emission of radioactive compound is deflected in a magnetic field . The compound can emit

(i) electron (ii)protons(iii)He^{2+}(iv) neutrons

The emission at instant can be

A. I,ii,iii

B. I,ii,iii,iv

C. iv

D. ii,iii

Answer: A

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53. The atomic number (A) and mass number (M) of the nuclide formed where three alpha (α) and two (β) particles are emitted from $._{92}^{238}U$

A. $A = 87, M = 233$

B. $A = 86, M = 226$

C. $A = 88, M = 227$

D. $A = 88, M = 226$

Answer: D

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54. Element $._{z}M^{A}$ emits one α (alpha) particle followed by two β(beta) particles. Among the following the daughter element is

A. $._{z-2}M^{A-4}$

B. $._{z-2}M^{A}$

C. $._{z}M^{A-4}$

D. $\cdot_{z+2} M^{a-4}$

Answer: C

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55. The particles which can be added to the nucleus of an atom without changing its chemical properties are

A. Neutrons

B. Electrons

C. Protons

D. Alpha Particles

Answer: A

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56. An Electric field can deflect

A. α-particles

B. X-rays

C. Neutrons

D. γ-rays

Answer: A

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57. On the bombardment of Boron with neutron. α-particle is emitted and product nucleus formed is......

A. $._6 C^{12}$

B. $._2 Li^6$

C. $._3 Li^8$

D. $._4 Be^9$

Answer: C

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58. The one has maximum activity

A. Uranium

B. Plutonium

C. Radium

D. Thorium

Answer: C

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59. Among the following one statement is not correct when a junction diode is forward bias

A. Electrons

B. β-rays

C. Positron

D. protons

Answer: D

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60. When $._{90}Th^{228}$ transforms to $._{83}Bi^{212}$, then the number of the emitted $\alpha-$ and $\beta-$ particle is, respectively.

A. $4\alpha, 7\beta$

B. $4\alpha, 1\beta$

C. 4α

D. 7β

Answer: C

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61. The reciprocal of radioactive decay constant is called

A. Half life peroid

B. Whole life period

C. Average life period

D. Avagadro number

Answer: C

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62. The missing particle in the reaction $._1^1 p \rightarrow \qquad + ._{-1}^{0} e$

A. deuteron

B. proton

C. neutron

D. β-particle

Answer: C

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63. In the Radioactive transformation

$R \xrightarrow{\alpha} X \xrightarrow{\beta} Y \xrightarrow{\beta} Z$, the nucllii R and Z are

A. Isotopes

B. isobars

C. isomers

D. Isotones

Answer: A

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64. In the reaction $._{15}P^{30} \rightarrow ._{14}Si^{30}$, The change requires the emission of

A. α-particles

B. β-particles

C. neutron

D. positron

Answer: D

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65. When a radioactive substances is subjected to a vacuum, the rate of disintergration per second

A. increases considerably

B. is not affected

C. increases only if the products are gases

D. suffers a slight decrease

Answer: B

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66. A radioactive nuclide can decay simultaneously by two different processes which have decay constants λ_1 and λ_2. The effective decay constant of the nuclides is λ.

A. $\lambda = \lambda_1 + \lambda_2$

B. $\lambda = \frac{1}{2}(\lambda_1 + \lambda_2)$

C. $\frac{1}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$

D. $\lambda = \sqrt{\lambda_1 \lambda_2}$

Answer: A

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67. A sample of radioactive material is used to provide desired doses of radiation for medical purposes. The total time for which the sample can be used will depend

A. only on the number of times radiation is drawn form it

B. only on the intensity of doses drawn from it

C. on both (a) and (b)

D. neither on (a) and (b)

Answer: D

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68. 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. May be (a), (b) or (c) depending on the values of the mean life and half-life.

Answer: A

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69. The short range attractive nuclear forces that are responsible for the binding of nucleons in a nucleus ae supposed to be caused by the role played by the particles called

A. Positron

B. m-Meson

C. K-Meson

D. π-Meson

Answer: D

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70. The strong interaction exists in

A. Gravitational forces

B. Elcetrostatic force of attraction

C. Nuclear forces

D. Magnetic force on a moving charge

Answer: C

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71. Nuclear forces are.

A. Non-central forces

B. saturated

C. Spin dependent

D. All of the above

Answer: D

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72. Identify the correct statement / statements

a) At greater distances nuclear forces are negligible

b) Nuclear forces are non central forces

c) Nuclear forces are weakest in nature

d)Nuclear forces are charge dependent forces

A. a,b

B. b,c

C. c,d

D. a,d

Answer: A

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73. Which of the following is not correct about nuclear forces?

A. They are short range attractive forces

B. They are changes to repulsion at very close distance

C. They change to repulsion at very close distance

D. They obey inverse square law

Answer: D

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74. Among the following, short ranges, charge independent and spin dependent forces are

A. Gravitational forces

B. Nuclear forces

C. Electromagntic forces

D. Weak forces

Answer: B

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75. Let F_pp, F_pn and $F_{\cap}$ denote the magnitudes of the nuclear force by a proton on a proton, by a proton on a neutron and by a neutron on a neutron respectively. When the separation is $1fm$,

A. $F_{pp} > F_{pn} = F_{nn}$

B. $F_{pp} = F_{pn} = F_{nn}$

C. $F_{pp} > F_{pn} > F_{nn}$

D. $F_{pp} < F_{pn} = F_{nn}$

Answer: B

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76. Two protons are kept at a separation of $10nm$. Let F_n and F_e be the nuclear force and the electromagnetic force between them.

A. $F_e = F_n$

B. $F_e > > F_n$

C. $F_e < < F_n$

D. $F_n = 3F_e$

Answer: C

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77. 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: D

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78. Two protons attract each other when

A. the distance between them is $10^{-10}m$

B. the distance between them is $10^{-1}m$

C. the distance between them is $10^{-15}m$

D. the distance between them is $10^{-6}m$

Answer: C

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79. Among gravitational, electrostatic and nuclear forces, the two attractive forces between two neutrons are

A. Electrostatic and nuclear

B. Electrostatic and gravitational

C. Gravitational and nuclear

D. Electrostatic

Answer: C

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80. Among the following interactions one is of least significant in nuclear physics is

A. nuclear interaction

B. gravitational interaction

C. electrostatic interaction

D. electromagnetic interaction

Answer: B

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81. The origin of nuclear force between nucleons is due to the exchange of

A. Mesons

B. Photons

C. Positrons

D. Electrons

Answer: A

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82. Which of the following is most unstable ?

A. Neutron

B. Proton

C. Electron

D. α-particle

Answer: A

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

A. a proton, an electron and an anti-neutron

B. a proton, an electron and a neutrino

C. a proton and electron

D. a proton, an electron, a neutrino an anti-neutrino

Answer: A

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84. Neutron was discovered by the experiment of

A. Artificial transmutation of $\left(._4 Be^9\right)$ by α-particles

B. Artificial transmutation of$\left(._7 N^{11}\right)$ by α-particles

C. Rutherford scattering of alpha particles by heavy nuclei

D. Beqerel with radio activity

Answer: A

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85. The average life of an isolated neutrons is

A. $1500s$

B. $1000s$

C. $1200s$

D. 3 minutes

Answer: B

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86. The energy of thermal neutrons is

A. $< 1eV$

B. $> 1eV$

C. $= 2Mev$

D. $= 4MeV$

Answer: A

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87. A nucleus with an excess of neutrons may decay with the emission of

A. a neutron

B. a proton

C. an electron

D. a positron

Answer: C

Watch Video Solution

88. The most penetrating atom smashing particles is

A. neutron

B. proton

C. alpha particle

D. deuteron

Answer: A

Watch Video Solution

89. Which of the follwing is formed by decay of a free neutron?

A. A number of electrons

B. Two protons

C. a proton and an electron

D. An α-particle

Answer: C

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90. In neutron discovery experiment, Be is bombarded with

A. Protons

B. Alpha particles

C. Neutrons

D. Deutrons

Answer: B

Watch Video Solution

91. Slow neutron are sometimes refer to as thermal neutrons because

A. they are short heart radiations

B. they are in thermal equilibrium

C. they are capable of generating heat

D. their energies are of same order as that of molecule enrgies at ambient temperatures.

Answer: D

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92. Thermal neutrons are

A. prompt neutrons

B. Slow neutrons

C. Neutrons which are in the nucleus

D. Neutrons from the sun

Answer: B

Watch Video Solution

93. In neutron discovery experiment,Be is bombarded with

A. Proton

B. Deutrons

C. α-particle

D. β-particle

Answer: C

Watch Video Solution

94. The process of producing a new stable nucleus from the other stable nucleus is called

A. Nuclear reaction

B. Artificial transmutation

C. Nuclear fusion

D. Nuclear fission

Answer: B

Watch Video Solution

95. At least how many thermal neutrons should be available to strat a fission reaction

A. 2

B. 3

C. 1

D. 4

Answer: C

Watch Video Solution

96. Which of the following changes in the artificial transmutation of elements?

A. number of neutrons

B. number of electrons

C. atomic weight

D. nucleus

Answer: D

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97. During the fission process of Uranium, the amount of energy liberated per fission is nearly

A. $100MeV$

B. $200MeV$

C. $150MeV$

D. $300MeV$

Answer: B

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98. The number of neutrons that are released on an average during the fission of U^{235} nucleus is

A. 3

B. 1

C. 2.5

D. 5

Answer: C

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99. Nuclear fission can be explained by

A. Optical model of the nucleus

B. Shell model of nucleus

C. Collective model of the nucleus

D. Liquid drop model of the nucleus

Answer: D

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100. Percentage of mass lost during the fission of $._{92} U^{235}$ approximately is

A. 0.01%

B. 0.1%

C. 0.7%

D. 0.9%

Answer: B

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101. Most of energy released in the fission is carried by

A. neutrons

B. fission fragments

C. neutrons and fragments carry equally

D. positrons

Answer: B

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102. Regarding Prompt neutrons

A. They are highly energetic

B. They constitute 99%

C. Cannot initiate chain reaction

D. $1, 2, 3$ are correct

Answer: D

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103. Nuclear reactios obey the law of conservation of

A. Mass and energy

B. Charge

C. Momentum

D. All of the above

Answer: D

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104. The critical mass of a fissionable material is

A. $0.1kg$ equivalent

B. The minimum mass needed for chain reaction

C. The rest mass equivalent to 1020 joule

D. $0.5kg$

Answer: B

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105. For fast chain reaction, the size of U^{235} block, as compared to its critical size, must be

A. greater

B. smaller

C. same

D. anything

Answer: A

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106. The critical mass of a fissionable uranium -235 can be reduced by

A. adding impurities

B. heating material

C. surrounding it by a neutron-reflecting material

D. surrounding it by a neutron-absorbing material

Answer: C

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107. Nuclear energy is released in fission since binding energy per nucleon is

A. smaller for fission fragments than for parent nucleus

B. the same for fission fragments and parent nucleus

C. larger for fission fragements than for parent nucleus

D. sometimes large and sometimes smaller

Answer: C

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108. In a critical chain reaction

A. energy is released at increasing are

B. energy is released at steady rate

C. energy is released at decreasing rate

D. energy is not released

Answer: B

Watch Video Solution

109. Among the following one is wrong

A. The energy of thermal neutrons is about $25meV$

B. In a nuclear reaction, when neutrons multiplication factor, $K = 1$ then the reaction is said to be critical

C. $._{92}U^{235}$ undergoes fission by bombardment of high energy neutron

D. On average 2.5 neutrons are emitted per fission of $._{92}U^{235}$

Answer: C

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110. When $1gm$ of U^{235} is completely annihilated energy liberated is E_1 and when $1gm$ of U^{235} completely undergoes fission the energy liberated is E_2, then

A. $E_1 > E_2$

B. $E_1 = E_2$

C. $E_1 < E_2$

D. $E_1 \leq E_2$

Answer: A

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111. In the process of fission, the binding energy per nucleon

A. Increases

B. Decreases

C. Remains unchanged

D. Increases for mass number $A < 56$ nuclei but decreases for mass number $A > 56$

Answer: A

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112. Assertion (A) : Fragments produced in the fission of U^{235} are radioactive.

Reason (R) : The fragments have abnormally high proton to neutron ratio

A. Both A and R are true and R is correct explanation of A

B. Both A and R are true and R is not correct explanation of A

C. A is true but R is false

D. A is false but R is true.

Answer: C

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113. The product of the fission of U^{235} by thermal neutron are

A. Ba^{141} and Kr^{92} and 3 neutron always

B. Xe^{140}, Sr^{94} and 2_0n^1 always

C. can be different in each fission

D. should have same mass number

Answer: C

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114. Consider the following statements A and B. Identify for correct in the given answer.

A) $p-n, p-p, n-n$ forces between nucleons are not equal and charge dependent.

B) In nuclear reactor the fission reaction will be in accelerating state if the value of neutron reproduction factor $K > 1$

A. Both A and B are correct

B. Both A and B are wrong

C. A is wrong B is correct

D. A is correct B is wrong

Answer: C

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115. The process of fission is responsible for the release of energy in

A. The hydrogen bomb

B. The atom bomb

C. The sun

D. The star

Answer: B

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116. The working principle in atom bomb is

A. under-critical chain reaction

B. Critical chain reaction

C. super-critical chain reaction

D. All the above.

Answer: C

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117. Heavy water is

A. Water at $4^{\circ} C$

B. Watercontaining various salts

C. Compound of heavy oxygen and hydrogen

D. Compound of oxgen and deuterium.

Answer: D

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118. Nuclear reactor is surrounded by concrete walls to

A. Strength the construction

B. Control the chain reaction

C. from a protective shield

D. as moderator

Answer: C

Watch Video Solution

119. The operation of a nuclear reactor is said to be critical, if the multiplication factor (k) has a value

A. 1

B. 1.5

C. 2.1

D. 2.5

Answer: A

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120. Cadmium and Broron rods are used in a nuclear reactor to

A. Slow down the nuetorns

B. Absorb excess number of thermal neutrons

C. speed up neutrons

D. absorb fast neutrons

Answer: B

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121. The coolant in the nuclear reactor is

A. Liquid sodium

B. cadmium

C. Deuterium

D. Liquid hydrogen

Answer: A

Watch Video Solution

122. Substance used to slow down the fast neutrons released during nuclear fission is called?

A. Fuel

B. Moderator

C. Controlling rods

D. Reflecting rods

Answer: B

Watch Video Solution

123. If the neutrons reproduction factor K is

a) greater than 1 the fission rection is accelerated b)less than 1 the fission reaction retards

c) equal to 1 the fission reaction is at steady state

A. onlu a, b are ture

B. only b, c are true

C. only a, c are true

D. only a, b, c true

Answer: D

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124. Ustable fission fragments decay by emitting neutrons and electrons, neutrons so emitted are called

A. prompt neutrons

B. delayed neutons

C. stray neutrons

D. sustained neutrons

Answer: B

Watch Video Solution

125. Chain reaction can be initiated by

A. promt neutrons

B. delayed neutons

C. slowed prompt neutrons

D. 2 or 3

Answer: D

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126. The man-made element which was made in the nuclear reactor is

A. polonium

B. Plutonium

C. thorium

D. uranium

Answer: B

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127. In a fast breeder factor, the main charm is that the nuclear ash is that it is

A. more fissile than parent fuel

B. not dangerous as a potential pollutant

C. easily disposed off

D. stable in terms of further decay

Answer: A

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128. If $'X'gm$ of a nuclear fuel of mass number A undergoes fission inside a reactor then the number of fissions will be (N-Avagadro number)

A. NA/x

B. NAx

C. Nx/A

D. Ax/N

Answer: C

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129. The reactor which produces power due to fission by fast neutron and at the same time regenerates more fissionable material than it consumes is

A. Thermal reactor

B. Breeder reactor

C. Both the above

D. Neither $1 \& 2$

Answer: B

Watch Video Solution

130. The reactor in which the number of fissionable nuclides produced are more than the used it called

A. breeder reactor

B. Pressurised reactor

C. Heterogenous reactor

D. Homogenerous reactor

Answer: A

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131. A good moderator should

A. be a gas

B. have appetite for neutrons

C. be lighter in mass number

D. heavier in mass number

Answer: C

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132. Who designed the atomic reactor ?

A. Wilson

B. Fermi

C. Rutherford

D. Teller

Answer: B

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133. In nuclear reactions, we have the conservation of

A. mass number and energy

B. mass number and charge number

C. charge number and mass

D. mass number, charge number and energy

Answer: D

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134. (A) Fission is a thermonuclear process

(B) Fusion is exothermic

(C) Fusion is exothermic

(D) Fission is exothermic

A. A and B are correct

B. B and C are correct

C. A and C are correct

D. B, C and are correct

Answer: D

Watch Video Solution

135. Consider the following statements A and B. Identify for correct in the given answer.

A) $p-n, p-p, n-n$ forces between nucleons are not equal and charge dependent.

