PHYSICS

BOOKS - DC PANDEY PHYSICS (HINGLISH)

NUCLEI

Example

1. what is the nuclear radius $of.^{125}$ Fe , if that of $.^{27}Al$ is 6.4 fermi?

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2. Assuming that protons and neutrons have equal masses, calculate how many times nuclear matter is denser than water. Take mass of a nucleon $= 1.67 \times 10^{-27} kg$ and $R_0 = 1.2 \times 10^{-15} m.$

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3. (a) Two stable isotope of ${}_{3}Li^{6}$ and ${}_{3}Li^{7}$ have respective abundances of $7.5\,\%$ and $92.5\,\%$. These isotopes have masses 6.01512 and 7.01600 u respectively. Find the atomic weight of lithium.

(b) Boron has two stable isotopes ${}_{5}B^{10}$ and ${}_{5}B^{11}$. Their respective masses are 10.01294 u and 11.00931 u, and the atomic weight of boron is 10.81 u. Find the abundances of ${}_{5}B^{10}$ and ${}_{5}B^{11}$.

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4. select the point of isotones from the following nuclei ${}_{12}Mg^{24}, {}_{1}H^{3}, {}_{2}He^{4}, {}_{11}Na^{23}$.

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5. calculate the mass defect of Helium $\left[{}_{2}He^{4}\right]$

mass of proton $= 1.007276u$,

Mass of neutron $= 1.008665u$,

Mass of ${}_2 He^4 = 1.001506u$,

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6. Calculate the energy required to remove the least tightly neutron form ${}^{20}\left(Ca^{40}\right)$. Given that

Mass of ${}^{20}\left(Ca^{40}\right) = 39.962589a\mu$

Mass of ${}^{20}\left(Ca^{39}\right) = 38.970691a\mu$

Mass of neutron $= 1.008665a\mu$

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7. A neutron breaks into a proton and electorn. Calculate the eenrgy produced in this reaction in $m_e = 9 \times 10^{-31} kg, m_p = 1.6725 \times 10^{-27} kg, m_n = 1.6747 \times 10^{-27} kg, c =$

.

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

Mass of helium nulceus $= 4.001235amu$

Mass of proton $= 1.007277amu$

Mass of neutron $= 1.00866amu$

(take 1 amu=$931.4813MeV$).

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9. Binding energy of $._{17}Cl^{35}$ and $._{15}P^{31}$ are 287.67 M and 262.498 Me V which of the two nucleri is more stable ?

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10. if the binding energy per nucleon of deuteron is 1.115 Me V , find its masss defect in atomic mass unit .

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11. A deuteron strikes $._7 N^{14}$ nucles with the subsequent emission of an α -particle ,Find the atomic number , Mass number and chemical name of the element so produced

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12. Neon-23 decays in the following way,

$._{10}^{23} Ne \rightarrow_{11}^{23} Na +_{-1}^{0} e + \bar{v}$

Find the minimum and maximum kinetic energy that the beta particle $\left(._{-1}^{0} e\right)$ can have. The atomic masses of $.^{23} Ne$ and $.^{23} Na$ are $22.9945u$ and $22.9898u$, respectively.

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13. find the amount of energy produced in jaoules due to fission of 1 g of $._{92} U^{235}$ assuming that 0.1% of mass is transormed into enengy ,Atomic mass of $._{92} U^{235} = 235$ amu , Avogodro number $N_A = 6.023 \times 10^{23}$. Given that the energy released per fission is 200 MeV.

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14. Find the amount of energy released when 1 atom of Uranium $._{92}U^{235}(235.0439\text{amu})$ undergoes fission by slow neturon (1.0087amu) and is splitted into Krypton $._{36}Kr^{92}(91.8973\text{amu})$ and Barium $._{56}Br^{141}(140.9139\text{amu})$ assuming no energy is lost. Hence find the enrgy in kWh, when $1g$ of it undergoes fission.

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15. In a neutron induced fission of $._{92}U^{235}$ nucleus, usable energy of $185MeV$ is released. If $._{92}U^{235}$ reactor is continuously operating it at a power level of $100MW$ power, how long will it take for $1kg$ of uranium to be consumed in this reactor?

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16. The binding energy per nucleon of deuterium and helium atom is $1.1MeV$ and $7.0MeV$. If two deuterium nuclei fuse to form helium atom, the energy released is.

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17. In the fusion reaction ${}_1^2H + {}_1^2H \rightarrow {}_2^3He + {}_0^1n$, the masses of deuteron, helium and neutron expressed in amu are $2.015, 3.017$ and 1.009 respectively. If $1kg$ of deuterium undergoes complete fusion, find the amount of total energy released. 1 amu $= 931.5MeV/c^2$.

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18. in a nucleri reactor U^{235} undergoes fission releasing energy 100 MeV , the reactor has 20% efficiency and the power produces is 2000 MW . If the reactor is to fuction for 5 yr , find the total mass of uranium required .

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19. How may $\alpha-$ and $\beta-$ particles will be emitted when $._{90}Th^{232}$ changes into $._{82}Pb^{208}$?

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20. 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.

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

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

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

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24. At time $t = 0$, activity of a radioactive substance is $1600 Bq$, at $t = 8s$ activity remains $100 Bq$. Find the activity at $t = 2s$.

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25. A $.^{7}Li$ target is bombarded with a proton beam current of 10^{-4} A for 1 hour to produce $.^{7}Be$ of activity 1.8×10^{8} disintegrations per second. Assuming that $.^{7}Be$ radioactive nucleus is produced by bombarding 1000 protons, determine its half-life.