B) In nuclear reactor the fission reaction will be in accelerating state if the value of neutron reproduction factor $K > 1$

A. Both A and B are correct

B. Both A and B are wrong

C. A is wrong B is correct

D. A is correct B is wrong

Answer: C

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136. A chain reaction in fission of Uranium is possible because

A. Large amount of energy is released

B. Two intermediate size nuclear fragments are formed

C. More than one neutron is given out in each fission

D. Fragments in fission are radioactive

Answer: C

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137. A slow neutron can cause fission in

A. U^{238}

B. U^{235}

C. Pb^{206}

D. Sr^{90}

Answer: B

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138. Heavy water is used as moderator in a nuclear reactor. The function of the moderator is

A. To slow down the neutrons to thermal energies

B. To control the energy released in the reactor

C. To cool the reactor faster

D. To absorb neutrons and stop chain reaction

Answer: A

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139. To control fission process of the reactor, the following material is used ______

A. Graphite

B. cadmium

C. Gold

D. uranium

Answer: B

Watch Video Solution

140. Nuclear fission is caused by

A. fast protons

B. fast neutrons

C. Slow protons

D. slow neutrons

Answer: D

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141. The liquid drop model of nucleus was proposed by

A. Bohr,Wheeler

B. Fermi

C. Rutherford

D. Chadwick

Answer: A

Watch Video Solution

142. Cadmium and Broron rods are used in a nuclear reactor to

A. Fuel

B. Moderator

C. Control Rods

D. None

Answer: C

Watch Video Solution

143. The material used to slow neutrons in a reactor is called

A. Controlrod

B. Moderator

C. Fuel

D. Heat exchanger

Answer: B

Watch Video Solution

144. Atomic mass of the most useful material for fusion reaction is

A. 1

B. 4

C. 235

D. 292

Answer: A

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145. Average $K.E$ of thermal neutron is of the order of (in KeV)

A. 3.0

B. 0.03

C. 0.3

D. 0.003

Answer: B

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146. Inside the sum

A. Four nuclei of hydrogen combine to form two nuclei of helium

B. Four nuclei of hydrogen combine to form four nuclei of helium

C. Four nuclei of hydrogen combine to form one nucleus of helium

D. Four nuclei of hydrogen is transformed into one nucleus of helium

Answer: C

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147. As the age of star increases

A. Helium quantity increases

B. Helium quantitiy decreases

C. Helium quantity does not change

D. Helium, Hydrogen both quantities increases

Answer: A

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148. In the carbon cycle of nuclear fussion carbon acts like a

A. Moderator

B. Activator

C. Catalyst

D. Controller

Answer: C

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149. In a fusion process a proton and neutron combine to give a deuterium nucleus. If m_o and m_p be the mass of neutron and proton respectively the mass of deuterium nucleus is

A. equal to $m_o + m_p$

B. more than $m_o + m_p$

C. less than $m_o + m_p$

D. can be less than or more than $(m_o + m_p)$

Answer: C

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150. The binding energies of the atom of elements P and Q are E_P and E_Q respectively. There atoms of element Q fuse on atom of element P. The correct relation between E_P, E_Q and e will be

A. $E_Q = 3E_P + e$

B. $E_Q = 3E_P - e$

C. $E_P = 3E_Q + e$

D. $E_P = 3E_Q - e$

Answer: C

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151. The $\frac{B.E}{A}$ for deutron and an α-particle are X_1 and X_2 respectively. The energy released α-particle is

A. $4(X_2 - X_1)$

B. $2(X_2 - X_1)$

C. $4(X_2 + X_1)$

D. $\frac{X_2 - X_1}{4}$

Answer: A

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152. If Q_1 and Q_2 are the energies released in the fusion of hydrogen in Carbon-nitrogen cycle and proton-proton cycle respectively then cycle repespectively then

A. $Q_1 > Q_2$

B. $Q_1 = Q_2$

C. $Q_1 < Q_2$

D. $Q_1 > Q_2$

Answer: B

Watch Video Solution

153. Fusion reaction is initiated with the help of

A. low temperature

B. high temperature

C. neutrons

D. any particle

Answer: B

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154. In an exo-ergic reaction the binding energies of reactants and products are E_1, E_2 respectively then

A. $E_1 < E_2$

B. $E_1 = E_2$

C. $E_1 > E_2$

D. $E_1 \geq E_2$

Answer: A

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155. In an endo-ergic reaction the binding energies of reactants and products are E_1, E_2 respectively

A. $E_1 < E_2$

B. $E_1 = E_2$

C. $E_1 > E_2$

D. $E_1 > E_2$

Answer: C

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156. Among the following reactions which is impossible

A. $._2 He^4 + ._4 Be^9 = ._0 n^1 + ._6 C^{12}$

B. $._2 He^4 + N^{14} = ._1 H^1 + ._8 O^{17}$

C. $4(._1 H^1) = ._2 He^4 + 2(._1 e^0)$

D. $._3 Li^7 + ._1 H^1 = ._4 Be^8$

Answer: C

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157. If the nuclei of masess X and Y are fused together to form a nucleus of mass m and some energy is released, then

A. $X+Y=m$

B. $X+Y<m$

C. $X+Y>m$

D. $X-Y=m$

Answer: C

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158. Fusion reactions take place at about

A. 3×10^2K

B. 3×10^3K

C. 3×10^4K

D. 3×10^6K

Answer: D

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159. The percentage of mass lost during nuclear fusion is

A. 0.1%

B. 0.4%

C. 0.5%

D. 0.65%

Answer: D

Watch Video Solution

160. Fusion reaction takes place at high temperature because

A. All nuclear reactions absorb heat

B. The particles cannot together unless they are moving rapidly

C. The binding energy must be supplied from an external source

D. The mass defect must be supplied

Answer: B

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161. Among the following true option is

A. Energy released per nucleon is same in both fission and fusion reactions

B. Energy released per nucleon is more in fission than in fusion reaction

C. Energy released per nucleon is less in fission than in fusion reaction

D. No energy is released in fusion reaction

Answer: C

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162. Fusion reaction takes place at high temperature because

A. atoms are ionized at high temperature

B. molecules break up at high temperature

C. nuclei break up at high temperature

D. Kinetic energy is high enough to overcome repulsion between nuclei

Answer: D

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163. In the carbon cycle from which stars hotter than the sun obtain their energy the $._6 C^{12}$ isotope

A. splits up into three alpha particles

B. fuses with another $._{6}C^{12}$ nucleons to from $._{12}Mg^{24}$

C. is completely converted into energy

D. is regenerated at the end of the cycle

Answer: D

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164. Source of solar energy can be said to be due to natural fusion in which hydrogen gets converted into helium with carbon serving as a natural catalyst. This carbon cycle was proposed by

A. Bethe

B. Yukawa

C. Fermi

D. Soddy

Answer: A

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165. In carbon-Nitrogen fusion cycle, protons are fused to from a helium nucleus, positrons and release some energy. The number of protons fused and the number of positrons released in this process respectively are

A. $4, 4$

B. $4, 2$

C. $2, 4$

D. $4, 6$

Answer: B

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166. Nuclear fission and fusion can be explained on the basis of _______

A. Einstein theory of relativity

B. Einstein specific heat equation

C. Einstein mass -energy relation

D. Einstein photo electric equation

Answer: C

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167. Energy in the sun is due to

A. Fossil fuels

B. Radioactivity

C. Fission

D. Fusion

Answer: D

Watch Video Solution

168. The overall process of carbon nitrogen fusion cycle results in the fission of 4 protons to yield helium nucleus and____

A. Positron

B. two electrons

C. two positrons

D. An electron

Answer: A

Watch Video Solution

169. The nucleus finally formed in fusion of protons in proton-proton cycle is that of

A. Heavy hydrogen

B. Carbon

C. Helium

D. Lithium

Answer: C

Watch Video Solution

170. The equation

$4H^+ \rightarrow_2^4 He^{2+} + 2e \overline{+} 26MeV represents$

A. Fusion

B. Fission

C. b-decay

D. g-decay

Answer: A

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171. The source of steller energy is____ process

A. Nuclear fission

B. Nuclear fussion

C. Nuclear fission & fusion

D. Nuclear decay

Answer: B

Watch Video Solution

172. Fusion reaction takes place at high temperature because

A. atoms are ionized at high temperature

B. molecules break up at high temperature

C. nuclei break up at high temperature

D. Kinetic energy is high enough to overcome repulsion between nuclei

Answer: D

Watch Video Solution

173. In the carbon cycle from which stars hotter than the sun obtain their energy the $._6 C^{12}$ isotope

A. slpits into three alpha particles

B. fuse with another $._6 C^{12}$ nucleus to form $._{12} Mg^{24}$

C. is completely converted into energy

D. is regenerated at the end of the cycle

Answer: D

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174. The phenomenon of pair production is the

A. The production of an electron and a positron from γ radiations

B. Ejection of an electron from a metal surface when exposed to ultaviolet light

C. Ejection of an electron from a nucleus

D. Ionization of a neutral atom

Answer: A

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175. When the particle and its antiparticle unite, the result is

A. a heavier particle

B. two or more smaller particles

C. photons

D. partly matter and partly photons.

Answer: C

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176. Particles and their antiparticles have

A. The same masses but opposite spins

B. The same masses but opposite magnetic moment

C. The same maasses and same magnetic moment

D. Opposite spins and same magnetic moment

Answer: B

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177. To produce an electron-position pair, the minimum energy of γ-ray photon must be

A. 0.15

B. 1

C. 1.02

D. 1.5

Answer: C

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178. The rest mass energy of electron or positron is (in MeV)

A. 0.51

B. 1

C. 1.02

D. 1.5

Answer: A

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179. A positron and an electron come close together to give a neutral one called

A. Electronium

B. Positronium

C. γ-photon

D. β-particle

Answer: C

Watch Video Solution

180. Positronium is converted into

A. 2 Photons each of energy $0.51 MeV$

B. Photon of energy $1.02 MeV$

C. 2 Photons each of energy $1.02 MeV$

D. One photon of energy $0.51 MeV$

Answer: A

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181. In pair annihiliation two γ-ray photons are produced it is due to

A. Law of conservation of energy

B. Law of conservation of mass

C. Law of conservation of momentum

D. Law of conservation of angular momentum

Answer: C

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182. In pair annihiliation the least number of γ-ray photons produced is

A. 2

B. 3

C. 4

D. 1

Answer: A

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183. The number of protons, electrons and neutrons in the nucleus of $_{13}Al^{27}$ is

A. 13, 13, 14

B. 13, 0, 14

C. 14, 14, 13

D. 14, 0, 13

Answer: B

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184. $._{19}^{39}K$ and $._{20}^{40}Ca$ are

A. Isotopes

B. isobars

C. Isotones

D. Isodiaphers

Answer: C

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185. K^{40}, Ar^{40}, Ca^{40} are

A. Isobars

B. Isotopes

C. Isotones

D. Isogonals

Answer: A

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186. Of the following atoms

$._6 C^{14}, ._7 N^{13}, ._{88} Ra^{236}, ._7 N^{14}, ._8 O^{16}$ and $._{86} Rn^{232}$ a pair of isobars is:

A. $._6 C^{11}, ._7 N^{13}$

B. $._7 N^{13}, ._7 N^{14}$

C. $._6 C^{14}, ._7 N^{14}$

D. $._6 C^{14}, ._8 O^{16}$

Answer: C

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187. Of the following pair of isotones is

A. $._{6}C^{11}, ._{7}N^{13}$

B. $._{7}N^{13}, ._{7}N^{14}$

C. $._{6}C^{14}, ._{7}N^{14}$

D. $._{6}C^{14}, ._{8}O^{16}$

Answer: D

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188. A pair of isotopes is

A. $._{6}C^{11}, ._{7}N^{13}$

B. $._{7}N^{13}, ._{7}N^{14}$

C. $._{6}C^{14}, ._{7}N^{14}$

D. $._{6}C^{14}, ._{8}O^{16}$

Answer: B

Watch Video Solution

189. Of the following a pair of of isodiaphers is

A. $._{88} Ra^{236}, ._{86} Ra^{232}$

B. $._{7} N^{13}, ._{7} N^{14}$

C. $._{6} C^{14}, ._{7} N^{14}$

D. $._{6} C^{14}, ._{8} O^{16}$

Answer: A

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190. (A): Free Neutron decays into proton, electron, and antinuetrino

(R): Neutron is unstable outide the nucleus

A. A and R are true and R is the correct explanation of A

B. A and R are true and R is not the correct explanation of A

C. A is true, R is false

D. A is false but R is true.

Answer: A

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191. (A): Nuclear forces arise from strong coulombic interactions between protons and neutrons

(R): Nuclear force are independent of charge of the nucleons

A. A and R are true and R is the correct explanation of A

B. A and R are true and R is not the correct explanation of A

C. A is true, R is false

D. A is false but R is true.

Answer: D

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Level-1 (C.W)

1. The desity of a nucleus in which mass of each nucleon is $1.67 \times 10^{-27} kg$ and $R_0 = 1.4 \times 10^{-15} m$ is

A. $1.453 \times 10^{17} kg/m^3$

B. $1.453 \times 10^{16} kg/m^3$

C. $1.453 \times 10^{21} kg/m^3$

D. $1.453 \times 10^{10} kg/m^3$

Answer: A

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2. r_1 and r_2 are the radii of atomic nuclei of mass numbers 64 and 27 repsectively. The ratio (r_1/r_2) is

A. $64/27$

B. $27/64$

C. $4/3$

D. 1

Answer: C

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3. The mass number of a nucleus is 216. The size of an atom without changing its chemical properties are called

A. $7.2 \times 10^{-13} cm$

B. $7.2 \times 10^{-11} cm$

C. $7.2 \times 10^{-10} cm$

D. $3.6 \times 10^{-11} cm$

Answer: A

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4. Energy released as mass of 2amu is converted into energy is

A. $1.5 \times 10^{-10} J$

B. $3 \times 10^{-10} J$

C. $1863 J$

D. $931.5 MeV$

Answer: B

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5. A $1 MeV$ positron encounters a $1 MeV$ electron travelling in opposite direction. The total energy released is (In MeV)

A. 2

B. 3.02

C. 1.02

D. 2.04

Answer: B

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6. The binding energies of the atom of elements P and Q are E_P and E_Q respectively. There atoms of element Q fuse on atom of element P. The correct relation between E_P, E_Q and e will be

A. $E_1 - 3E_b = Q$

B. $3E_b - E_1 = Q$

C. $E_1 + 3E_b = Q$

D. $E_b + 3E_b = Q$

Answer: A

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7. The binding energies per nucleon for deuterium and helium are $1.1MeV$ and $7.0MeV$ respectively. What energy in joules will be liberated when 2 deuterons take part in the reaction.

A. $18.88 \times 10^{-3}J$

B. $18.88 \times 10^{-5}J$

C. $18.88 \times 10^{-7}J$

D. $18.88 \times 10^{-10}J$

Answer: C

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8. $1kg$ of iron (specific heat $120CalKg^{-1}C^{-1}$) is heated by $1000^{\circ}C$. The increases in its mass is

A. zero

B. $5.6 \times 10^{-8}Kg$

C. $5.6 \times 10^{-16} Kg$

D. $5.6 \times 10^{-12} Kg$

Answer: D

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9. In nuclear fission , 0.1% mass in converted into energy. The energy released in the fission of $1 Kg$ mass is

A. $2.5 \times 10^{5} KWH$

B. $2.5 \times 10^{7} KWH$

C. $2.5 \times 10^{9} KWH$

D. $2.5 \times 10^{-7} KWH$

Answer: B

Watch Video Solution

10. After emission of one α particle followed by one β-particle from $_{92}^{238}X$, the number of neutrons in the atom will be

A. 140

B. 142

C. 144

D. 146

Answer: B

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11. 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. $56, 23$

B. $180, 72$

C. $120, 52$

D. $84, 38$

Answer: B

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12. An atomic nucleus $._{90}Th^{232}$ emits several α and β radiations and finally reduces to $._{82}Pb^{208}$. It must have emitted.

A. $6, 4$

B. $4, 6$

C. $8, 6$

D. $6, 8$

Answer: A

Watch Video Solution

13. The decay constant of a radio active element, which disintergrates to $10gms$ from $20gms$ in 10 minutes is

A. $0.693_{\min^{-1}}$

B. $6.93_{\min^{-1}}$

C. $0.693_{\sec^{-1}}$

D. $0.0693_{\min^{-1}}$

Answer: D

Watch Video Solution

14. Half life period of radium is 1600 years. $2gm$ of radium undergoes decay and gets reduced to $0.125gms$ in

A. 3200 years

B. 25600 years

C. 8000 years

D. 6400 years

Answer: D

Watch Video Solution

15. After a certain lapse of time, fraction of radioactive polonium undecayed is found to be 12.5% of the initial quantity. What is the duration of this time lapsed if the half life of polonium is 138 days ?

A. 414 days

B. 407 days

C. 421 days

D. 410 days

Answer: A

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16. 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

A. $1:1$

B. $2:1$

C. $1:2$

D. $2:3$

Answer: C

Watch Video Solution

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

A. $1.2 \times 10^{5} s$

B. $1.39 \times 10^{11} s$

C. $2.1 \times 10^{5} s$

D. $7.194 \times 10^{10} s$

Answer: D

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18. No. of uranium 235 nuclei required to undergo fission to give 9×10^{13} joule of energy is

A. 2.8125×10^{24}

B. 28.125×10^{24}

C. 281.25×10^{24}

D. 28215×10^{24}

Answer: A

Watch Video Solution

19. The energy supplied by a power plant is 40 million kilowatt hour. It is supplied by annihilation of matter, the mass that is annihilated is.

A. $1.6gm$

B. $1.6kg$

C. $1.6mg$

D. 1.6amu

Answer: A

Watch Video Solution

20. The amount of energy released in the fusion of two $._1 H^2$ to form a $._2 He^4$ nucleus will be {Binding energy per nucleon of $._1 He^2 = 1.1MeV$ Binding energy per nucleon of $._2 He^4 = 7MeV]$

A. $8.1MeV$

B. $5.9 MeV$

C. $23.6 MeV$

D. $2 MeV$

Answer: C

Watch Video Solution

21. The miniumum amount of energy released in annihilation of electron-Positron is

A. $1.02 MeV$

B. $0.58 MeV$

C. $185 MeV$

D. $200 MeV$

Answer: A

Watch Video Solution

Level-II (C.W)

1. A nucleus X^{235} splits into two nuclei having the mass numbers in the ratio $2:1$. The ratio of the radii of those two nuclei is

A. $2:1$

B. $1:2$

C. $2^{1/3}:1$

D. $1:2^{1/3}$

Answer: C

Watch Video Solution

2. A mathc box of $5cm \times 5cm \times 1cm$ dimensions is filled with nuclear matter. Its weight is in the order of

A. $10g$

B. $10^8 g$

C. $10^{12} g$

D. $10^{15} g$

Answer: D

Watch Video Solution

3. If the speed of light were $2/3$ of its present value, the energy released in a given atomic explosion will be decreased by a fraction.