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26. Determine the amount of $_{84}Po^{210}$ (polonium) necessary to provide a source of α -particles of 5 millicurice strength , if life of polonium is 138 days (given ,1 curie $= 3.7 \times 10^{10}$ disintegrations /s)

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27. (a) Calculate the activity of one mg sample $._{28}Sr^{90}$ whose half life period is 28 years.

(b) An experiment is performed to determine the half-life of a radioactive substance which emits one beta particle for each decay process. Observation shown that an average of $8.4\beta -$ particles are emitted each

second by $2.5mg$ of the substance. the atomic weight of the substance is 230. calculate the half0life of the substance.

(c) Determine the quantity of ${}_{84}{}^{Po^{210}}$ necessary to provide a source of alpha particle of $5mCi$ strength ($T_{1/2}$ for Po $= 138$ day).

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28. In an experiment on two radioactive isotopes of an element (which do not decay into each other), their number of atoms ratio at a given instant was found to be 3. The rapidly decaying isotope has large mass and an activity of $1.0\mu Ci$ initially. The half-lives of the two isotopes are known to be 12 hours and 16 hours. what would be the activity of each isotope and their number of atoms ration after two days?

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29. At a given instant there are 25% undecayed rodioctive nuclei in sample After 10 s the number of undecyed nuclei reduces to 12.5 $\%$ calculate the mean life of the nuclei .

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30. 1g of a radioactive substance disintegrates at the rate of 3.7×10^{10} disintegrations per second. The atomic massof the substance is 226. Calculate its mean life.

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31. In the chemical analysis of a rock the mass ratio of two radioactive isotopes is found to be $100:1$. The mean lives of the two isotopes are 4×10^9 years and 2×10^9 years, respectively. If it is assumed that at the time of formation the atoms of both the isotopes were in equal propotional, calculate the age of the rock. Ratio of the atomic weights of the two isotopes is $1.02:1$.

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32. Uranium ores on the earth at the present time typically have a composition consisting of $99.3\,\%$ of the isotope $._{92}U^{238}$ and $0.7\,\%$ of the isotope $._{92}U^{235}$. The half-lives of these isotopes are $4.47 \times 10^9 yr$ and $7.04 \times 10^8 yr$, respectively. If these isotopes were equally abundant when the earth was formed, estimate the age of the earth.

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33. The nuclei of two radioactive isotopes of same substance A^{236} and A^{234} are present in the ratio of $4:1$ in an ore obtained from some other planet. Their half lives are $30\ \min$ and $60\ \min$ respectively. Both isotopes are alpha emitters and the activity of the isotope with half-life $30\ \min$ is $10^6 dps$. Calculate after how much time their activites will become identical. Also calculate the time required to bring the ratio of their atoms to $1:1$.

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34. 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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35. U^{238} is found to be in secular equilibrium with Ra^{226} on its ore. If chemical analysis shows 1 nuclei of Ra^{226} per 3.6×10^{-6} nuclei of U^{238}, find the half-life of U^{238}. Given the half-life is 1500 years.

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36. A radioactive element decays by β-emission. A detector records n-beta particles in 2 s and in next 2 s it records 0.45 n beta particles. Find mean life.

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37. A small quantity of solution containing Na^{24} radio nuclide $(half-l \text{ if } e=15h)$ of activity $1.0microcurie$ 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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38. A 25 g piece of charcoal is found in some ruins of an ancient city. The sample shows a C^{14} activity of 250 decay/minutes. How long has the three this charcoal came from been dead ? Given, the half-life of C^{14} is 5730 years. The ratio of C^{14} and C^{12} in the living sample is 1.3 $\times10^{-12}$.

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Checkpoint 13 1

1. The mass number of a nucleus is.

A. always less than its atomic number

B. always more than its atomic number

C. always equal to its atomic number

D. sometimes more than and sometimes equal to its atomic number

Answer: d

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2. Outside a nucleus.

A. neutron is stable

B. proton and neutron both are stable

C. neutron is unstable

D. neither neutron nor proton is stable

Answer: c

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3. Nucleus of an atom whose mass number is 24 consists of

A. 11 electrons ,11 protrons and 13 eutrons

B. 11 electrons 13 proton and 1 neutrons

C. 11 protons and 3 protons

D. 11 protons and 31 electrons

Answer: a

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4. For a nucleus to be stable, the correct relation between neutron number N and proton number Z is.

A. NgtZ

B. N=Z

C. NltZ

D. Ngtz

Answer: b

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5. In helium nucleus, there are.

A. 2 proons and 2 elecrons

B. 2 neutrons ,12 protons and 2 electrons

C. 2 protons and 2 neutrons

D. 2 positrons and 2 protons

Answer: c

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6. In $._{88}Ra^{226}$ nucleus there are

A. 138 protons and 88 neutrons

B. 138 neutrons and 88 protons

C. 226 neutrons and 88 electons

D. 226 neutons and 138 electrons

Answer: b

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7. If the atomic masses of C and S are 12 and 32 respectively, then atom of S is how many times heavier than an atom of carbon ?

A. two extra protons and two extra electrons

B. two extra prtions but no extra but no wxtra electrons

C. two extra neutrons and no extra electrons

D. two extra neutrons and two extra elecrrons

Answer: c

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8. The radius of a nucleus of a mass number A is directly proportional to.

A. A^3

B. A

C. $A^{2/3}$

D. $A^{1/3}$

Answer: d

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9. the radius of $_{29}Cu^{64}$ nucleus in fermi is

(given , $r_0 1.2 \times 10^{-15}$M)

A. 4.8

B. 1.2

C. 7.7

D. 9.6

Answer: a

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10. the three stable isotopes of 9.051% , 0.27% and 9.22% the atomic masses of the three isotopes are 19.99 u , 20 .99 u and 21.99u respectively the average atomic mass of neon will be

A. 20.71u

B. 30.17u

C. 20.98u

D. 30.98u

Answer: A

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Checkpoint 13 2

1. $1g$ of hydrogen is converted into $0.993g$ of helium in a thermonuclear reaction. The energy released is.

A. $63 \times 10^7 J$

B. $36 \times 10^{10} J$

C. $63 \times 10^{14} J$

D. $63 \times 10^{20} J$

Answer: B

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2. if an electron and a positron annihilitate , them the energy relasesed is

A. $3.2 \times 10^{-13} J$

B. $1.6 \times 10^{-13} J$

C. $4.8 \times 10^{-13} J$

D. $6.4x10^{-13} J$

Answer: b

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3. The mass defect in a particular nuclear reaction is 0.3 grams. The amont of energy liberated in kilowatt hours is.

(Velocity of light $= 3 \times 10^8 m/s$).

A. 1.5×10^6

B. 2.5×10^6

C. 3×10^6

D. 7.5×10^6

Answer: d

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4. $M, M_n \& M_p$ 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. $M < (A - Z)_{mn} + Z_{mp}$

B. $M = (A - Z)_{mn} + Z_{mp}$

C. $M = (A - Z)_{mp} + Z_{mn}$

D. $M > (A - Z)_{mn} + Z_{mp}$

Answer: a

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5. The masses of neutron and proton are 1.0087 a.m.u. and 1.0073 a.m.u. respectively. If the neutrons and protons combine to form a helium nucleus (alpha particle) of mass 4.0015a.m.u. The binding energy of the helium nucleus will be $(1a.\,m.\,u.\ = 931MeV)$.

A. 28.4meV

B. 20.8 MeV

C. 27.3 MeV

D. 14.2 MeV

Answer: A

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

The total energy liberated will be about.

A. 200 keV

B. 2 MeV

C. 200 MeV

D. 2000 MeV

Answer: C

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

A. increases with mass number at high mass numbers

B. decreases with mass number at high mass number

C. increases with mass number ata low mass number

D. decreasewith mass number at low mass number

Answer: b

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8. A chain reaction is continuous due to

A. large mass defect

B. large energy

C. producation of more neutrons in fission

D. none of the above

Answer: c

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9. The principle of controlled chain reaction is used in.

A. atomic energy reactor

B. atom bomb

C. the core of sum

D. artificial readioactivieity

Answer: a

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10. Which of these is a fusion reaction ?

A. ${}^{3}H_{1} + {}^{2}H_{1} \rightarrow {}^{3}He_{1} + {}^{1}N_{0}$

B. ${}^{238}U_{92} + {}^{206}Pb_{82} + 8\left({}^{4}He_{2}\right) + 6\left({}^{0}B_{1}\right)$

C. ${}^{12}C_{7} \rightarrow {}^{12}C_{6} + \beta + \gamma$

D. none of the above

Answer: a

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11. Solar energy is mainly caused due to

A. fission of uranium present in the sun

B. fusion of protons during sythesis of heavier elements

C. Gravitional contraction

D. burning of hdrogen in the oxygen

Answer: b

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12. Nuclear fusion is common to the pair

A. thermonuclear reactor , uranium based nuclear rector

B. energy producation in sun , uranium based nucleat reactor

C. energy producation insun ,hyducation in sun , hydrogen bomb

D. disntegration of heavy nuclei , hydrogen bomb

Answer: c

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13. Fusion raction takes place at high temperature because

A. molecules break up at high termperature

B. nuclei break up at high temperature

C. atoms get ionsed at high temperature

D. kintic energy is high enough to over come the coulomb repulsion between nuclei

Answer: d

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

A. to control the energy relased in the reactor

B. to absorb neutrons and stop chain reaction

C. to cool the reactor factor

D. to slow down the neutron to thermal anergires

Answer: d

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15. Pick out the correct statement from the following

A. Energy released per unit mass of the reactant is less in case of fusion reaction

B. parcking fraction may be postitive or may be negative

C. Pu^{239} is not suitable for a fission reaction

D. for stable nucleus , the specific bonding energy is low

Answer: b

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Check Point 13 3

1. Alpha rays emitted from a radioactive substance are

A. negatively charged particles

B. ionised hydrogen nuclei

C. doubly ionised helium atom

D. uncharged particles having the mass equal to proton

Answer: C

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2. Pick out the correct statement from the following.

A. α-particles are not deflected by electric and magnetic field.

B. β-particle has less penetrating power than α-particles.

C. γ-rays has the least ionising power than α and β particles

D. γ-rays has the least penetrating power than α and β rays

Answer: C

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3. In the reaction, identify X, ${}_7N^{14} + \alpha \rightarrow {}_8X^{17} + {}_1P^1$

A. An oxygen nucleus with mass 17

B. An oxygen nucleus with mass 16

C. An nitrogen nucleus with mass 17

D. A nitrogen nucleus with mass 16

Answer: A

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4. The emission of beta particle is from A)The valence shell of an atom B)The inner shell of an atom C)The nucleus due to the nuclear conversion :

$\text{Proton} \rightarrow \text{neutron} + \text{electron}$ D)The nucleus due to the nuclear conversion :

$\text{neutron} \rightarrow \text{proton} + \text{electron}$

A. innermost electron orbit

B. a stable nucleus

C. outermost electrons orbit

D. radioactive nucleus

Answer: D

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5. During a negative beta decay,

A. an atomic electron is ejected

B. an electron which is already present with in the nucleus is ejected

C. a neutron in the nucleus decays emitting on electron

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

Answer: A

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6. A radioactive nucleus $._{92}X^{235}$ decays to $._{91}Y^{231}$. Which of following particles are emitted ?