A. $2/3$

B. $4/9$

C. $4/3$

D. $5/9$

Answer: B

Watch Video Solution

4. 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. $495 MeV$

B. $49.5 MeV$

C. $4.95 MeV$

D. $0.495 MeV$

Answer: C

Watch Video Solution

5. In a fission reaction $._{92}^{236}U \rightarrow ^{117}X + ^{117}Y + n + n$, the binding energy per nucleon of X and Y is $8.5 MeV$ whereas of $.^{236}U$ is $7.6 MeV$. The total energy liberated will be about.

A. $212eV$

B. $212MeV$

C. $2.12MeV$

D. $0.9MeV$

Answer: B

Watch Video Solution

6. $.^{22}Ne$ nucleus after absorbing energy decays into two $\alpha-$ particles and an unknown nucleus. The unknown nucleus is.

A. Carbon

B. Nitrogen

C. Boron

D. oxygen

Answer: A

Watch Video Solution

7. The mass of one curie of U^{234} is

A. $3.7 \times 10^{10}g$

B. $3.7 \times 10^{-10}g$

C. $6.25 \times 10^{-34}g$

D. $1.438 \times 10^{-11}g$

Answer: D

Watch Video Solution

8. A radio active isotope having a half life of 3 days was received after 9 days. It was found that there was only $4gms$ of the isotope in the container. The initial weight of the isotope when packed was

A. $8g$

B. $64g$

C. $48g$

D. $32g$

Answer: D

Watch Video Solution

9. Half life of a radio active element is $5 \text{ min} . 10 \text{sec}$. Time taken for 90% of it to disintergrate is nearly

A. 100 min

B. 1000sec

C. 10^4 sec

D. 10^4 min

Answer: B

Watch Video Solution

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

A. $1.23 \times 10^4 Bq$

B. $2.4 \times 10^5 Bq$

C. $1.82 \times 10^6 Bq$

D. $4.02 \times 10^8 Bq$

Answer: A

Watch Video Solution

11. In a thermo nuclear reaction $10^{-3} Kg$ of hydrogen is converted into $0.99 \times 10^{-3} Kg$ of helium. If the efficiency of the generator is 50%, the electrical energy generated in KWH is

A. 10^5

B. 1.5×10^5

C. 1.25×10^5

D. 1.3×10^5

Answer: C

Watch Video Solution

12. A nuclear reactor generates power at 50% efficiency by fission of $._{92}^{235} U$ into two equal fragments of $._{46}^{116} U$ into two equal fragments of $._{46}^{116} Pd$ with the emission of two gamma rays of 5.2 MeV each and three neutrons. The average binding energies per particle of $._{92}^{235} U$ and $._{46}^{116} Pd$ are 7.2 MeV and 8.2MeV respectiveley. Calculate the energy released in one fission event. Also-estimate the amount to $.^{235} U$ consumed per hour to produce 1600 megawatt power.

A. $120gm$

B. $1.4kg$

C. $140.5gm$

D. $281gm$

Answer: A

Watch Video Solution

13. In nuclear fusion, One gram hydrogen is converted into $0.993gm$. If the efficiency of the generator be 5%, then energy obtained in KWH is

A. 8.75×10^3

B. 4.75×10^3

C. 5.75×10^3

D. 3.73×10^3

Answer: A

Watch Video Solution

14. A photon of energy $1.12 MeV$ splits into electron positron pair. The velocity of electron is (Neglect relativistic correction)

A. $3 \times 10^8 ms^{-1}$

B. $1.33 \times 10^8 ms^{-1}$

C. $6 \times 10^8 ms^{-1}$

D. $9 \times 10^8 ms^{-1}$

Answer: B

Watch Video Solution

Level-III

1. 50% of a radio active substance decays in 5 hours. The time required for the 87.5% decays is

A. 10 hours

B. 15 hours

C. 12.5 hours

D. 17.5 hours

Answer: B

Watch Video Solution

2. 4 grams of radioactive substance A left $1/2gm$ after some ture. 1 gran of another radioactive substance B left $1/4gm$ in the same period, If half life of B is 2 hours, the half life of A is (in hours)

A. $3/4$

B. $4/3$

C. $1/4$

D. $1/2$

Answer: B

Watch Video Solution

3. One mole of α emitter of half life equal to 2 days was placed in a sealed tube for 4 days at $S.T.P$ volume of helium collector is

A. $22.4 lit$

B. $16.8 lit$

C. $11.2 lit$

D. $5.6 lit$

Answer: B

Watch Video Solution

4. 3 ruthuerfords of a radio active isotope of half-life equal to 3 days was received after 12 days. Initial isotope packed was

A. 48 rutherfords

B. 12 rutherfords

C. 25 rutherford

D. 36 rutherfords

Answer: A

Watch Video Solution

5. The half life of a radio active substance is 6 hours. The amount of the substance undergone disintegration when $36gms$ of it undergoes decay for 18 hours is

A. $31.5gm$

B. $4.5gm$

C. $18gm$

D. $9gm$

Answer: A

Watch Video Solution

6. The radio active nuclides A and B have half lives t and $2t$ respectivey. If we start an experiment with one mole of each of them, the mole ratio after time interval of $6t$ will be

A. $1:2$

B. $1:8$

C. $1:6$

D. $1:1$

Answer: B

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7. 20% of a radio active element disintergrates in 1 hr. The percentage of the radio active element disintergrated in 2 hrs will be

A. 36%

B. 64%

C. 60%

D. 40%

Answer: A

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8. The C^{14} to C^{12} ratio in a certain piece of wood is 25% of that in atmosphere. The half life period of C^{14} is $5, 580$ years. The age of wood piece is (in years)

A. $5, 580$

B. 2790

C. 1395

D. $11, 60$

Answer: D

Watch Video Solution

9. 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

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

A. $T = T_1 + T_2$

B. $\frac{1}{T} = \frac{1}{T_1} + \frac{1}{T_2}$

C. $T = \frac{T_1 + T_2}{T_1 T_2}$

D. $T = \frac{T_1 - T_2}{T_1 T_2}$

Answer: B

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10. The age of the wood if only $1/16$ part of original C^{14} is present in its piece is (in years) (T of C^{14} is $5, 580$ years)

A. 5580

B. $11, 160$

C. 22320

D. 16740

Answer: C

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11. A piece of wood is found to have the $\frac{C^{14}}{C^{12}}$ ratio to be 0.5 times of that in a living plant The number of years back the plant died will be (T of $C^{14} = 5, 580$ years)

A. $2, 790$ years

B. $5, 580$ years

C. $11, 60$ years

D. $27, 900$ years

Answer: B

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12. A piece of wood collected from cro-Magnon caves gave 4 disintergrations / min. A freshly cut wood of the same weight gives 16 d.pm. The cro-magnon man lived about (Half life of C^{14} is 5760 years. Assume the activity is due to C^{14} only)

A. 5700 years ago

B. 2900 years ago

C. 11520 years ago

D. 1400 years ago

Answer: C

Watch Video Solution

Watch Video Solution

13. The number of U^{238} nuclei in a rock sample equal to the number of Pb^{206} atoms. The half life of U^{238} is 4.5×10^{9} years. The age of the rock is

A. $4.5 \times 10^{9} y$

B. $9 \times 10^{9} y$

C. $13.5 \times 10^{9} y$

D. $18 \times 10^{9} y$

Answer: A

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14. Equal masses of two samples of charcoal A and B are burnt separately and the resulting carbon dioxide are collected in two vessels. The radioactivity of $\hat{} 14C$ is measured for both the gas samples. The gas from the charcoal A gives $2100 counts$ per week and the gas from the charcoal A gives 2100 counts per week and the gas from the charcoal B gives 1400 counts per week. Find the age difference between the two samples. Half-life of $\hat{} \, 14C = 5730y$.

A. $5730y$

B. $11460y$

C. $17190y$

D. $22920y$

Answer: B

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15. The half life of a radioactive substance is 20 minutes . The approximate time interval $(t_2 - t_1)$ between the time t_2 when $\frac{2}{3}$ of it had decayed and time t_1 when $\frac{1}{3}$ of it had decay is

A. 14 min

B. 20 min

C. 28 min

D. 7 min

Answer: B

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16. A charged capacitor of capacitance C is discharged through a resistance R. A radioactive sample decays with an average-life τ.Find the value of R for which the ratio of the electrostatic field energy stored in the capacitor to the activity of the radioactive sample remains constant in time.

A. $\frac{2t}{C}$

B. $\frac{C}{2t}$

C. $2tC$

D. tC

Answer: A

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17. Uranium- 238 decays to thorium-234 with half-life $5 \times 10^{9} yr$. The resulting nucleus is in the excited state and hence further emits γ-rays to come to the ground state. It emits 20γ-rays per second. The emission rate will drop to 5γ-rays per second in

A. $1.25 \times 10^{9} yr$

B. $10^{10} yr$

C. $10^{-8} yr$

D. $1.25 \times 10^{-9} s$

Answer: B

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

A. λm

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

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

D. $mN_{A^{e^{\lambda}}}$

Answer: C

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19. 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,

A. $\left(\frac{mN_A}{M}\right)e^{\lambda t}$

B. $\left(\frac{mN_A\lambda}{M}\right)e^{-\lambda t}$

C. $\left(\frac{mN_A}{M\lambda}\right)e^{-\lambda t}$

D. $\frac{m}{\lambda}\left(1-e^{-\lambda t}\right)$

Answer: B

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20. In moon rock sample the ratio of the number of stable argon-40 atoms present to the number of radioactive potassium-40 atoms is $7:1$. Assume that all the argon atoms were produced by the decay of potassium atoms, with a half-life of $2.5 \times 10^9 yr$. The age of the rock is

A. $2.5 \times 10^9 yr$

B. $5.0 \times 10^9 yr$

C. $7.5 \times 10^9 yr$

D. $10^{10} yr$

Answer: C

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21. The half-life of a radioactive sample is T. If the activities of the sample at time t_1 and t_2 $(t_1 < t_2)$ and R_1 and R_2 respectively, then the number of atoms disintergrated in time $t_2 - t_1$ is proportional to

A. $(R_1 - R_2)T$

B. $(R_1 + R_2)T$

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

D. $\frac{R_1 R_2}{T}$

Answer: A

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22. Consider a hypothetical annihilation of a stationary electron with a stationary positron. What is the wavelength of the resulting radiation?

A. $\frac{h}{2m_0 C}$

B. $\frac{2h}{m_0 C}$

C. $\frac{ln2}{3t}$

D. $\frac{3ln2}{t}$

Answer: C

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23. A radioactive nucleus can decay by two different processes. The half life for the first process is $2t$ and that for the second process is t. The effective disintergration constant of nucleus is

A. $\frac{3}{2tln}$

B. $\frac{3ln2}{2t}$

C. $\frac{ln2}{3t}$

D. $\frac{3ln2}{t}$

Answer: B

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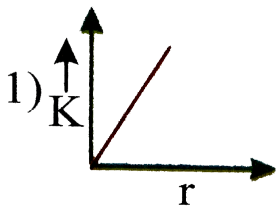
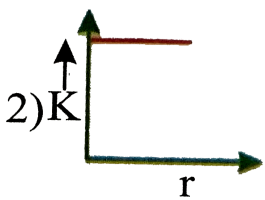
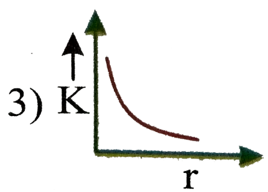
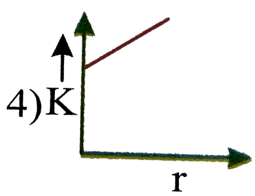
24. A proton with kinetic energy K, strikes another proton at rest. If the collision is head-on, find the correct graph between K and the distance of closest approach, r.

A. 

B. 

C. 

D. 

Answer: C

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25. The fraction quantity of a radiactive sample will decay during half of its half-life period is

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

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

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

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

Answer: C

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26. A small quantity of a solution containing N^{24} radio-nuclide of half-life T and activity R_0 is injected into blood of a person. $1cm^3$ of sample of blood taken from the blood of the person shows activity R_1. If the total volume of the blood in the body of the person is V, find the timer after which sample is taken.

A. $\frac{T}{1n(2)}\left[1n\frac{R_0}{VR_1}\right]$

B. $\frac{T}{\ln(2)}\left[1n\frac{VR_0}{R_1}\right]$

C. $\frac{T}{\ln(2)}\left[1n\frac{VR_1}{R_0}\right]$

D. $\frac{T}{\ln(2)}\left[1n\frac{VR_1}{VR_0}\right]$

Answer: A

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27. 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. $5.4 MeV$

C. $5.6 MeV$

D. $6.5 MeV$

Answer: B

Watch Video Solution

28. Some amount of a radioactice 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?.

A. 20 days

B. 34.8 days

C. 56.4 days

D. 62.9 days

Answer: C

Watch Video Solution

29. In the options given below, let E denote the rest mass energy of a nucleus and n a neutron. The correct option is:

A. $E\left(._{9}^{236}U\right) > E\left(._{53}^{137}I\right) + E\left(._{39}^{97}Y\right) + 2E(n)$

B. $E\left(._{9}^{236}U\right) < E\left(._{53}^{137}I\right) + E\left(._{39}^{97}Y\right) + 2E(n)$

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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30. Four different radioactive elements are kept in separated containers. In the beginning the container A has $200g$-atom with half-life of 2 days, B

has $20g$-atom with half-life of 20 days, C has $2g$-atom with half-life 200 days and D has $100g$-atoms wityh half-life of 10 days. In the begining the maximum activity exhibited by the container is

A. A

B. B

C. C

D. D

Answer: A

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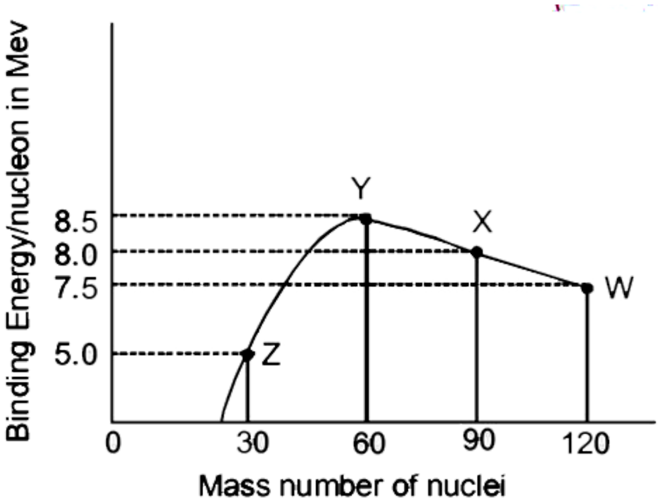
31. Binding energy per nucleons vs mass curve for nucleus is shown in the figure W, X, Y and Z are four nuclei indicated on the curve . The process that would release energy is



A. $Y \rightarrow 2Z$

B. $W \rightarrow X + Z$

C. $X \rightarrow Y + Z$

D. $W \rightarrow 2Y$

Answer: D

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32. When $\_(3)Li^{7}$ nuclei are bombarded by protons , and the resultant nuclei are $\_(4)Be^{8}$, the emitted particle will be

A. alpha particles

B. beta particles

C. gamma photons

D. neutrons

Answer: C

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33. 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. $51.41\ \%$, $2.13\ \%$, $46.46\ \%$

B. $51.41\ \%$, $46.46\ \%$, $2.13\ \%$

C. $2.13\ \%$, $51.41\ \%$, $46.46\ \%$

D. $46.46\ \%$, $2.13\ \%$, $51.41\ \%$

Answer: A

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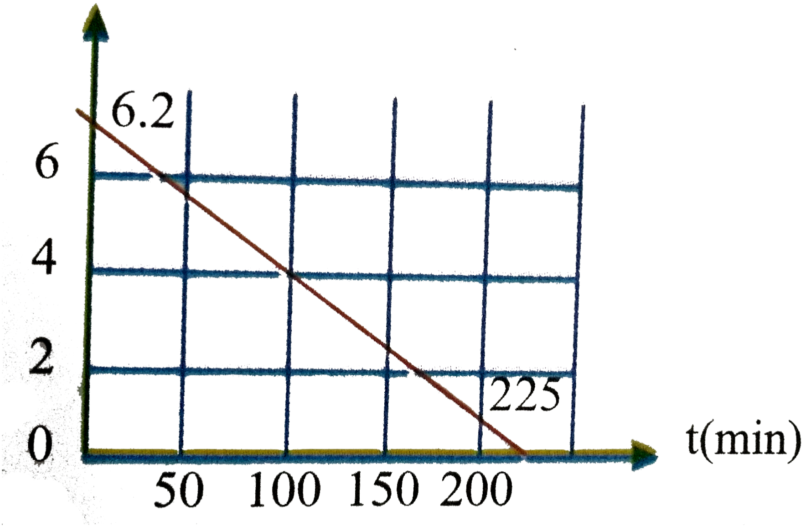
34. The table that follows shows some measurementf of the decay rate of a sample of $.^{128} I$, a radio nuclide often used medically as a tracer to measure the rate at which iodine is absorbed by the thyroid gland.