A. One alpha and one electron

B. Two deuterons and one positron

C. One alpha and one proton

D. One proton and four neutrons

Answer: A

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7. The half-life of a radioactive element which has only $\frac{1}{32}$ of its original mass left after a lapse of 60 days is

A. 12 days

B. 32 days

C. 60 days

D. 64 days

Answer: A

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8. A radioactive element decays by $\beta -$ emission. A detector racords n-beta particles in 2 sec and in next 2 sec it records $0.65n$-beta particles. Find mean life.

A. 4 s

B. 2 s

C. $\frac{2}{(In2)}s$

D. 2 (In 2)s

Answer: C

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9. The half-life (T) and the disintegration constant (λ) of a radioactive substance are related as

A. $\lambda T_{1/2}$

B. $\lambda T_{1/2} = 0.693$

C. $\frac{T_{1/2}}{\lambda} = 0.693$

D. $\frac{\lambda}{T_{1/2}} = 0.693$

Answer: B

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10. Half-life of radioactive element depend upon

A. amount of element present

B. temperature

C. pressure

D. nature of element

Answer: D

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11. The half-life of pononium is 140 days. After how many days. $16gm$ polonium will be reduced to $1gm$ (or $15gm$ will decay) ?

A. 700 days

B. 280 days

C. 560 days

D. 420 days

Answer: C

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12. Ceratain radioactive substance reduces to $25\ \%$ of its value is $16 days$.

Its half-life is

A. 32 days

B. 8 days

C. 64 days

D. 28 days

Answer: B

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13. C^{14} has a half life of 5700 yrs. At the end of 11400 years, the actual amount left is

A. 0.5 of original amount

B. 0.25 of original amount

C. 0.125 of original amount

D. 0.0625 of original amount

Answer: B

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14. If the half-life of a radioactive sample is 10 hours its mean life is

A. 14.4 h

B. 7.2 h

C. 20 h

D. 6.93 h

Answer: A

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15. Mean life of a radioactive sample is 100s . Then ,its half-life (in min) is

A. 0.693

B. 1

C. 10^{-4}

D. 1.155

Answer: D

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Chapter Exercises

1. Following process is known as $hv \rightarrow e^{+} + e^{-}$

A. Pair production

B. Photoelectric effect

C. Compton effect

D. Zeeman effect

Answer: A

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2. 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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3. Which of the following is not used for the treatment of cancer

A. K^{40}

B. Co^{60}

C. Sr^{90}

D. I^{131}

Answer: B

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4. Identify the correct statement given below.

A. Alpha rays have the highest penetrating powe

B. Beta rays have the highest penetrating power

C. Gamma rays have the highest penetrating power

D. All three kinds of rays have the same penetrating power

Answer: C

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

A. neutrons are heavier than protons

B. electrostatic force between protons are repulsive

C. neutrons decay into protons through beta decay

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

Answer: B

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7. In one average-life,

A. half the active nuclei decay

B. less than half the active nuclei decay

C. more than half the active nuclei decay

D. All the nuclei decay

Answer: C

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

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

B. It is the energy made available when free nucleons combine to form a nucleus

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

D. None of the above

Answer: D

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9. As compared to $\hat{}\ 12C$ atom, $\hat{}\ 14C$ atoms has

A. two extra protons and two extra electrons

B. two extra protons but no extra electron

C. two extra neutrons and no extra electron

D. two extra neutrons and two extra electrons

Answer: C

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

A. increases continuously with mass number

B. decreases continuously with mass number

C. remians constant with mass number

D. first increases and then decreases with increases of mass number

Answer: D

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11. The binding energy per nucleon is maximum in the case of.

A. ${}_{2}^{4}He$

B. ${}_{26}^{56}Fe$

C. ${}_{56}^{141}Ba$

D. ${}_{92}^{235}U$

Answer: B

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12. Which of the following process will result into fission reaction ?

A. ${}_{92}U^{235}$ is bombarded with fast moving neutrons

B. ${}_{92}U^{235}$ is bombared with thermal neutrons

C. U^{238} is bombarded with slow moving neutrons

D. U^{235} being unstable breaks into smaller fragments

Answer: B

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13. What fissionable material was used in the bomb dropped at Nagasaki (Japan) in the year 1945 ?

A. Uranium

B. Neptunium

C. Berkelium

D. Plutonium

Answer: D

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14. The principle of controlled chain reaction is used in.

A. atomic energy reactor

B. atom bomb

C. the core of sun

D. artificial radioactivity

Answer: A

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15. In an atom bomb, the energy is released because of the.

A. chain reaction of neutrons and $_{92}U^{235}$

B. chain reaction of neutrons and $_{92}U^{238}$

C. chain reaction of neutrons and $_{92}U^{240}$

D. chain reaction of neutrons and $_{92}U^{236}$

Answer: A

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16. Boron rods are used in nuclear reactors because

A. boron can absorb neutrons

B. strength is given to the plant

C. chain reaction of neutrons and $_{92}U^{240}$

D. the reactors look good

Answer: A

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17. A nuclear reaction along with the masses of the particle taking part in it is as follows

$$\underset{1.002\ \text{amu}}{A} + \underset{1.004\ \text{amu}}{B} \rightarrow \underset{1.001\ \text{amu}}{C} + \underset{1.003\ \text{amu}}{D} + QMeV$$

The energy Q liberated in the reaction is

A. $1.234MeV$

B. $0.931MeV$

C. $0.465MeV$

D. $1.862MeV$

Answer: D

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18. The curve of blinding energy per nucleon as a function of atomic mass number has a sharp peak for helium nucleus. This implies that helium.

A. can easily be broken up

B. is very stable

C. can be used as fissionable material

D. is radioactive

Answer: B

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19. In the given nuclear reaction A, B, C, D, E represents ${}_{92}U^{238} \rightarrow^{\alpha} {}_{B}Th^{A} \rightarrow^{\beta} {}_{D}Pa^{C} \rightarrow^{E} {}_{92}U^{234}$.

A. $A = 234, B = 90, C = 234, D = 91$ and $E = \beta$

B. $A = 234, B = 90, C = 238, D = 94$ and $E = \alpha$

C. $A = 238, B = 93, C = 234, D = 91$ and $E = \beta$

D. $A = 234, B = 90, C = 234, D = 93$ and $E = \alpha$

Answer: A

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20. An atom of mass number 15 and atomic number 7 captures an $\alpha -$ particle and then emits a proton. The mass number and atomic number of the resulting product will respectively be.

A. 14 and 2

B. 15 and 3

C. 16 and 4

D. 18 and 8

Answer: D

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21. The binding energies of the nuclei A and B are E_α and E_α respectively. Three atoms of the element B fuse to give one atom of element A and an energy Q is released. Then, E_a, E_b Q are relaetd as

A. $E_a - 3E_b = Q$

B. $3E_b - E_a = Q$

C. $E_a + 3E_b = Q$

D. $E_b + 3E_a = Q$

Answer: A

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22. The total number of α and β particles emitted in the nuclear reaction $^{238}_{92}U \rightarrow {}^{214}_{82}Pb$ is

A. 6

B. 7

C. 8

D. 10

Answer: C

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

C. The containers will in general have different 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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24. $90\,\%$ of a radioactive sample is left undecayed after time t has elapesed. What percentage of the initial sample will decay in a total time $2t$?

A. 0.2

B. 0.19

C. 0.4

D. 0.38

Answer: B

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25. 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. $Q_1 = (M_x - M_y)c^2$ and $Q_2 = [M_x - M_y - 2m_e]c^2$

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

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

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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26. Half life of a radio-active substance is 20 minutes. The time between $20\,\%$ and $80\,\%$ decay will be

A. 20 min

B. 40 min

C. 30 min

D. 25 min

Answer: B

Watch Video Solution

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

A. 128 h

B. 24 h

C. 6h

D. 12h

Answer: D

Watch Video Solution

28. The decay constant of a radioactive sample is $'\lambda'$. The half-life and mean life of the sample are respectively a) $\frac{1}{\lambda}, \frac{\text{in}2}{\lambda}$ b) $\frac{\text{in}2}{\lambda}, \frac{1}{\lambda}$ c) $\text{in}2, \frac{1}{\lambda}$ d) $\frac{\lambda}{\text{in}2}, \frac{1}{\lambda}$

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

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

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

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

Answer: B

Watch Video Solution

29. A radioactive substance disintegrates 1/64 of initial value in 60 s. The half-life of this substance is

A. 5 s

B. 10 s

C. 30 s

D. 20 s

Answer: B

Watch Video Solution

30. In the reaction $._1^2H + ._1^3H \rightarrow ._2^4He + ._0^1n$, if the binding energies of $._1^2H$, $._1^3H$ and $._2^4He$ are respectively a, b and c (in MeV), then the energy (in MeV) released in this reaction is.

A. c+a+b

B. c-a-b

C. a+b+c

D. a+b-c

Answer: B

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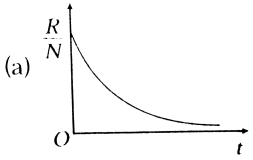
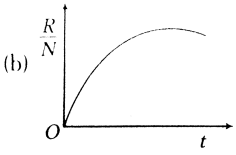
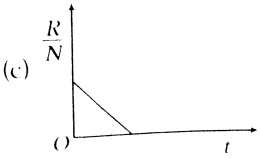
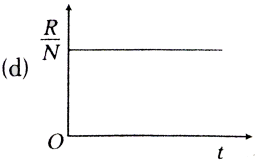
31. A radioactive sample has N_0 active at $t = 0$. If the rate of disintegration at any time is R and the number of atoms is N, them the ratio R/N varies with time as.

A. 

B. 

C. 

D. 

Answer: D

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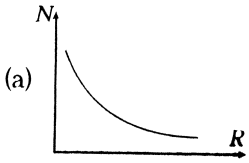
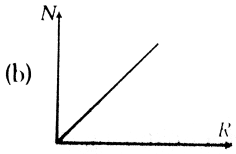
32. The plot of the number (N) of decayed atoms versus activity (R) of a radioactive substance is

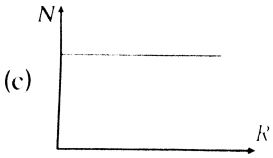
A.



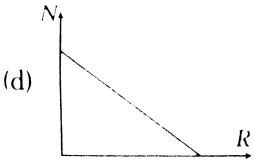
B.



C.



D.



Answer: D

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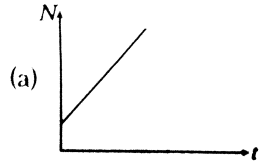
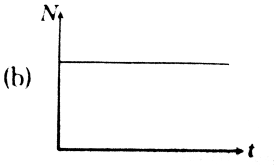
33. The graph between the instantaneous concentration (N) of a radioactive element and time (t) is.

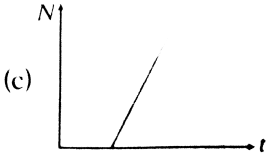
A.