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.

A. 25 min

B. 50 min

C. 2.5 min

D. 5 min

Answer: A

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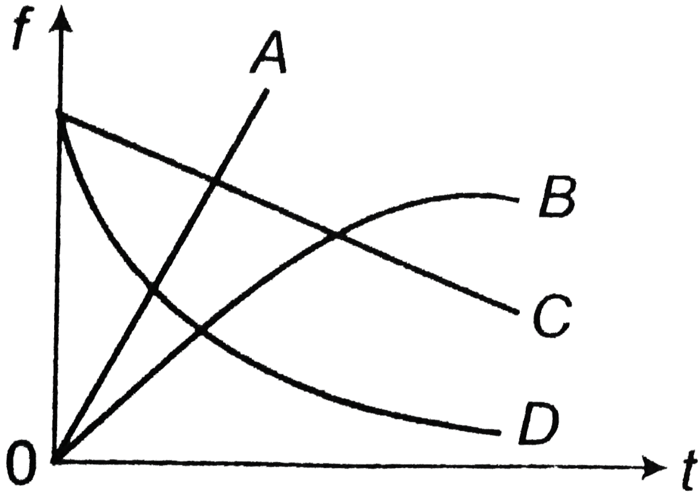
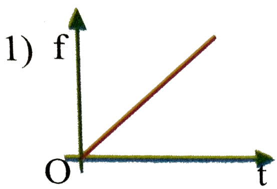
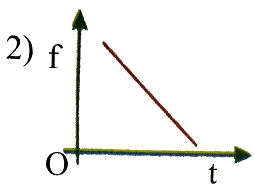
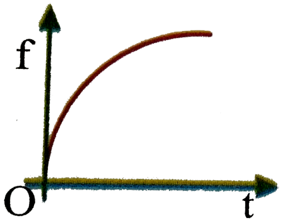
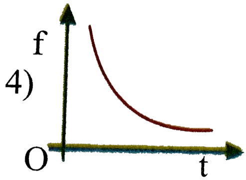
35. The fraction f of radioactive material that has decayed in time t, varies with time t. The correct variation id given by the curve.



A. 

B. 

C. 

D. 

Answer: C

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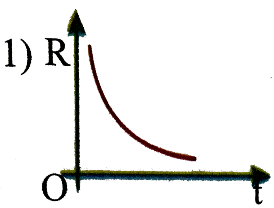
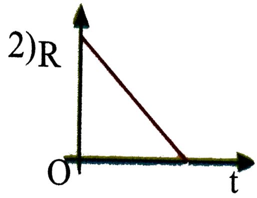
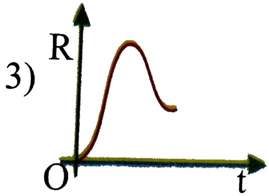
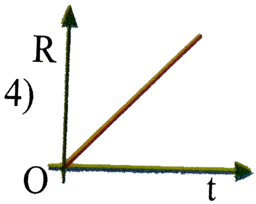
36. The rate of decay (R) of nuclei in a radioactive sample is plotted against time (t). Which of the following best represents the resulting curve ?

A. 

B. 

C. 

D. 

Answer: A

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

Answer: A

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38. A radioactive isotope is being produced at a constant rate $dN/dt = R$ in an experiment. The isotope has a half-life $t_{1/2}$.Show that after a time $t > > t_{1/2}$,the number of active nuclei will become constant. Find the value of this constant.

A. AT

B. $\frac{A}{T}\ln$

C. $AT\ln$

D. $\frac{AT}{\ln(2)}$

Answer: D

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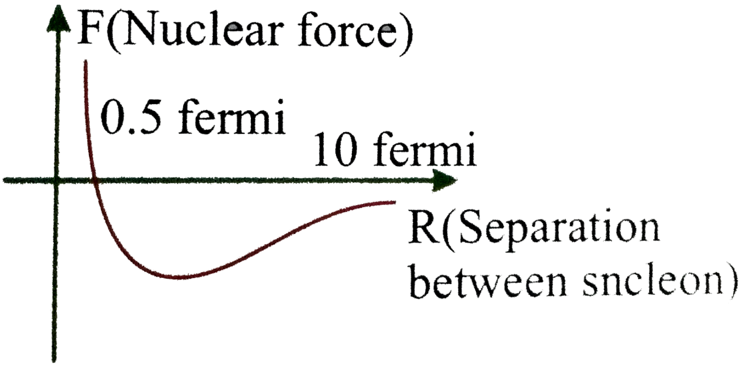
Level-V questions(Single answer type questions)

1. The dependence of nuclear force on distance between nucleons is not known precisely, but approximate variation is shown graphically. From graph which of following statement cannot be concluded ?



A. Nuclear force is repulsive for separation less than 0.5 fermi

B. Nuclear force is attractive for separation less than 0.3 fermi

C. Nuclear force is attractive for separation more than 0.5 fermi

D. Nuclear force is negligible when separation between nucleon is more than 10 fermi

Answer: B

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2. In a fission reaction $._{92}^{236}U \rightarrow ^{117}X + ^{117}Y + n + n$, the binding energy per nucleon of X and Y is $8.5 MeV$ whereas of $.^{236}U$ is $7.6 MeV$. The total energy liberated will be about.

A. $2 MeV$

B. $20 MeV$

C. $195.4 MeV$

D. $2000 MeV$

Answer: C

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3. The half-lives of radioactive sample are 30 years and 60 years for two decay processes. If the sample decays by both the processes simultaneously. The time after which, only one-fourth of the sample will remain is

A. 10 years

B. 20 year

C. 40 year

D. 60 year

Answer: C

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4. Two radioactive samples of different elements (half-lives t_1 and t_2 respectively) have same number of nuclei at $t = 0$. The time after which their activities are same is

A. $\frac{t_1 t_2}{0.693(t_2 - t_1)}$

B. $\frac{t_1 t_2}{0.993} \frac{\ln(t_2)}{t_1}$

C. $\frac{t_1 t_2}{0.693(t_1 - t_2)}$

D. None of these

Answer: A

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5. 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. $\frac{A_t - A_2}{t_2 - t_1} = \text{constant}$

C. $A_2 = A_1 e^{\frac{(t_1 - t_2)}{T}}$

D. $A_2 = A_1 e^{(t_1 / t_2 / T)}$

Answer: C

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6. Find the decay constant of $.^{55}Co$ radio nuclide if its activity is known to decrease 4% per hour. The decay product is non-radioactive.

A. $1.1 \times 10^{-5}s^{-1}$

B. $2.2 \times 10^{-5}s^{-1}$

C. $3.3 \times 10^{-5}s^{-1}$

D. $4.4 \times 10^{-5}s^{-1}$

Answer: A

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

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

B. XY

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

D. X/Y

Answer: A

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8. Nuclei of radioactive element A are produced at rate $'t^2'$ (where t is time) at any time t. The element A has decay constant λ. Let N be the number of nuclei of element A at any time t. At time $t = t_0$, dN/dt is minimum. The number of nuclei of element A at time $t = t_0$ is

A. $\frac{-2t_0 + \lambda t_0^2}{\lambda^2}$

B. $\frac{t_0 - \lambda t_0^2}{\lambda^2}$

C. $\frac{2t_0 + \lambda t_0^2}{\lambda}$

D. $\frac{2t_0 - \lambda t_0^2}{\lambda}$

Answer: A

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

A. 20

B. 40

C. 60

D. 80

Answer: C

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10. The count rate observed from a radioactive source at t sound was N_0 and at $4t$ second it was $\frac{N_0}{16}$. The count rate observed at $\left(\frac{11}{2}\right)t$ second will be

A. $\frac{N_0}{128}$

B. $\frac{N_0}{64}$

C. $\frac{N_0}{32}$

D. None of these

Answer: B

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11. The energy released by the fission of a single uranium nucleus is $200MeV$. The number of fission of uranium nucleus per second required to produce $16MW$ of power is (Assume efficiency of the reactor is 50%)

A. 2×10^6

B. 2.5×10^6

C. 5×10^6

D. 1×10^{18}

Answer: D

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12. A star initially has 10^{40} deuterons. It produces energy via the process $_(1)H^2 +_1 H^2 + \rightarrow_1 H^3 + p$. and $_(1)H^2 +_1 H^3 + \rightarrow_2 He^4 + n$ .If the average power radiated by the state is $10^{16}W$, the deuteron supply of the star is exhausted in a time of the order of .

The masses of the nuclei are as follows:

$M(H^2) = 2.014 a\mu,$

$M(p) = 1.007 a\mu, M(n) = 1.008 a\mu, M(He^4) = 4.001 a\mu.$

A. $10^6 s$

B. $10^8 s$

C. $10^{12} s$

D. $10^{16} s$

Answer: C

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Level-V Multiple answer questions

1. Regarding the nuclear forces, choose the correct options.

A. They are short range foces

B. They are charge independent forces

C. They are not electromagnetic forces

D. They are exchange forces

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

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2. Regarding a nucleus choose the correct options.

A. Density of a nucleus is directly proprtional to mass number A

B. Density of all the nuclei is almost constant, of the order of $10^{17} kg/m^3$

C. Nucleus radius is of the order of $10^{-15} m$

D. Nucleus radius is directly proprtional to mass number, A

Answer: B::C

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3. Choose the correct alternative

A. K_α wavelength emitted by an atom of atomic number $Z = 21$ is λ then K_α wavelength emitted by an atom of atomic number $Z = 31$ is $\frac{4\lambda}{9}$

B. Half life of radioactive substance is 5 year, Probability that a nucleus decays in 10 years is $3/4$

C. Mass number of a nucleus is always greater than its atomic number

D. Gamma rays are emitted due to nuclear deexciation

Answer: A::B::D

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4. 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 1 hour

B. the mean life to the sample is $1/\ln 2$ hour

C. the decay constant of the sample is $\ln 2 hour^{-1}$

D. after a further 4 hours, the amount of the substance left over would be only 0.39% of the original amount

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

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5. Choose the correct options

A. By gamma radiations atomic number is not changed

B. By gamma radiations mass number is not changed

C. By the emission of one α and two β particles isotopes are produced

D. By the emission of one α and four β particles isobars are produced

Answer: A::B::C

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6. A nuclide A undergoes α-decay and another nuclides B undergoes β-decay

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

B. The α-particles emitted by A may have widely different speed.

C. All the β^- particle emitted by B will have almost three same speed

D. The β^- particles emitted by B may have widely different speeds

Answer: A::D

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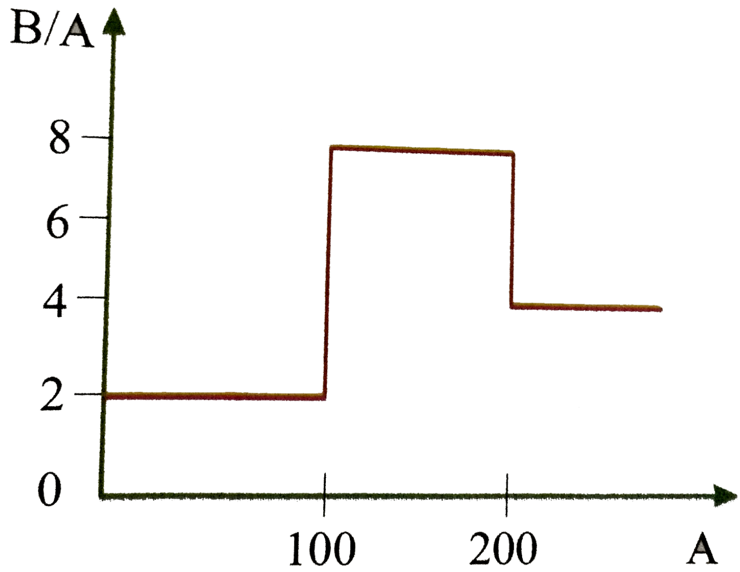
7. Assume that the nuclear binding energy per uncleon (B/A) versus mass number (A) is as shwon in Fig. Use this plot to choose the correct choice (s) given below:



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

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

C. Fission of a nucleus lying in the mass range of $100 < A < 200$ 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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8. From the following equation pick out the possible nuclear fusion reactions

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

B. $._6 C^{14} + ._1 H^1 \rightarrow ._7 N^{13} + 2 MeV$

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

D. $._{36} Sr^{94} + ._0 n^1 + ._0 n^1 + \gamma + 200 MeV$

Answer: B::D

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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 tempreture and high pressure

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

D. All of 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 are 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. $\frac{0.693N}{n}s$

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

Answer: C

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12. 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. $Z_1 - Z_2 = 4$

B. $A_1 - A_2 = 4$

C. both (a) and (b) are correct

D. both (a) and (b) are wrong

Answer: C

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13. 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. $\frac{9N_0}{2}$

D. $\frac{5N_0}{2}$

Answer: C

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14. 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 min

B. 6 min

C. 8 min

D. 2 min

Answer: B

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15. The mass of nucleus $._{z}X^{A}$ is less than the sum of the masses of $(A-Z)$ number of neutrons and Z number of protons in the nucleus. The energy equivalent to the corresponding mass difference is known as the binding energy of the nucleus. A heavy nucleus of mass M can break into two light nuclei of mass m_1 and m_2 only if $(m_1+m_2)<M$. Also two light nuclei of massws m_3 and m_4 can undergo complete fusion and form a heavy nucleus of mass M "only if $(m_3+m_4)>M$". The masses of some neutral atoms are given in the table below.

$._1^1H$	$1.007825u$	$._1^2H$	$2.014102u$
$._1^3H$	$3.016050u$	$._2^4H$	$4.002603u$
$._3^6Li$	$6.015123u$	$._3^7Li$	$7.016004u$
$._{30}^{70}Zn$	$69.925325u$	$._{34}^{82}Se$	$81.916709u$
$._{64}^{152}Gd$	$151.91980u$	$._{82}^{206}Pb$	$205.97445u$
$._{83}^{209}Bi$	$208.980388u$	$._{84}^{210}Po$	$209.982876u$

The correct statement is

A. The nucleus $._3^6Li$ can emit an alpha particle

B. The nucleus $._{84}^{210}Po$ can emit a proton

C. Deutron and alpha particle can undergo complete fusion.

D. The nuclei $._{30}^{70}Zn$ and $._{34}^{82}Se$ can usdergo complete fusion.

Answer: C

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16. The mass of nucleus $._z X^A$ is less than the sum of the masses of $(A - Z)$ number of neutrons and Z number of protons in the nucleus. The energy equivalent to the corresponding mass difference is known as the binding energy of the nucleus. A heavy nucleus of mass M can break into two light nuclei of mass m_1 and m_2 only if $(m_1 + m_2) < M$. Also two light nuclei of massws m_3 and m_4 can undergo complete fusion and form a heavy nucleus of mass M "only if $(m_3 + m_4) > M$". The masses of some neutral atoms are given in the table below.

$$\begin{vmatrix} ._1^1 H & 1.007825u & ._1^2 H & 2.014102u \\ ._1^3 H & 3.016050u & ._2^4 H & 4.002603u \\ ._3^6 Li & 6.015123u & ._3^7 Li & 7.016004u \\ ._{30}^{70} Zn & 69.925325u & ._{34}^{82} Se & 81.916709u \\ ._{64}^{152} Gd & 151.91980u & ._{82}^{206} Pb & 205.97445u \\ ._{83}^{209} Bi & 208.980388u & ._{84}^{210} Po & 209.982876u \end{vmatrix}$$

The kinetic energy (in KeV) of the alpha particle, when the nucleus at rest undergo alpha decay, is

A. 5319

B. 5422

C. 5707

D. 5818

Answer: A

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17. 4×10^{23}tritium atoms are contained in a vessel. The half-life of decay of trituim nuclei is 12.3 y. Find (a) the activity of the sample ,(b) the number of decays in the next 10 hours (c) the number of decays in the next 6.15 y.

A. $7 \times 10^{14} s^{-1}$

B. $7 \times 10^{18} s^{-1}$

C. $7 \times 10^{24} s^{-1}$

D. $7 \times 10^{4} s^{-1}$

Answer: A

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18. 4×10^{23}tritium atoms are contained in a vessel. The half-life of decay of trituim nuclei is 12.3 y. Find (a) the activity of the sample ,(b) the number of decays in the next 10 hours (c) the number of decays in the next 6.15 y.

A. 2.5×10^{4}

B. 2.5×10^{7}

C. 2.5×10^{14}

D. 2.5×10^{19}

Answer: C

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19. 4×10^{23} tritium atoms are contained in a vessel. The half-life of decay of trituim nuclei is 12.3 y. Find (a) the activity of the sample ,(b) the number of decays in the next 10 hours (c) the number of decays in the next 6.15 y.

A. 1.2×10^{14}

B. 1.2×10^{18}

C. 1.2×10^{23}

D. 1.2×10^{30}

Answer: A

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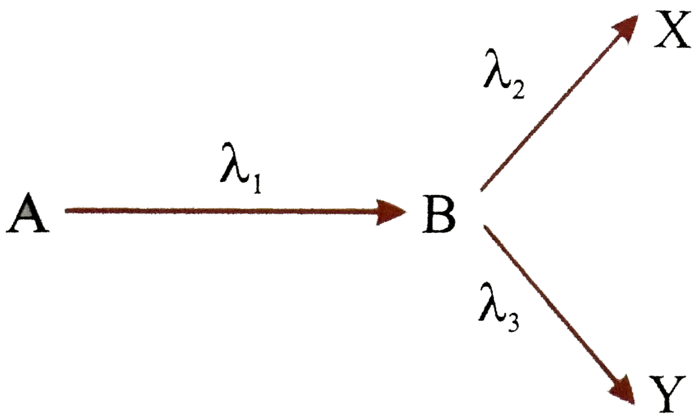
20. Consider radioactive decay of A to B with which further decays either to X or Y, λ_1, λ_2 and λ_3 are decay constant for A to B decay, B to X decay and Bto Y decay respectively. At $t = 0$, the number of nuclei of A, B, X and Y are N_0, N_0 zero and zero respectively.