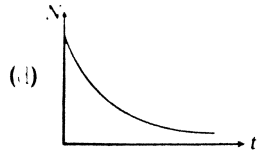
B.



C.



D.



Answer: D

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34. Two redioactive materials X_1 and X_2 have decay constants 10λ and λ, respecitvely. If initially they have the same number of nuclei,

then the ratio of the number of nuclei of X_1 to that of X_2 will be 1/e after a time

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

B. $\left(\frac{1}{11\lambda}\right)$

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

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

Answer: D

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

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

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

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

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

Answer: C

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36. What is the binding energy per nucleon of $_{}(6)C^{12}$nucleus?

Given , mass of C^{12} $(m_c)_m$ = 12.000 u

Mass of proton m_p = 1.0078 u

Mass of neutron m_n = 1.0087 u

and 1 amu = 931.4 MeV

A. 5.26 MeV

B. 6.2 MeV

C. 4.65 MeV

D. 7.68 MeV

Answer: D

Watch Video Solution

37. A radioactive isotope X with a half-life of 1.37×109 years decays to Y which is stable. A sample of rock from the moon was found to contain both the elements X and Y which were in the ratio of $1:7$. The age of the rock is.

A. $1.96 \times 10^8 yr$

B. $3.85 \times 10^9 yr$

C. $4.11 \times 10^9 yr$

D. $9.59 \times 10^{14} yr$

Answer: C

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

A. 0.5×10^{14}

B. 0.5×10^{22}

C. 5×10^{12}

D. 5×10^{14}

Answer: D

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39. A common example of $\beta -$ decay is

$_{15}P^{32} \rightarrow {}_{16}P^{32} + x + y$

Then, x and y stand for

A. electron and nectrino

B. positron and neutrino

C. electron and antineutrino

D. positron and antineutrino

Answer: C

Watch Video Solution

40. A nucleus with Z =92 emits the following in a sequence:

$\alpha, \beta^-, \beta^-, \alpha, \alpha, \alpha, \alpha, \beta^-, \beta^-, \alpha, \beta^+, \beta^+, \alpha$. The Z of the resulting nucleus is

A. 74

B. 76

C. 78

D. 82

Answer: C

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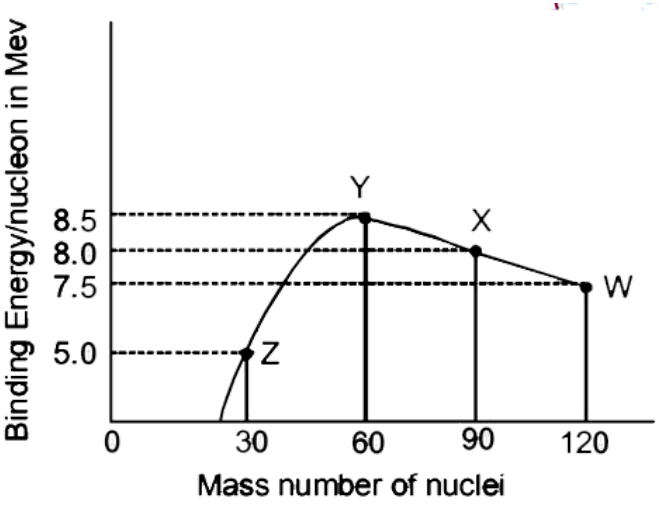
41. Binding energy per nucleons vs mass curve for nucleus is shown in the figure W, X, Y and Z are four nuclei indicated on the curve . The process that would release energy is



A. $Y \rightarrow 2Z$

B. $W \rightarrow X + Y$

C. $W \rightarrow 2Y$

D. $X \rightarrow Y + Z$

Answer: C

Watch Video Solution

42. 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 proess connot 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. Ferr neutrons decay due to external perturbations which is absent in triton nucleus

Answer: A

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43. 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 relate to the mass of the hydrogen atom

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

Answer: B

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44. In a sample of radioactive material, what fraction of initial number of active nuclei will remain undistintegrated after half of a half0life of the sample?

A. $\sqrt{2} - 1$

B. $1\sqrt{2}$

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

D. $1/4$

Answer: B

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45. In a radioactive sample, the fraction of initial number of redioactive nuclie, which remains undecayed after n mean lives is

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

B. e^n

C. $1-\frac{1}{e^n}$

D. $\left(\frac{1}{e-1}\right)^n$

Answer: A

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

A. $1:1$

B. $2:1$

C. $1:2$

D. $1:4$

Answer: A

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47. A radioactive isotope X with half-life 1.5×10^9 yr decays into a stable nucleus Y .A rock sample contains both elements X and Y in the ratio 1 : 15. They age of the rock is

A. $3.0 \times 10^9 yr$

B. $4.5 \times 10^9 yr$

C. $6.0 \times 10^9 yr$

D. $9.0 \times 10^9 yr$

Answer: C

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48. The half-life of a sample of a radioactive substance is 1 hour. If 8×10^{10} atoms are present at $t = 0$, then the number of atoms decayed in the duration $t = 2$ hour to $t = 4$ hour will be

A. 2×10^{10}

B. 1.5×10^{10}

C. zero

D. infinity

Answer: B

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49. Half-life of a radioactive substance is 20 minutes. Difference between points of time when it is $33\,\%$ disintegrated and $67\,\%$ disintegrated is approximate.

A. 10 min

B. 20 min

C. 30 min

D. 40 min

Answer: B

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50. A and B are two radioactive substances whose half lives are 1 and 2 years respectively. Initially $10gm$ of A and $1gm$ of B is taken. The time (approximate) after which they will have same quantity remaining is.