N_1, N_2, N_3 and N_4 are the number of nuclei of A, B, X and Y at any instant t.



The net rate of accumulation of B at any instant is

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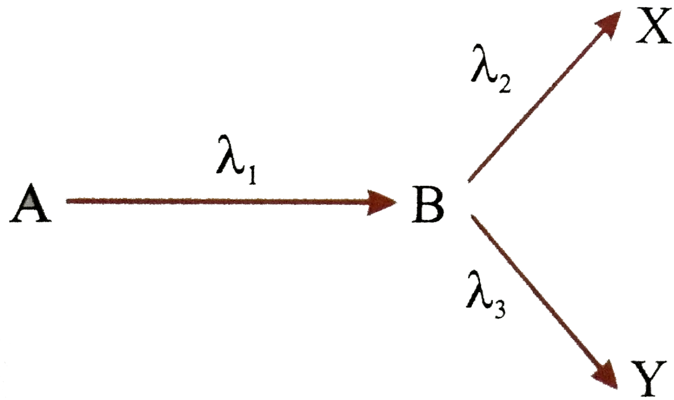
21. Consider radioactive decay of A to B with which further decays either to X or Y, λ_1, λ_2 and λ_3 are decay constant for A to B decay, B to X decay and Bto Y decay respectively. At $t = 0$, the number of nuclei of A, B, X and Y are N_0, N_0 zero and zero respectively.

N_1, N_2, N_3 and N_4 are the number of nuclei of A, B, X and Y at any instant t.



The number of nuclei of B will first increase and then after a maximum value, it decreases for

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

B. $\lambda_1 = \lambda_2 = \lambda_3$

C. $\lambda_1 = \lambda_2 + \lambda_3$

D. For any values of λ_1, λ_2 and λ_3

Answer: A

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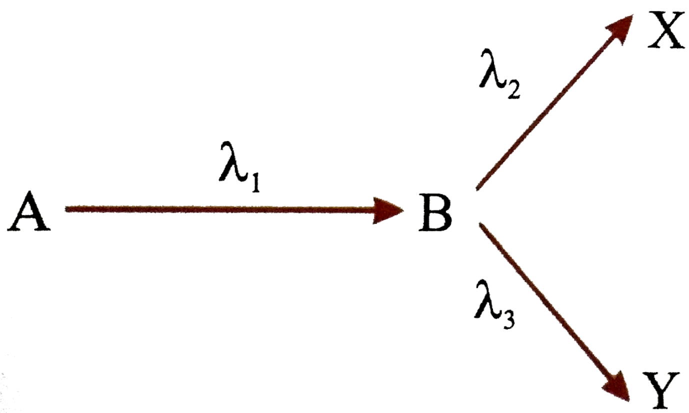
22. Consider radioactive decay of A to B with which further decays either to X or Y, λ_1, λ_2 and λ_3 are decay constant for A to B decay, B to X decay and Bto Y decay respectively. At $t = 0$, the number of nuclei of A, B, X and Y are N_0, N_0 zero and zero respectively.

N_1, N_2, N_3 and N_4 are the number of nuclei of A, B, X and Y at any instant t.



At $t = \infty$, which of following is incorrect ?

A. $N_2 = 0$

B. $N_3 = \dfrac{N_0\lambda_2}{\lambda_2 + \lambda_3}$

C. $N_4 = \dfrac{2N_0\lambda_3}{\lambda_2 + \lambda_3}$

D. $N_1 + N_2 + N_3 + N_4 = 2N_0$

Answer: B

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23. 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_X of nuclei of X at time $t = T_{1/2}$ is .

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

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

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

D. $\left[\lambda N_0 - \dfrac{q}{2}\right]\dfrac{1}{\lambda}$

Answer: A

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24. 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. $qt-\left(\frac{q-\lambda N_0}{\lambda}\right)e^{-\lambda t}+\frac{q-\lambda N_0}{\lambda}$

B. $qt+\left(\frac{q-\lambda N_0}{\lambda}\right)e^{-\lambda t}$

C. $qt+\left(\frac{q-\lambda N_0}{\lambda}\right)e^{-\lambda t}+\frac{1-\lambda N}{\lambda}$

D. $qt-\left(\frac{q-\lambda N_0}{\lambda}\right)e^{-\lambda t}$

Answer: C

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

B. $q\frac{\ln 2}{\lambda} - \frac{3}{2}\left(\frac{q - \lambda N_0}{\lambda}\right)$

C. $q\frac{\ln 2}{\lambda} - \frac{1}{2}\left(\frac{q - \lambda N_0}{\lambda}\right)$

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

Answer: C

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26. A town has a population of 1 million. The average electric power needed per person is 300W. A reactor is to be designed to supply power to this town. The efficiency with which thermal power is converted into electric power is aimed at 25%.(a) Assuming 200 MeV of thermal energy to come form each fission event on an average, find the number of events on an place every day. (b) Assuming the fission to take place largely through U^{235}, at what rate will the amount of U^{235} decrease ? Express

uour answer in kg per day. (c) Assuming that uranium enriched to 3% in U^{235} will be used, how much uranium is needed per month (30 days)?

A. 3.24×10^{24}

B. 3.24×10^{21}

C. 3.24×10^{22}

D. 3.24×10^{20}

Answer: A

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27. A town has a population of 1 million. The average electric power needed per person is 300W. A reactor is to be designed to supply power to this town. The efficiency with which thermal power is converted into electric power is aimed at 25%.(a) Assuming 200 MeV of thermal energy to come form each fission event on an average, find the number of events on an place every day. (b) Assuming the fission to take place largely through U^{235}, at what rate will the amount of U^{235} decrease ? Express

uour answer in kg per day. (c) Assuming that uranium enriched to 3% in U^{235} will be used, how much uranium is needed per month (30 days)?

A. 3.264

B. 2.264

C. 4.264

D. 1.264

Answer: D

Watch Video Solution

28. A town has a population of 1 million. The average electric power needed per person is 300W. A reactor is to be designed to supply power to this town. The efficiency with which thermal power is converted into electric power is aimed at 25%.(a) Assuming 200 MeV of thermal energy to come form each fission event on an average, find the number of events on an place every day. (b) Assuming the fission to take place largely through U^{235}, at what rate will the amount of U^{235} decrease ? Express

uour answer in kg per day. (c) Assuming that uranium enriched to 3% in U^{235} will be used, how much uranium is needed per month (30 days)?

A. $631.5kg$

B. $1263kg$

C. $2263kg$

D. $3263kg$

Answer: B

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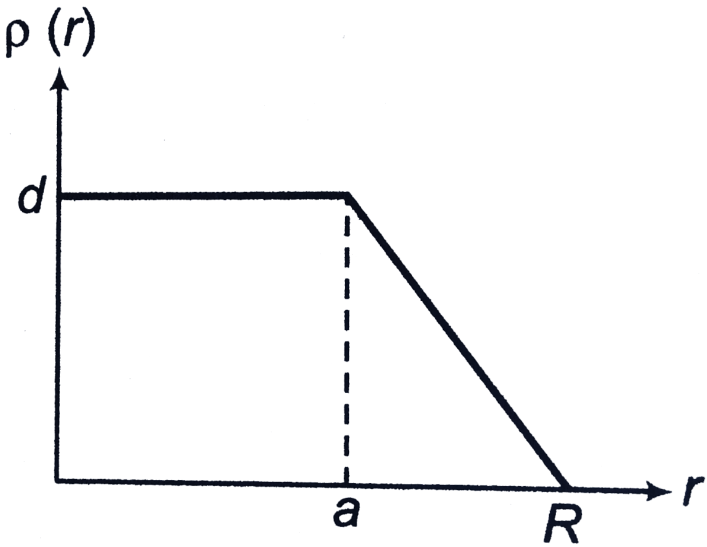
29. The nuclear charge (Ze) is non uniformlly distribute with in a nucleus of radius r. The charge density $\rho(r)$ (charge per unit volume) is dependent only on the radial distance r form the centre of the nucleus s shown in figure. The electric field is only along the radial direction.



The electric field at $r = R$ is

A. independent of a

B. directly proportional to a

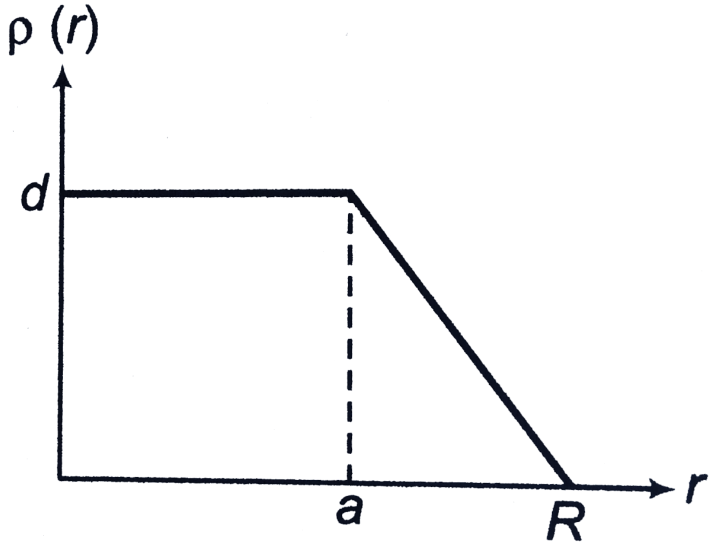
C. directly proportional to a^2

D. inversely proportional to a

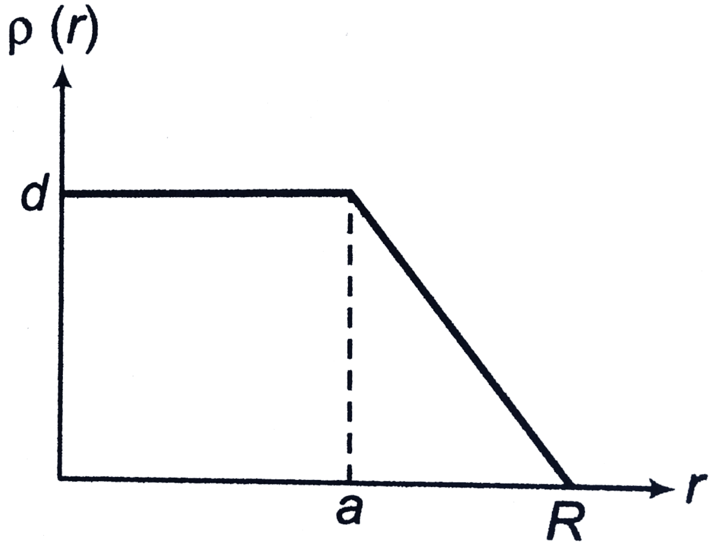
Answer: A

Watch Video Solution

30. The nuclear charge (Ze) is non uniformlly distribute with in a nucleus of radius r. The charge density $\rho(r)$ (charge per unit volume) is dependent only on the radial distance r form the centre of the nucleus s shown in figure. The electric field is only along the radial direction.



For a=0 the value of d (maximum value of ρ as shown in the figure) is



A. $\frac{3Ze}{4\pi R^3}$

B. $\frac{3Ze}{\pi R^3}$

C. $\frac{4Ze}{3\pi R^3}$

D. $\frac{Ze}{3\pi R^3}$

Answer: B

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31. Assume that the mass of nucleus is given by $M = Amp$ where A is the mass number and $mp = 1.00727u$. The density of the matter in the nucleus is about $y \times 10^{17} kg/m^3$. Then y is ______

(Take $R_0 = 1.5Fm$)

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32. 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 .

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33. At a given instant, there are 25% undecayed radio-active nuclei in a sample. After $8\sec$, the number of undecayed nuclei reduced to 12.5%. The time after which the number of undecayed unclei will further reduce to 6.25% of the reduced number is _____sec

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34. There are two radio-active nuclei A and B. A in an alfa-emitter while B is a beta-emitter, Their disintegration constant are in the ratio of $1:4$. The ratio of number of nuclei of A and B at any time $'t'$ such that probabilities of getting number of alpha and beta particles are same at the instant is $y:1$. Then y_____is

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35. 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 $=3.7\times10^{10}$ disintegrations per second)

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36. 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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37. 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 $100 MeV$ energy. Half life of Y equals T and decays to a stable product Z. Each decay of Y releases $50 MeV$. All energy released inside the reactor is used to produce electricity at an afficiency of 25%. Calculate the electrical power in kw generated in the reactor in steady state.

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38. A charged capacitor of capacity C is discharge through a resistance R. A radioactive sample decays with an average life J. If the ratio of electrostatic field energy stored in the capacitor to the activity of the radioactive sample remains constant with time then $R = (xJ/C)$. where x is _______

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39. A radio nuclide with half-life T days emits β-particles of average kinetic energy EJ. The radionuclide is used as a source in a machine which generates electric energy with efficiency $25\,\%$. The number of moles of the nuclide required to generate electrical energy at an initial rate P is $n = \dfrac{yTP}{EN\ln(2)}$ where $'y'$ is

Watch Video Solution

40. The average lifetime for the $n = 3$ excited state of a hydrogen-like atom is $4.8 \times 10^{-8}s$ and that for the $n = 2 stateis 12.8 \times 10^{-8}s$. The ratio of average number of revolution made in the $n = 3$ sate before any transition can take place from these state is.

Watch Video Solution

41. 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)

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42. Consider a nuclear reaction $A+B\to C$. 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 $25.0, 10.0, 34.995a\mu$, respectively.

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

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43. $|Q|$ value of the reaction, $N^4 + \alpha \rightarrow O^{17} + p$

[the masses of N^{14}, He^4, p, O^{17} are respectively $14.00374u, 4.0026u, 1.00783u$ and $16.99913u$ is $x/5MeV$. Value of x is nearly $[1u = 931.5MeV]$

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44. In a nucleus reactor 0.96 grams of $._{92}U^{235}$ is consumed in one day. If 0.1% of mass of $._{92}U^{235}$ is available as energy fine the power of reactor (in MW)

Watch Video Solution

45. The amount of heat generated by $1.0mg$ of a Po^{210} preparation during the one mean lifetime period of there nuclei, if the emitted a-particles are known to possess the kinetic energy $5.3MeV$ is $n(0.2MJ)$. Assume all daughter nuclei are partically formed in ground state. What is the value of n ?

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NCERT Based question

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

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

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

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

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

Answer: C

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

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

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

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

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

$$-\frac{|V|}{c^2}\left(\begin{array}{l}|V| = \text{magnitude of hte potentail energy} \\ \text{of electron in the} H - \text{atom}\end{array}\right)$$

Answer: B

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

A. do not change for any type of radioactivity

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

C. change for α-radioactivity but not for others

D. change for β-radioactivity but not for others

Answer: B

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

A. $Q_1(M_9x) - M_y)$ and

$Q_2 = [M_x - M_y - 2m_e]c^2$

B. $Q_1(M_9x) - M_y)$ and

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

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

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

Answer: A

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

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

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

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

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

Answer: A

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

A. neutrons are heavier than prtons.

B. electrostatic force between protons are repulsive.

C. neutrons decay into protons through beta decay.

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

Answer: B

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

A. they will break up.

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

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

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

Answer: B

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8. Fusion processes, like combining two deuterons to form a He nucleus are impossible at ordinary temperature and pressure. The reasons for this can be traced to the fact:

A. nuclear forces have short range.

B. nuclei are positively charged.

C. the original nuclei must be completely ionized before fusion can take place.

D. the original nuclei must first break up before combining with each other.

Answer: A::B

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

A. Initial rate of decay of A is twice the initial rate of decay of B and

$\lambda_A = \lambda_B$

B. Initial rate of decay of A is twice the initial rate of decay of B and

$\lambda_A > \lambda_B$

C. Initial rate of decay of B is twice the initial rate of decay of A and

$\lambda_A > \lambda_B$

D. Initial rate of decay of B is same as the rate of decay of A at $t = 2h$

and $\lambda_B = \lambda_A$

Answer: B

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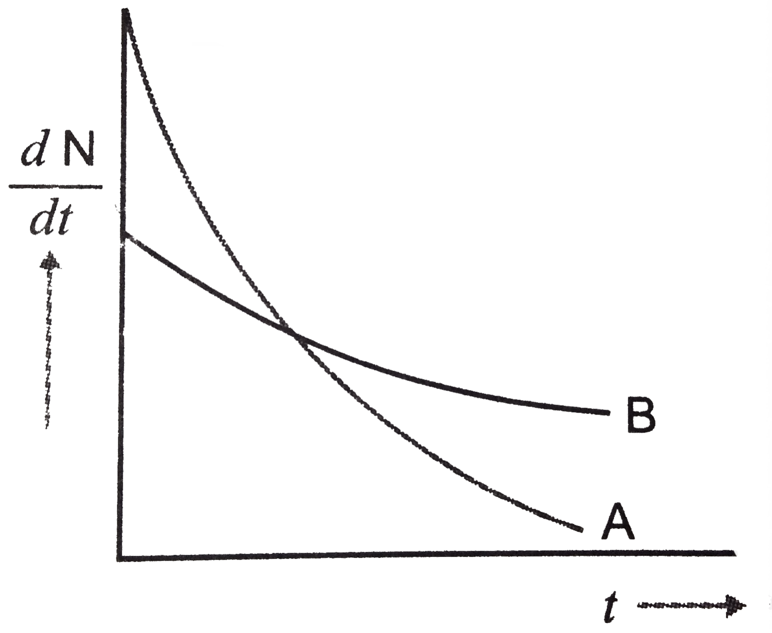
10. The variation of decay rate of two radioactive samples A and B with time is shown in fig.



Which of the following statements are true?

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

B. Decay constant of B is greater than that of A but its decay rate is always smaller than that of A.

C. Decay constant of A is greater than that of B but it does not always decay faster then B.

D. Decay constant of B is smaller than that of A at a later instant.

Answer: C::D

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11. He_2^3 and He_1^3 nuclei have the same mass number. Do they have the same binding energy ?

A. Yes

B. No, $._2^3 He$ has greater binding energy than, $._1^3 He$ due to extra proton.

C. No, $._2^3 He$ has lower binding energy than, $._1^3 He$ due to extra proton.

D. Cannot the concluded

Answer: C

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12. Draw a graph showing the variation of decay rate with number of active nuclei.

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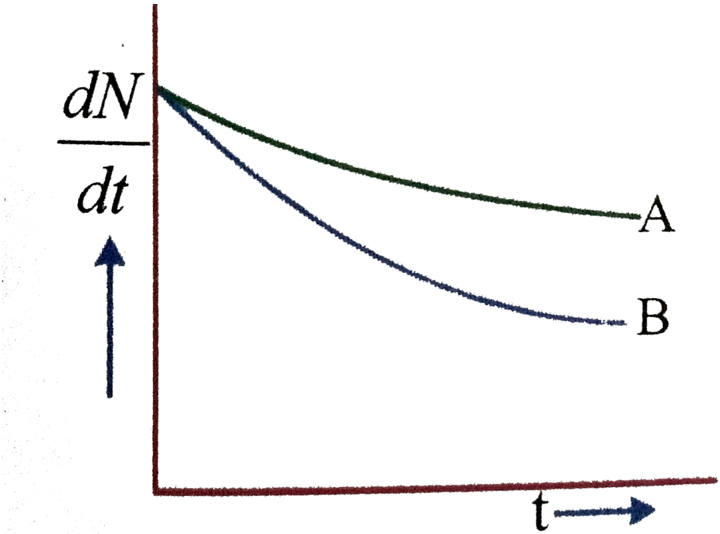
13. Which sample A or B shown in figure has shorter mean-life ?



A. $\tau_B < \tau_A$

B. $\tau_B > \tau_A$

C. $\tau_B = \tau_A$

D. Nothing can be concluded

Answer: A

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

A. Protons do not take part in nuclear forces

B. Protons attract neutrons

C. Nuclear forces are short ranged

D. Coloumb foces are short ranged.

Answer: C

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15. Consider a radioactive nucleus A which decays to a stable nucleus C through the following sequence

$A \to B \to C$

Here B is an intermediate nuclei which is also radioactive. Considering that there are N_0 atoms of A initially , plot the praph showing the variation of number of atoms of A and B versus time.

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16. Two radioactive materials X_1 and X_2 have decay constant 11λ and λ respectively. If initially they have same number of nuclei, then ratio of number of nuclei of X_1 to X_2 will be $\frac{1}{e^2}$ after a time

A. $\frac{1}{5\lambda}$

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

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

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

Answer: A

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17. Radon 220 decays to Bismuth 212 by the following series of decay

$\cdot_{86} Rn \rightarrow_{84} \quad Po^{216} +_2 \quad He^4 \quad T_{1/2} = 55s$

$\cdot_{84} Po^{216} \rightarrow_{82} \quad Pb^{212} +_2 \quad He^4 \quad T_{1/2} = 0.016s$

$\cdot_{82} Pb^{212} \rightarrow_{83} \quad Bi^{212} +_{-1} \quad e^0 \quad T_{1/2} = 10. .6s$

If certain mass of randon is allowed to decay in certain container, after five minutes element with greatest and least mass will respectively be

A. Randon, bismuth

B. Polonium, lead

C. Lead, bismuth

D. Bismuth, lead

Answer: C

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18. Find the half life of U^{238}, if one gram of it emits 1.24×10^4 α-particle per second. Avogadro's Number $= 6.023 \times 10^{23}$.

A. 4.5×10^9 years

B. 1.2×10^9 years

C. 2.2×10^9 years

D. 9.1×10^9 years

Answer: A

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19. What is the age of an ancient wooden piece if it is known that the specific activity of C^{14} nuclide in it amouts 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. 4112 years

B. 2092 years

C. 5570 years

D. 2785 years

Answer: A

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20. In the uranium ore, the ratio of U^{238} nuclei to Pb^{206} nuclei is 2.8. If it is assumed that all the lead Pb^{206} to be a final decay product of the uranuium series, the age of the ore is $\left[T_{1/2}\right.$ for U^{238} is 4.5×10^9 years]

A. 4.5×10^9 years

B. 2.0×10^9 years

C. 3.2×10^9 years

D. 6.4×10^9 years

Answer: B

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21. The specific activity of a preparation consisting of radioactive Co^{58} and non-radioactive Co^{59} is equal to 2.2×10^{12} disintergration per sec gram. The half-life of Co^{58} os 71.3 days. The ratio of the mass of radioactive cobalt in that prepartaion to the total mass of the prepartion in percentage is

A. $2.1\ \%$

B. $99\ \%$

C. $0.1818\ \%$

D. $97.9\ \%$

Answer: C

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22. An unstable element is produced in nuclear reaction at a constant rate R. Its disintergration constant is λ. Find number of nuclei after time $'t'$ if initialy it was Zero

A. $\frac{R}{\lambda}e^{-\lambda t}$

B. $\frac{R}{\lambda}(1-e^{-\lambda t})$

C. $\frac{R}{\lambda}(1+e^{\lambda t})$

D. None of these

Answer: B

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23. Two identical samples (same material and same amout) P and Q of a radioactive substance having mean life T are observed to have activities A_P and A_Q respectively at the time of observation. If P is older than Q, then the difference in their age is

A. $T\ln\left(\frac{A_P}{A_Q}\right)$

B. $T\ln\left(\frac{A_Q}{A_P}\right)$

C. $T\left(\frac{A_P}{A_Q}\right)$

D. $T\left(\frac{A_Q}{A_P}\right)$

Answer: B

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24. A radionuclide is produced at constant rate $'q'$ having half life T. Find time after which activity of nuclei will be A, if initially number of nuclei were zero.

A. $\frac{TA}{q\ln(2)}$

B. $\frac{T}{\ln(2)}\frac{\ln(A)}{q}$

C. $\frac{T}{\ln(2)}\ln\left(1-\frac{A}{q}\right)$

D. None of these

Answer: C

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25. In an agriculture experiment, a solution containing 1 mole of a radioactive meterial $\left(t_{1/2} = 14.3 days\right)$was injected into the roots of a plants.the plant was allowed 70 hours to settle down and then activity eas measured in its fruit. If the activity measured was $1 \mu Ci$ what per cent of activity is transmitted from the root to the fruit in steady state?

A. $1.26 \times 10^{-11}\ \%$

B. $2.52 \times 10^{-11}\ \%$

C. $0.63 \times 10^{-11}\ \%$

D. $1.78 \times 10^{-11}\ \%$

Answer: A

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26. To investigate the beta-decay of Mg^{23} radionuclide, a counter was activated at the moment $t = 0$. It registered N_1 beta particles by a moment $t_1 = 2\,\text{sec}$, and by a moment $t_2 = 3t_1$ the number of registered beta particles was 2.66 times greater. the mean life of the given nuclei is

A. $3\,\text{sec}$

B. $7\,\text{sec}$

C. $16\,\text{sec}$

D. $14\,\text{sec}$

Answer: C

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27. Nucleus A decays to B with decay constant λ_1 and B decays to C with decay constant λ_2. Initially at $t = 0$ number of nuclei of A and B are $2N_0$ and N_0 respectively. At $t = t_o$, no. of nuclei of B is $\frac{3N_0}{2}$ and nuclei of B stop changing. Find t_0?

A. $\frac{1}{\lambda_1}\ln\left(\frac{2\lambda_1}{3\lambda_2}\right)$

B. $\frac{1}{\lambda_1}\ln\left(\frac{8\lambda_1}{3\lambda_2}\right)$

C. $\frac{1}{\lambda_1}\ln\left(\frac{7\lambda_1}{3\lambda_2}\right)$

D. $\frac{1}{\lambda_1}\ln\left(\frac{4\lambda_1}{3\lambda_2}\right)$

Answer: D

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28. 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. $2.2keV$

B. $1.1keV$

C. $3.1keV$

D. $22keV$

Answer: B

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29. 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

A. 4.4

B. 5.4

C. 5.6

D. 6.5

Answer: B

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30. Two radioactive substances have half-lives T and $2T$. Initially, they have equal number of nuclei. After time $t = 4T$, the ratio of their number of nuclei is x and the ratio of their activity is y. Then,

A. $x = 1/8$

B. $x = 1/4$

C. $y = 1/2$

D. $y = 1/4$

Answer: B::C

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31. Two radioactive nuclei A and B are intially in the ratio $1:4$. Also initial activities of the nuclei are in the ratio $1:8$. Given that, half life of A is 2 years, choode the correct alternatives

A. Half life of nuclei B is 1 year

B. At $t = 4$ years, activities of A and B are equal

C. At $t = 6$ years, ratio of number of nuclei of A to that of B is $2:1$

D. Fraction of nuclei decayed in one mean life for A and B are f_1 and f_2 respectivity, $f_1 > f_2$

Answer: A::C

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32. At $t = 0$, number of radioactive nuclei of a radioactive substance are x and its radioactivity is y. Half-life of radioactive substance is T. Then,

A. $\frac{x}{y}$ is constant throughout

B. $\frac{x}{y} > T$

C. Value of xy remains half after one half-life

D. Value of xy becomes one fourth after one half-life

Answer: A::B::D

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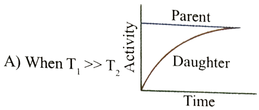
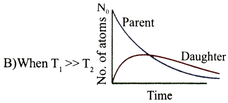
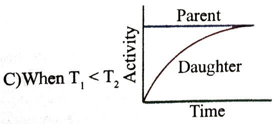
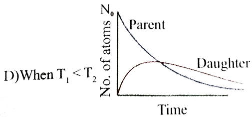
33. A nucleus A (parent) decays into B (Daughter) with half life T_1 and B decays into C with half life T_2. Graph is drawn between number of atoms

/ activity versus time. Select the correct graph (s)

A. 

B. 

C. 

D. 

Answer: A::D

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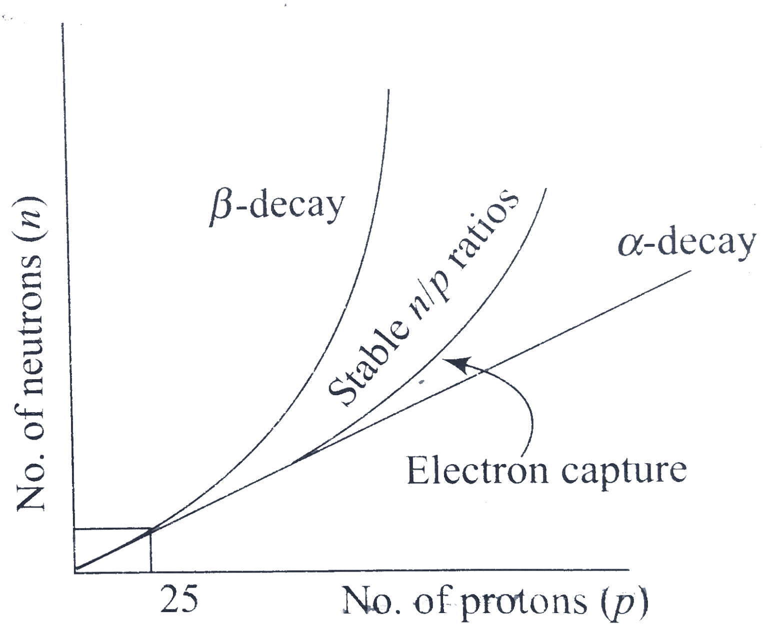
34. Various rules of thumb have seen proposed by the scientific community to expalin the mode of radioactive decay by various radioisotopes. One of the major rules is called the n/p ratio. If all the known isotopes of the elemnts are plotted on a graph of number of neutrons (n) versus number of protons (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

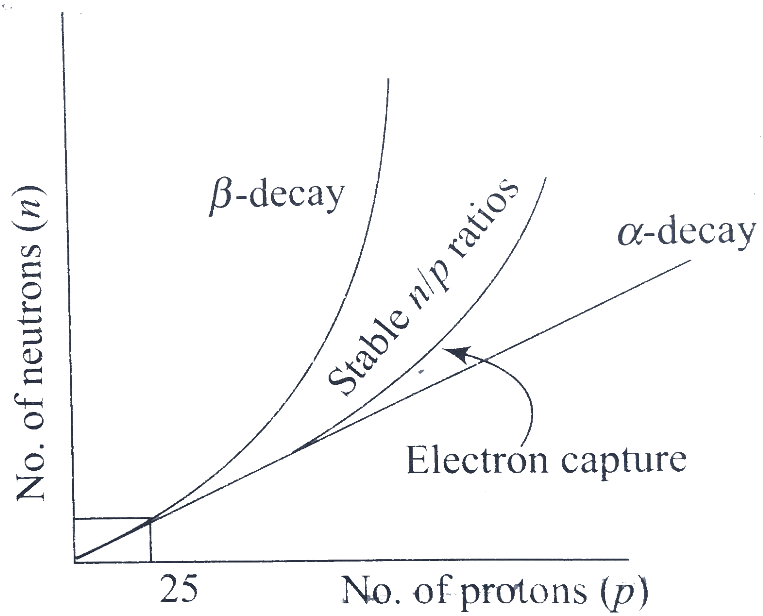
C. Beat decay

D. Gamma ray emission

Answer: C

Watch Video Solution

35. 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. $\alpha, \alpha, \alpha, \gamma, \beta$

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

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

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

Answer: B

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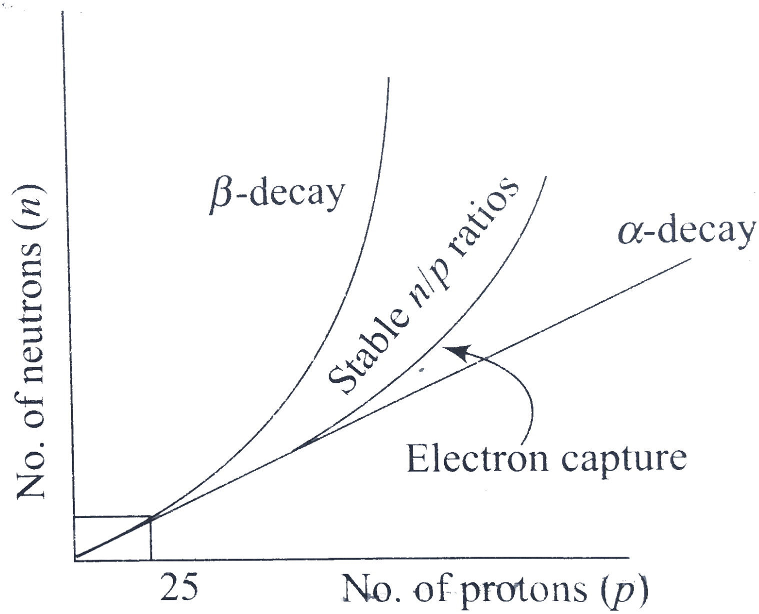
36. Various rules of thumb have seen proposed by the scientific community to expalin the mode of radioactive decay by various radioisotopes. One of the major rules is called the n/p ratio. If all the known isotopes of the elemnts are plotted on a graph of number of neutrons (n) versus number of protons (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. γ gt $\alpha > \beta$

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

Answer: D

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37. 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 $.^{56}Mn = 56gmol^{-1}$).

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

A. $2 \times 10^{11}\text{nuclei}/s1$

B. $13.86 \times 10^{10}\text{nuclei}/s$

C. $9.6 \times 10^{10}\text{nuclei}/s$

D. $6.93 \times 10^{10}\text{nuclei}/s$

Answer: B

Watch Video Solution

38. 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

$.^{56} Mn + d$ rarr $.^{56} Mn + p$

After being bombarded for a long time, the activity of $.^{56} Mn$ becomes constant, equal to $13.86 \times 10^{10} s^{-1}$. (Use $ln2 = 0.693$, Avagadro number $= 6 \times 10^{23}$, atomic weight of $.^{56} Mn$=$56 g mol^{-1}$).

After the activity of $.^{56} Mn$ becomes constant, number of $.^{56} Mn$ 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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39. 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 $.^{56} Mn = 56 gmol^{-1}$).

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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40. When subatomic particles undergo reaction energy is conserved, but mass is not necessarily conserved. However, a particle's mass 'contributes' to its total energy, in accordance with Einstein'f famouns equation, $E = mc^2$

In this question, E denotes the equivalent energy when a particle of mass m is converted into energy. The particle can also have additional energy due to its motion and its interactions with other particles.

Consider a neutron at rest, and well separated from other particles. It decays into a proton, an electron, and an undetected third particle: $\text{Neutron} \rightarrow \text{proton} + \text{electron} + \text{third particle}$

The table below summarizes some data from a single nuetron decay. Column 2 shows the rest mass of the particle times the speed of light squared.

Particle	MxC^2 (MeV)	Kinetic Energy (MeV)
Neutron	940.97	0
Proton	939.66	0.02
Electron	0.51	0.42

Assuming the table contains no major errors, what can we conclude about the (mass xc^2 of the undetcted third particle ?