A. $6.62yr$

B. 5yr

C. $3.2yr$

D. 7yr

Answer: A

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51. The decay constant of a radioactive element is defined as the reciprocal of the time interval after which the number of atoms of the radioactive element falls to neraly

A. 50% of its original number

B. 36.8% of its original number

C. 63.2% of its original number

D. 75% of its original number

Answer: B

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52. They decay constant of radioactive element is $1.5 \times 10^9 s^{-1}$ Its mens-life (in second) will be

A. $1. \times 10^9$

B. 4.62×10^8

C. 6.67×10^8

D. 10.35×10^8

Answer: C

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53. A radioactive material has mean lives of 1620 yr and 520 yr for α and $\beta-$ emission, respectively. The material decays by simultaneous α and $\beta-emissions$. The time in which 1/4th of the material remains intact is

A. 4.675 yr

B. 7.20 yr

C. 5.45 yr

D. 324 yr

Answer: C

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

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

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

C. N_0

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

Answer: A

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55. After three 'average life times' of a radioactive sample, the amount of substance remains x% of the original amount. Then, approximate value of x is

A. 14

B. 37

C. 7

D. 5

Answer: D

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56. An archaeologist analyses the wood in a phehistoric structure and finds that C^{14} (Half-life $= 5700$ years) to C^{12} only one-fourth of that found in the cells buried plants. The age of the wood is about

A. 5700 yr

B. 2850 yr

C. 11400 yr

D. 22800 yr

Answer: C

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57. A radioactive element A of decay constant λ_A decays into another radioactive element B of decay constant λ_B. Initially the number of active nuclei of A was N_0 and B was absent in the sample. The maximum number of active nuclei of B is found at t=2. In $2/\lambda_A$. The maximum number of active nuclei of B is

A. $\frac{N_0}{4}$

B. $\frac{\lambda_A}{\lambda_B} N_0 e^{-\lambda_B t}$

C. $\frac{\lambda_A}{\lambda_B} \frac{N_0}{4}$

D. None of these

Answer: C

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58. 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. $TIn\left(\frac{R_p}{R_q}\right)$

B. $TIn\left(\frac{R_q}{R_p}\right)$

C. $T\left(\frac{R_p}{R_q}\right)$

D. $T\left(\frac{R_q}{R_p}\right)$

Answer: B

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59. An energy of $24.6eV$ is required to remove one of that electrons from a neutal helium atom. The enegy (in eV)required to remove both the electrons from a netural helium atom is

A. 38.2

B. 49.2

C. 51.8

D. 79.0

Answer: D

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60. The activity of a sample of radioactive material is R_1 at time t_1 and R_2 at time $t_2 (t_2 > t_1)$. Its mean life is T. Then,

A. $R_1 t_1 = R_2 t_2$

B. $\frac{R_1 - R_2}{t_1 - t_2}$=constant

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

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

Answer: C

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61. A heavy nucleus at rest breaks into two fragments which fly off with velocities in the ratio $8:1$. The ratio of radii of the fragments is.

A. $1:2$

B. $1:4$

C. $4:1$

D. $2:1$

Answer: A

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62. For a substance the average life for $\alpha-$ emission is 1620 years and for $\beta-$ emission is 405 years. After how much time the $1/4$ of the material remains after α and β emission ?

A. 1500 yr

B. 300 yr

C. 449 yr

D. 810 yr

Answer: C

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63. Two radioactive nuclei P and Q, in a given sample decay into a stable nucleus R. At time $t = 0$, number of P species are $4N_0$ and that of Q are N_0. Half-life of P (for conversation to R) is $1mm$ whereas that of Q is $2\ \min$. Initially there are no nuclei of R present in the sample. When number of nuclei of P and Q are equal, the number of nuclei of R present in the sample would be :

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

B. $2N_0$

C. $3N_0$

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

Answer: D

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64. The half-life a radioacitve substance is 40 yeard. How long will it take to reduce to one fourth of its original amount and what is the value of decay constant ?

A. $40yr, 0.9173/yr$

B. $90yr, 9.017/yr$

C. $80yr, 0.0173/yr$

D. None of these

Answer: C

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65. Starting with a sample of pure $.^{66}Cu, 7/8$ of it decays into Zn in $15\ \min$. The corresponding half-life is.

A. 5 min

B. $7\frac{1}{2}\ \min$

C. 10 min

D. 15 min

Answer: A

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66. A stationary radioactive nucleus of mass 210 units disintegrates into an alpha particle of mass 4 units and residual nucleus of mass 206 units. If the kinetic energy of the alpha particle is E, then the kinetic energy of the residual nucleus is

A. $\left(\frac{2}{105}\right)E$

B. $\left(\frac{2}{103}\right)E$

C. $\left(\frac{103}{105}\right)E$

D. $\left(\frac{103}{2}\right)E$

Answer: B

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67. A bone containing $200g$ carbon-14 has β-decay rate of 375 decay/min. Calculate the time that has elapsed since the death of the living one. Given the rate of decay for the living organism is equal to 15 decay per min per gram of carbon and half-life of carbon-14 is $5730 years$.