A. It is $0.90MeV$

B. It is $0.36MeV$

C. It is less than or equal to $0.90MeV$, but we cannot be more percise

D. It is less than or equal to $0.36MeV$, but we cannot be more percise

Answer: D

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41. When subatomic particles undergo reaction energy is conserved, but mass is not necessarily conserved. However, a particle's mass 'contributes' to its total energy, in accordance with Einstein'f famouns equation,

$E = mc^2$

In this question, E denotes the equivalent energy when a particle of mass m is converted into energy. The particle can also have additional energy due to its motion and its interactions with other particles.

Consider a neutron at rest, and well separated from other particles. It decays into a proton, an electron, and an undetected third particle:

$\text{Neutron} \rightarrow \text{proton} + \text{electron} + \text{third particle}$

The table below summarizes some data from a single nuetron decay. Column 2 shows the rest mass of the particle times the speed of light squared.

Particle	MxC^2 (MeV)	Kinetic Energy (MeV)
Neutron	940.97	0
Proton	939.66	0.02
Electron	0.51	0.42

From the given table, which properties of the undetected third particle can we calculate ?

A. Total energy but not kinetic energy

B. Kinetic energy, but not total energy

C. Both total energy, but not kinetic energy

D. Neither total energy nor kinetic energy

Answer: A

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42. When subatomic particles undergo reaction energy is conserved, but mass is not necessarily conserved. However, a particle's mass 'contributes' to its total energy, in accordance with Einstein'f famouns equation, $E = mc^2$

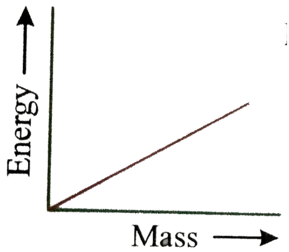
In this question, E denotes the equivalent energy when a particle of mass m is converted into energy. The particle can also have additional energy due to its motion and its interactions with other particles.

Consider a neutron at rest, and well separated from other particles. It decays into a proton, an electron, and an undetected third particle: $\text{Neutron} \rightarrow \text{proton} + \text{electron} + \text{third particle}$

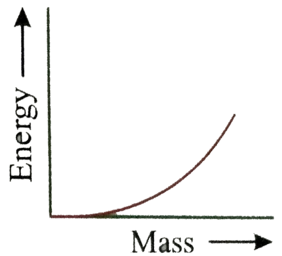
The table below summarizes some data from a single nuetron decay. Column 2 shows the rest mass of the particle times the speed of light squared.

Particle	MxC^2 (MeV)	Kinetic Energy (MeV)
Neutron	940.97	0
Proton	939.66	0.02
Electron	0.51	0.42

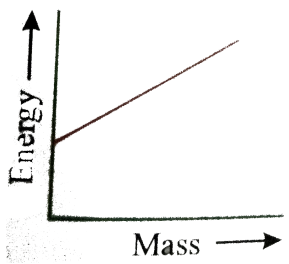
Consider an ensemble of particles, all of which have the same positive kinetic energy but different masses. For this ensemble, which graph best represents the relationship between the particle's mass and its total energy ?



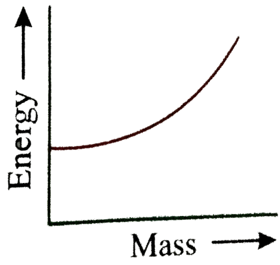
A.



B.



C.

D. 

Answer: C

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43. When subatomic particles undergo reaction energy is conserved, but mass is not necessarily conserved. However, a particle's mass 'contributes' to its total energy, in accordance with Einstein'f famouns equation, $E = mc^2$

In this question, E denotes the equivalent energy when a particle of mass m is converted into energy. The particle can also have additional energy due to its motion and its interactions with other particles.

Consider a neutron at rest, and well separated from other particles. It decays into a proton, an electron, and an undetected third particle: $\text{Neutron} \rightarrow \text{proton} + \text{electron} + \text{third particle}$

The table below summarizes some data from a single nuetron decay. Column 2 shows the rest mass of the particle times the speed of light squared.

Particle	MxC^2 (MeV)	Kinetic Energy (MeV)
Neutron	940.97	0
Proton	939.66	0.02
Electron	0.51	0.42

Could this reaction occur ?

$$\text{Proton} \rightarrow \text{neutron} + \text{other particles}$$

A. Yes, if the other particles have much more kinetic energy than mass energy

B. Yes, but only if the proton has potential energy (due to interactions with other particles)

C. No, because a neutron is more massive than a proton

D. No, because a proton is positively charged while a neutron is electrically neutral

Answer: B

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44. 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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45. 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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46. 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. $0.31 \times 10^{7} ms^{-1}$

Answer: B

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

(a) Two deuterium $\left(._{1}^{2} D\right)$ 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,

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

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

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

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

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

A. $4.03MeV$

B. $17.58MeV$

C. $20.61MeV$

D. $21.61MeV$

Answer: A

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

(a) Two deuterium $\left(._1^2 D\right)$ 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,

$._1^2 D = 2.014102 amu$

$._1^3 T = 3.016049$

$._2^4 He = 4.002603 amu$.

$._1^1 H = 1.007825 amu$

$._0^1 n = 1.00665 amu$

A. $1.34 MeV$

B. $5.86 MeV$

C. $6.87 MeV$

D. $7.21 MeV$

Answer: C

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

(a) Two deuterium $\left(._1^2 D\right)$ 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,

$._1^2 D = 2.014102 amu$

$._1^3 T = 3.016049$

$._2^4 He = 4.002603 amu$.

$._1^1 H = 1.007825 amu$

$._0^1 n = 1.00665 amu$

A. 0.5%

B. 0.7%

C. 0.38%

D. 1.18%

Answer: D

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

$._{92}^{225}X \rightarrow Y + \alpha$

At $t = 0$, the emitted α-particles enter a region of space where a uniform magnetic field $\overrightarrow{B} = B_0\hat{i}$ and elecrtic field $\overrightarrow{E} = E_0\hat{i}$ exist. The α-particles enters in the region with velocity $\overrightarrow{V} = v_0\hat{j}$ from $x = 0$. At time $t = \sqrt{3} \times 10^6 \dfrac{m_0}{q_0 E_0} s$, 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 $m(Y) = 221.03u, m(\alpha) = 4.003u, m(n) = 1.09u, m(P) = 1.0$

.

A. $1.2 \times 10^7 m/s$

B. $9 \times 10^6 m/s$

C. $1.5 \times 10^7 m/s$

D. $8 \times 10^5 m/s$

Answer: C

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51. A nucleus X, initially at rest , undergoes alpha dacay according to the equation ,

$_(92)^A X \rightarrow_Z^{228} Y + \alpha$

(a) Find the value of A and Z in the above process.

(b) The alpha particle produced in the above process is found to move in a circular track of radius $0.11m$ in a uniform magnetic field of 3 Tesla find the energy (in MeV) released during the process and the binding energy of the parent nucleus X

Given that : $m(Y) = 228.03u, m\left(\_ (0)^1 n\right) = 1.0029u.$

$m\left(\_ (2)^4 He\right) = 4.003u, m\left(\_ (1)^1 H\right) = 1.008u$

A. 2.5

B. 4.7

C. 9.9

D. 8

Answer: B

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52. A nucleus X, initially at rest , undergoes alpha dacay according to the equation ,

$\_ (92)^A X \rightarrow_Z^{228} Y + \alpha$

(a) Find the value of A and Z in the above process.

(b) The alpha particle produced in the above process is found to move in a circular track of radius $0.11m$ in a uniform magnetic field of 3 Tesla find the energy (in MeV) released during the process and the binding energy of the parent nucleus X

Given that : $m(Y) = 228.03u, m\left(\_ (0)^1 n\right) = 1.0029u.$

$m\left(\_ (2)^4 He\right) = 4.003u, m\left(\_ (1)^1 H\right) = 1.008u$

A. 2.3

B. 4.7

C. 6

D. 7.8

Answer: D

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53. Uranium $._{92}^{238} U$ is an ustable nucleus. It decays to Thorium $._{92}^{238} Th$, which is again an unstable nucleus which further decays to $._{91}^{234} Pa$. Let $._{92}^{238} U$ be called A of decay constant λ_1 and $._{90}^{234} Th$ is called as B of decay constant λ_2 and stable nuclei $._{91}^{234} Pa$ be called as C. Here A is called parent nucleus and B is called daughter nucleus of A. Any two adjacent nuclei may be consider parent or daughter nuclei A, B and C respectively at time $'t'$.

Then we can write $A \xrightarrow{\lambda_1} B \xrightarrow{\lambda_2} C$

Rate of disintergration of $A = \dfrac{dN_1}{dt} = \lambda_1 N_1$

Rate of disintergration of $B = \dfrac{dN_2}{dt} = \lambda_1 N_1 - \lambda_2 N_2$

Rate of formation of nuclei C is equal to

$\dfrac{dN_3}{dt} = \lambda_2 N_2$

If at $t = 0$, there are N_0 number of nuclei of A where as nuclei B and C are absent in the sample Answer the following questions

Number of nuclei of B at any time t is

A. $\dfrac{N_0 \lambda_1}{\lambda_2 - \lambda_1} \left(e^{\lambda_1 t} - e^{\lambda_2 t}\right)$

B. $\dfrac{N_0 \lambda_1}{\lambda_2 - \lambda_1} \left(e^{-\lambda_1 t} - e^{-\lambda_2 t}\right)$

C. $\dfrac{N_0 \lambda_1}{\lambda_2 - \lambda_1} \left(e^{-\lambda_1 t} - e^{-\lambda_2 t}\right)$

D. $\dfrac{N_0 \lambda_2}{\lambda_2 - \lambda_1} \left(e^{-\lambda_1 t} + e^{-\lambda_2 t}\right)$

Answer: C

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54. Uranium $._{92}^{238}U$ is an ustable nucleus. It decays to Thorium $._{92}^{238}Th$, which is again an unstable nucleus which further decays to $._{91}^{234}Pa$. Let $._{92}^{238}U$ be called A of decay constant λ_1 and $._{90}^{234}Th$ is called as B of decay constant λ_2 and stable nuclei $._{91}^{234}Pa$ be called as C. Here A is called parent nucleus and B is called daughter nucleus of A. Any two adjacent nuclei may be consider parent or daughter nuclei A, B and C respectively at time $'t'$.

Then we can write $A \xrightarrow{\lambda_1} B \xrightarrow{\lambda_2} C$

Rate of disintergration of $A = \dfrac{dN_1}{dt} = \lambda_1 N_1$

Rate of disintergration of $B = \dfrac{dN_2}{dt} = \lambda_1 N_1 - \lambda_2 N_2$

Rate of formation of nuclei C is equal to

$$\frac{dN_3}{dt} = \lambda_2 N_2$$

If at $t = 0$, there are N_0 number of nuclei of A where as nuclei B and C are absent in the sample Answer the following questions ltbgt Numeber of the nuclei of nuclei C at time t is

A. $N_0\left[1 + \dfrac{\lambda_1}{\lambda_2 - \lambda_1}e^{-\lambda_2 t} - \dfrac{\lambda_2}{\lambda_2 - \lambda_1}e^{-\lambda_1 t}\right]$

B. $N_0\left[\dfrac{\lambda_1}{\lambda_2 - \lambda_1}e^{-\lambda_2 t} - \dfrac{\lambda_2}{\lambda_2 - \lambda_1}e^{-\lambda_1 t}\right]$

C. $N_0 \frac{\lambda_1}{\lambda_2 - \lambda_1} \left(e^{-\lambda_2 t} - e^{-\lambda_1 t}\right)$

D. $N_0 \left[\frac{\lambda_1}{\lambda_2 - \lambda_1} e^{-\lambda_2 t} - \frac{\lambda_2}{\lambda_2 - \lambda_1} e^{-\lambda_1 t} - 1\right]$

Answer: A

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55. Uranium $._{92}^{238}U$ is an ustable nucleus. It decays to Thorium $._{92}^{238}Th$, which is again an unstable nucleus which further decays to $._{91}^{234}Pa$. Let $._{92}^{238}U$ be called A of decay constant λ_1 and $._{90}^{234}Th$ is called as B of decay constant λ_2 and stable nuclei $._{91}^{234}Pa$ be called as C. Here A is called parent nucleus and B is called daughter nucleus of A. Any two adjacent nuclei may be consider parent or daughter nuclei A, B and C respectively at time $'t'$.

Then we can write $A \xrightarrow{\lambda_1} B \xrightarrow{\lambda_2} C$

Rate of disintergration of $A = \frac{dN_1}{dt} = \lambda_1 N_1$

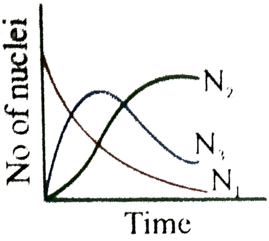
Rate of disintergration of $B = \frac{dN_2}{dt} = \lambda_1 N_1 - \lambda_2 N_2$

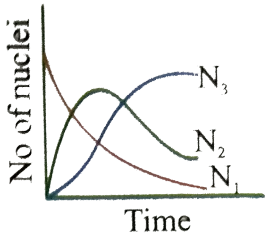
Rate of formation of nuclei C is equal to

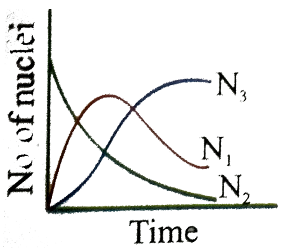
$$\frac{dN_3}{dt} = \lambda_2 N_2$$

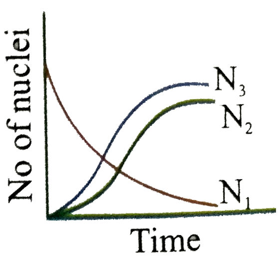
If at $t = 0$, there are N_0 number of nuclei of A where as nuclei B and C are absent in the sample Answer the following questions

The graph N_1, N_2 and N_3 with time can be best represent by

A. 

B. 

C. 

D. 

Answer: B

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56. 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 $t = 0$.

Which differential equation correctly represents the above process?.

A. $\dfrac{dN}{dt} + a_0 t = \lambda N$

B. $\dfrac{dN}{dt} - \lambda N = a_0 t$

C. $\dfrac{dN}{dt} + \lambda N = a_0 t$

D. $\dfrac{dN}{dt} + a_0 t = -\lambda N$

Answer: C

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57. A radionuclide with decay constant λ is being produced in a nuclear reactor at a rate $a_0 t$ per second, where a_0 is 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. $\left(a_0 t + \frac{a_0}{\lambda} + \frac{a_0}{\lambda} e^{-\lambda t}\right) E_0$

B. $\left(a_0 t + \frac{a_0}{\lambda} - \frac{a_0}{\lambda} e^{-\lambda t}\right) E_0$

C. $\left(a_0 t - \frac{a_0}{\lambda} - \frac{a_0}{\lambda} e^{-\lambda t}\right) E_0$

D. $\left(A_0 T - \frac{a_0}{\lambda} - \frac{a_0}{\lambda} e^{-\lambda t} E_0\right)$

Answer: C

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58. 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. $\left(\frac{a_0 t}{2} - \frac{a_0}{\lambda} + \frac{a_0}{\lambda^2 t} - \frac{a_0}{\lambda^2 t} e^{-\lambda t}\right) E_0$

B. $\left(\frac{a_0 t}{2} + \frac{a_0}{\lambda} + \frac{a_0}{\lambda^2 t} - \frac{a_0}{\lambda^2 t} e^{-\lambda t}\right) E_0$

C. $\left(\frac{a_0 t}{2} + \frac{a_0}{\lambda} + \frac{a_0}{\lambda^2 t} + \frac{a_0}{\lambda^2 t} e^{-\lambda t}\right) E_0$

D. $\left(\frac{a_0 t}{2} + \frac{a_0}{\lambda} + \frac{a_0}{\lambda^2 t} + \frac{a_0}{\lambda^2 t} e^{-\lambda t}\right) E_0$

Answer: A

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

Fractional loss of mass in the fission is

A. 1.21×10^{-8}

B. 2.56×10^{-8}

C. 1.73×10^{-8}

D. 3.52×10^{-8}

Answer: A

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

Velocity of small daughter nucleus is

A. $5.6 \times 10^4 m / s$

B. $6.6 \times 10^4 m / s$

C. $7.6 \times 10^4 m / s$

D. $8.6 \times 10^4 m / s$

Answer: B

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61. 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. $0.02 A^0$

B. $0.03 A^0$

C. $0.15 A^0$

D. $0.05 A^0$

Answer: D

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62. The ratio of the radii of the $._{79}Au^{197}$ nucleus to that of the radius of its innermost Bohr orbit is nearly $16x$. Find the value of x. (Given $R_0 = 1.2 \times 10^{-15} m$).

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63. The isotope $._{92}U^{238}$ successively undergoes eight α-decays and six β-decays. The resulting isotope is found to be $._{92-5y}X^{238-4x}$. Find the value of ratio x/y.

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64. The alpha activity of a $10 kg$ sample of $._{92}U^{235}$ that is used in a nuclear reactor is found to be $x \times 10^{-8}$ Bq. If the half of life of uranium -

235 for emitting alpha particles is 7.04×10^8 year, then find the value $'x'$. (Given 1 year $= 3.15 \times 10^7 s$)

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65. The mean lives of a radioactive substance are 1620 years and 405 years for α emission and β emission respectively. Find out the time during which three fourth of a sample will decay if it is decaying both by α-emission and β-emission simultaneously. $(\log_e 4 = 1.386)$.

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66. Energy is released from stars due to nuclear fusion taking place in two cycles proton-proton cycle and carbon nitrogen cycle. In these cycles four hydrogen nuclei combine to from helium nucleus. In this fusion reaction in addition to energy how many number of nutrinous are released ?

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67. Mean free path (λ) in a fission reaction is the average distance covered by a neutron between two fissions. Generation of nearly 200 neutrons are needed to fission all the nuclei in $10kg$ of $._{92}U^{235}$. If $\lambda = 4cm$ and the fastest moving neutrons generated in a fission reaction have an energy of $2MeV$, then the time for 200 neutron generation is found to be $p \times 10^{-7}$ seconds. Find $'p'$.

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68. There is a stream of neutrons with kinetic energy of 0.0327 eV. If half life of neutrons is 700s, what fraction of neutrons will decay before they travel a distance of 10m? Take mass of neutron =$1.675 \times 10^{-27} kg$.

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69. Half-life for certain radioactive element is 5 min . Four nuclei of that element are observed at a certain instant of time. After 5 minutes

STATEMENT-I: It can be definitely said that two nuclei will be left undecayed.

STATEMENT-II: After half-life that is 5 minutes, half of totan nuclei will disintegrate. So, only two nuclei will be left undecayed.

A. Statement-1 is True, Statement-2 is Ture, Statement-2 is correct explanation for Statement-1

B. Statement-1 is Ture, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement -2 is False

D. Statement-1 is False, Statement-2 is True.

Answer: D

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70. STATEMENT-I: It is easy to remove a proton from $._{20}^{40}Ca$ nucleus as compared to a neutron.

STATEMENT-II: Inside nucles neutrons are acted on only by attractive forces but protons are also acted on by repulsive forces.

A. Statement-1 is True, Statement-2 is Ture, Statement-2 is correct explanation for Statement-2

B. Statement-1 is Ture, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement -2 is False

D. Statement-1 is False, Statement-2 is True.

Answer: A

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71. STATEMENT-I: It is possible for a thermal neutron to be absorbed by a nucleus where as proton or an alpha particle would need a much larger amount of energy for being absorbed by the same nucleus.

STATEMENT-II: Neutron is electically neutral but proton and alpha particle are positively charged.

A. Statement-1 is True, Statement-2 is Ture, Statement-2 is correct explanation for Statement-3

B. Statement-1 is Ture, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement -2 is False

D. Statement-1 is False, Statement-2 is True.

Answer: A

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72. STATEMENT-I: Consider the following nuclear reaction of an ustable $._6^{14}C \rightarrow ._7^{14}N +_{-1}^0 e + \bar{v}$. In a nuclear reaction total energy and momentum is conserved experiments show that the electrons are emitted with a continous range of kinetic energies upto some maximum value.

STATEMENT-II: Remaining energy is released as thermal energy.

A. Statement-1 is True, Statement-2 is Ture, Statement-2 is correct explanation for Statement-4

B. Statement-1 is Ture, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement -2 is False

D. Statement-1 is False, Statement-2 is True.

Answer: C

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Previous JEE questions

1. The isotope $\_(5)^{12}B$ having a mass $12.014u$undergoes beta - decay to $_(6)^{12}C_6^{12}C$has an excited state of the nucleus

$\left(\_(6)^{12} C^* at 4.041 MeV\right.$ above its ground state if $\_(5)^{12} E$ decay to $\_(6)^{12} C^*$, the maximum kinetic energy of the β - particle in unit of MeV is $\left(1u = 931.5 MeV / c^2\right.$ where c is the speed of light in vaccuum) .

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2. As accident in a nuclear laboratory resulting in deposition of a certain amount of radioactive material of half life 18days inside the laboratory Tests revealed that the radiation was 64 times more than the permissible level required for save operation of the laboratory what is the minimum number of days after which the laboratory can be considered safe for use?

A. 64

B. 90

C. 108

D. 120

Answer: C

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3. 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

A. 3

B. 4

C. 2

D. 1

Answer: C

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4. The electrostatic energy of Z protons uniformly distributed throughout a spherical nucleus of radius R is given by

$$E = \frac{3Z(Z-1)e^2}{5}(4\pi e_0 R)$$

The measured masses of the neutron $_(1)^1 H,_7^{15} N$ and $,_8^{16} O are 1.008665u, 1.007825u, 15.000109u$ and 15.0030

respectively Given that the ratio of both the $_(7)^{12} N$ and $_(8)^{15} O$ nucleus are same , 1 u = = 931.5 Me Vc^2 (c is the speed of light) and $e^2/(4\pi e_0) = 1.44 MeV$ fm Assuming that the difference between the binding energies of $_7^{15} N$ and _(8)^(15) O ` is purely due to the electric energy , The radius of the nucleus of the nuclei is

A. $2.85 fm$

B. $30.3 fm$

C. $3.42 fm$

D. $3.80 fm$

Answer: C

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5. The count rate meter is used to measure that activity of a given amount of a radio active element. At one instant, the meter shows 475 counts/minute. Exactly 5 minutes later, is shown 270 counts/minute then The decay constant is

A. 0.82/minute

B. 0.113/minute

C. 0.166/minute

D. 0.182/minute

Answer: B

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6. The count rate meter is used to measure that activity of a given amount of a radio active element. At one instant, the meter shows 475 counts/minute. Exactly 5 minutes later, is shown 270 counts/minute then Mean life of the sample is (in minutes)

A. 6.35

B. 7.45

C. 8.85

D. 9.92

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7. The count rate meter is used to measure that activity of a given amount of a radio active element. At one instant, the meter shows 475 counts/minute. Exactly 5 minutes later, is shown 270 counts/minute then Half life of the sample is (in minute)

A. 6.13

B. 8.42

C. 8.85

D. 9.92

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8. Atomic nucleus is central core of every atom in which the whole of positive charge and almost entire mass of atom is concentrated. It is a tiny sphere of a radius R is given by $R = R_o A^{1/3}$, where $R_o = 1.4 \times 10^{-15} m$, a constant and A the mass number of nucleus

A graph between $'\log\left(\frac{R}{R_0}\right)$, and $'\log A'$

A. Is a parabola

B. Is a straight line passing through origin

C. Is a straight line have an intercept

D. In an ellipse

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9. Atomic nucleus is central core of every atom in which the whole of positive charge and almost entire mass of atom is concentrated. It is a tiny sphere of a radius R is given by $R = R_o A^{1/3}$, where $R_o = 1.4 \times 10^{-15} m$, a constant and A the mass number of nucleus

On increasing the value of 'A' the density of the nucleus

A. Increases

B. Decreases

C. Remain constant

D. None

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10. Atomic nucleus is central core of every atom in which the whole of positive charge and almost entire mass of atom is concentrated. It is a tiny sphere of a radius R is given by $R = R_o A^{1/3}$, where $R_o = 1.4 \times 10^{-15} m$, a constant and A the mass number of nucleus

The radius of the nucleus of mass number 125 is

A. $175 \times 10^{-15} m$

B. $35 \times 10^{-15} m$

C. $70 \times 10^{-15} m$

D. $7 \times 10^{-15} m$

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11. A nuclear of mass $M + \delta m$ is at rest and decay into two daughter nuclei of equal mass $\frac{M}{2}$ each speed is c

The binding energy per nucleon for the nucleus is E_1 and that for the daugther nuclei is E_2 Then

A. $E_1 = 2E_1$

B. $E_1 > E_2$

C. $E_2 > E_1$

D. $E_1 = 2E_2$

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12. A nuclear of mass $M + \delta m$ is at rest and decay into two daughter nuclei of equal mass $\frac{M}{2}$ each speed is c

The speed of daughter nuclei is

A. $c\frac{\Delta m}{M + \Delta m}$

B. $c\sqrt{\frac{2\Delta m}{M}}$

C. $c\sqrt{\frac{\Delta m}{M}}$

D. $c\sqrt{\frac{\Delta m}{M + \Delta m}}$

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13. Choose the correct from the following.

A) Large mass number nuclei undergo fission

B) Low mass number nuclei undergo fusion

C) For heavy nuclei the decrease in binding energy per nucleon shows the contribution of the increasing coulomb repulsion.

A. A,B are correct

B. A,B,C are correct

C. B,C are correct

D. A,C are correct

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14. Which of the following are not fundamental particles

i) Electron ii) Photon

iii) α-particle iv) Deutron

A. Only i & ii are true

B. Only ii and iii are true

C. Only i & iii are ture

D. Only iii & iv are true

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15. When a nucleus with atomic number Z and mass number A undergoes a radioactive decay process,

(i) Both Z and A will decrease, if the process is α decay

(ii) Z will decrease but A will not change, if the process is $\beta^+ -$ decay

(iii) Z will increase but A will not change, if the process is $\beta -$ decay

(iv) Z and a will remain uncharged, if the prices is γ decay

A. a & b are true

B. b & d are true

C. a, b & c are ture

D. a,b,c,d are ture

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

A. a,b are true

B. b,c are true

C. a,d are true

D. a,d are true

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17. In the fission of U^{235}

i) Slow neutron is absorbed by U^{235}

ii) The products is the process are not same always, their atomic number varies from 34 to 58

iii) About $200 MeV$ energy is released per fission

iv) The product are always Ba and Kr

A. Only i,ii & iii are ture

B. Only ii & iii are true

C. All are ture

D. Only, i,ii & iv are true

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18. Which of the following statements are correct

i) Positron is predicted by Dirac and discovered by Anderson

ii) Liquid drop model of nucleus is developed by Bohr and Wheeler

iii) Carbon cycle was proposed by Bethe

iv) Fission reaction is first observed by OttoHahn ans Strassman

A. All are ture

B. Only I,ii & iv are true

C. Only i, iii & iv are true

D. Only iii & iv are true

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19. Consider the following statement A and B and identify the correct answer given below:

A) Nuclear density is same for all nuclei

B) Radius of the nucleus (R) and its mass number (A) are related as $\sqrt{A} \alpha R^{1/6}$

A. A and B are true

B. A and B are false

C. A is true but B is false

D. A is false but B is true

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20. Cosider the following statements A, B and identify the correct choice in the given answers A : Density of a nucleus is independent of is mass number

B: Beryllium is used as moderator in nucleus reactors

A. A and B are correct

B. A and B are wrong

C. A is correct, B is wrong

D. A is wrong, B is correct

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21. Consider the following statements (A) and (B) and identify the correct answer given below. Statement (A): Positive values of packing fraction implies a large value of binding energy. Statement (B): The difference between the mass of the nucleus and the mass number of the nucleus is called packing fraction

A. (A) and (B) are correct

B. (A) and (B) are false

C. (A) is true, (B) is false

D. A is false, B is true

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LEVEL-I-(H.W)

1. Assume that the nuclear mass is of the order of $10^{-27} kg$ and the nuclear radius is of the order of $10^{15} m$. The nuclear density is of the order of

A. $10^{2} Kg/m^{3}$

B. $10^{10} Kg/m^3$

C. $10^{17} Kg/m^3$

D. $10^{31} Kg/m^3$

Answer: C

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2. Highly energetic electrons are bombarded on a target of an element containing 30 neutrons. The ratio of radii of nucleus to that of Helium nucleus is $141/3$. The atomic number of nucleus will be.

A. 25

B. 26

C. 56

D. 30

Answer: B

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3. Sun radiates energy at the rate of $3.6 \times 10^{26} J/s$. The rate of decrease in mass of sun is $\left(Kgs^{1}\right)$.

A. 12×10^{10}

B. 1.3×10^{20}

C. 4×10^{9}

D. 3.6×10^{36}

Answer: C

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4. A slow neutron strikes a nucleus of $._{92}^{235} U$ splitting it into lighter nuclei of $._{56}^{141} Ba$ and $._{36}^{92} Kr$ along with three neutrons. The energy released in this reaction is (The masses of uranium, barium and krypton of this reaction are $235.043933, 140.917700$ and $91.895400u$ respectively. The mass of a neutron is $1.008665u$

A. $740.69MeV$

B. $156.9MeV$

C. $186. MeV$

D. $198.9MeV$

Answer: D

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5. The energy required to separate the typical middle mass nucleus $._{50}^{120}Sn$ into its constituent nucleons (Mass of $._{50}^{120}sn = 119.902199u$, mass of proton $= 1.007825u$ and mass of neutron $= 1.008665u$)

A. $951MeV$

B. $805MeV$

C. $1021MeV$

D. $1212MeV$

Answer: C

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6. The mass defect in a nucleus is 3.5amu. Then the binding energy of the nucelus is

A. $32.58MeV$

B. $325.85MeV$

C. $3260.25MeV$

D. $3.258MeV$

Answer: C

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7. Consider the following nuclear reaction,

$X^{200} \rightarrow A^{110} + B^{90} + Energy$

If the binding energy per nucleon for X, A and B are $7.4 MeV$, $8.2 MeV$ and $8.2 MeV$ respectively, the energy released will be

A. $200 MeV$

B. $160 MeV$

C. $110 MeV$

D. $90 MeV$

Answer: B

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8. An isotope $._{92}U^{238}$ decays successively to form $._{90}Th^{234}$, $._{91}Pa^{234}$, $._{92}Th^{234}$, $._{90}Th^{230}$ and $._{88}Ra^{226}$. What are the radiations emitted in these five steps?

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

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

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

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

Answer: C

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9. The nuclide which disintergrates by emitting a β-particles to form $._7^{14} N$ contains

A. 8 neutrons

B. 10 neutrons

C. 7 neutrons

D. 6 neutrons

Answer: A

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10. A nucleus X initially at rest, undergoes alpha decay according to the equation

$._{Z}^{232} X \rightarrow_{90}^{A} Y + \alpha$

What fraction of the total energy released in the decay will be the kinetic energy of the alpha particle?

A. $\frac{90}{92}$

B. $\frac{228}{232}$

C. $\sqrt{\frac{228}{232}}$

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

Answer: B

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11. A radio active sample contains 600 radio active atoms. Its half life period is 30 minutes. The no. of radio active atoms remaining, if the decay accurs for 90 minutes is

A. 300

B. 200

C. 400

D. 75

Answer: D

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12. Radio active carbon-14, in a wood sample decays with a half life of 5700 years. The fraction of the radio active carbon -14, that remains after a decay period of 17,100 year is

A. $1/4$

B. $3/4$

C. $1/8$

D. $7/8$

Answer: C

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13. The half-life of $._{92}^{238}U$ against alpha decay is 4.5×10^9 year. How much disintegration per second occurs in $1g$ of $._{92}^{238}U$?

A. $1.53 \times 10^4 s^{-1}$

B. $1.325 \times 10^4 s^{-1}$

C. $1.412 \times 10^4 s^{-1}$

D. $1.235 \times 10^4 s^{-1}$

Answer: D

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14. A certain substance decays to $1/32$ of its initial activity in 25 days. Calculate its half-life.

A. 1 day

B. 3 days

C. 5 days

D. 7 days

Answer: C

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15. Calculate the energy released by the fission $1g$ of $.^{235}U$ in joule, given that the energy released per fission is $200MeV$.

(Avogadro's number $= 6.023 \times 10^{23}$)

A. 8.202×10^{12}

B. 8.202×10^{8}

C. 8.202×10^{10}

D. 8.202×10^{14}

Answer: C

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16. The ratio of the amounts of energy released as a result of the fusion of $1kg$ hydrogen (E_1) and fission of $1kg$ of $._{92} U^{236} (E_2)$ will be

A. 1.28

B. 3.28

C. 5.28

D. 7.28

Answer: D

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LEVEL-II-(H.W)

1. A nucleus splits into two nuclear parts having radii in the ratio $1:2$ Their velocities are in the ratio

A. $8:1$

B. $6:1$

C. $4:1$

D. $2:1$

Answer: A

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2. The atomic mass of $._7 N^{15}$ is 15.000108amu and that of $._8 O^{16}$ is 15.994915amu. The minimum energy required to remove the least tightly bound proton is (mass of proton is 1.007825amu)

A. $0.013018eV$

B. $12.13MeV$

C. $13.018MeV$

D. $12.13eV$

Answer: B

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3. Assume that a neutron breaks into a proton and an electron . The energy reased 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 $= 9 \times 10^{-31} kg)$

A. 0.73

B. 7.1

C. 6.3

D. 5.4

Answer: A

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4. 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. 4.4

B. 5.4

C. 5.6

D. 6.5

Answer: B

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5. If the activity of $.^{108}Ag$ is 3 micro curie, the number of atoms present in it are $(\lambda = 0.005 \sec^{-1})$

A. 2.2×10^7

B. 2.2×10^6

C. 2.2×10^5

D. 2.2×10^4

Answer: A

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6. The half life period of Pb^{210} is 22 years. If $2g$ of Pb^{210} is taken, then after 11 years the amount of Pb^{210} will be present is

A. $0.1414g$

B. $1.414g$

C. $2.828g$

D. $0.707g$

Answer: B

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7. $_(87)^{221}$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. $1/2$

C. $1/4$

D. $3/4$

Answer: D

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8. When $._{92}U^{235}U$ undergoes fission. About 0.1% of the original mass is converted into energy. Then the amount of $._{92}U^{235}$ should undergo fission per day in a nuclear reactor so that it provides energy of 200 mega watt electric power is

A. $9.6 \times 10^{-2} kg$

B. $4.8 \times 10^{-2} kg$

C. $19.2 \times 10^{-2} kg$

D. $1.2 \times 10^{-2} kg$

Answer: C

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9. A gamma ray photon creates an electron-positron pair. If the rest mass energy of an electron is $0.5 MeV$ and the total $K.E.$ of the electron-position pair is $0.78 MeV$, then the energy of the gamma ray photon must be.

A. 1.78

B. 0.28

C. 1.28

D. 0.14

Answer: A

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