A. 22920 yr

B. 11460 yr

C. 17190 yr

D. None of these

Answer: C

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

A. 10kg

B. 1kg

C. 1g

D. 10g

Answer: C

Watch Video Solution

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

A. $5\log_e 2$

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

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

D. $5\log_{10} 2$

Answer: A

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70. In the nuclear fusion reaction

$$_{-}(1)^2H + {}^3_1H \rightarrow {}^4_2He + n$$

given that the repulsive potential energy between the two nuclei is $-7.7 \times 10^{-14} J$, the temperature at which the gases must be heated the

reaction is nearly

[Boltzmann's constant $k = 1.38 \times 10^{-23} J/K$]

A. $10^9 K$

B. $10^7 K$

C. $10^5 K$

D. $10^3 K$

Answer: A

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

A. 3.8 days

B. 16.5days

C. 33 days

D. 76 days

Answer: B

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72. The half-life of radioactive Polonium (Po) is 138.6 days. For ten lakh Polonium atoms, the number of disintegrations in 24 hours is.

A. 2000

B. 3000

C. 4000

D. 5000

Answer: D

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73. If half-life of a substance is 3.8 days and its quantity is $10.38gm$. Then substance quantity remaining left after 19 days will be

A. $2.151g$

B. 0.31 g

C. 1.51 g

D. 0.16 g

Answer: B

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

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

B. 4λ

C. 2λ

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

Answer: D

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75. 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:

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

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

A. 10^{18} s

B. 10^{28} s

C. 10^{12} s

D. 10^{16} s

Answer: C

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76. The sun radiates energy in all directions. The average radiations received on the earth surface from the sun is $1.4 \text{kilowatt}/m^2$. The average earth-sun distance is 1.5×10^{11} meters. The mass lost by the sun per day is.

A. $4.4 \times 10^9 kg$

B. $7.6 \times 10^{14} kg$

C. $3.8 \times 10^{12} kg$

D. $3.8 \times 10^{14} kg$

Answer: D

Watch Video Solution

77. If $10\ \%$ of a radioactive material decays in 5 days, then the amount of original material left after 20 days is approximately.

A. $60\ \%$

B. $65\ \%$

C. $70\ \%$

D. $75\ \%$

Answer: B

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78. A small quantity of solution containing Na^{24} radio nuclide $(half - l \text{ if } e = 15h)$ of activity $1.0microcurie$ is injected into the blood of a person. A sample of the blood of volume $1cm^3$ taken after $5h$ shows an activity of 296 disintegrations per minute. Determine the total

volume of the blood in the body of the person. Assume that the radioactive solution mixes uniformly in the blood of person.

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

A. $5.94L$

B. 2 L

C. 317 L

D. 1 L

Answer: A

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B Medical Entrance Special Format Questions

1. Radioactive nuclei emit β^{-1} particles.

Electrons exist inside the nucleus.

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason are true but Reason is not correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: C

2. Density of all the nuclei is same.

Radius of nucleus is directly proportional to the cube root of mass number.

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason are true but Reason is not correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: A

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3. Assertion Ionisation power of α-particles is maximum while penetration power of γ-rays is maximum.

Reason α-particles are haaviest particles, while γ-rays have maximum energy.

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason are true but Reason is not correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: A

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4. The binding energy per nucleon, for nuclei with atomic mass number $A > 100$, decreases with A.

The nuclear forces are weak for heavier nuclei.

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason are true but Reason is not correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: C

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5. Assertion : In a nuclear process energy is released if total binding energy of daughter nuclei is more than the total binding energy of parent nuclei.

Reason: If energy is released then total mass of daughter nuclei is less than the total mass of parent nuclei.

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason are true but Reason is not correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: B

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6. Assertion In one half-life of a radioactive substance more number of nuclei are decayed than in one average life.

Reason Average life = Half -life/in (2)

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason are true but Reason is not correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: D

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7. Assertion Two different radioactive substances have initially same number of nuclei. Their decay constants are λ_1 and $\lambda_2 (< \lambda_1)$. Then, initially first radioactiv substance decays at faster rate.

Reason Half-life of first radioactive substance is less.

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason are true but Reason is not correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: A

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8. Assertion Positive value of packing fraction implies a large value of binding energy.

Reason The ratio of the difference between the atomic mass of nucleus and the mass number of the nucleus to that of atomic mass is called packing fraction.

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason are true but Reason is not correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: D

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9. Assertion If high pressur is applied on a radioactive substance rate of radioactivity is a nuclear process.

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason are true but Reason is not correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: D

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Match The Columns

1. From a radioactive substance x numbers of α-particles any y numbers of β-particles are emitted. As a result atomic number decreases by n and mass number by m. Then, match the following two columns.

	Column I		Column II
(A)	$x = 1$ and $y = 2$	(p)	$n = 2, m = 0$
(B)	$x = 2$ and $y = 1$	(q)	$n = 0, m = 4$
(C)	$x = 0$ and $y = 2$	(r)	$n = 2, m = 4$
(D)	$x = 1$ and $y = 0$	(s)	None

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2. Match the statement in Column I to the approprate statement(s) from Column II.

	Column I		Column II
(A)	Nuclear fusion	(p)	Converts some matter into energy
(B)	Nuclear fission	(q)	Generally possible for nuclei with low atomic number
(C)	β-decay	(r)	Generally possible for nuclei with higher atomic number
(D)	Exothermic nuclear reaction	(s)	Essentially proceeds by weak nuclear forces

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3. Match the statement in Column I to the appropriate statement(s) from Column II.

	Column I		Column II
(A)	Stability of nucleus decided by	(p)	–ve
(B)	Four radioactive substance spontaneously decays because its	(q)	Binding energy per nucleon is minimum
(C)	For the stable orbit or bound orbit, total energy	(r)	Neutron-proton ratio
(D)	Stopping potential	(s)	Packing fraction

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4. Match the Clumn I of the nuclear processes with Column II containing parent nucleus and one of the end products of each process.

	Column I		Column II
(A)	Alpha decay	(p)	${}_{8}^{15}O \rightarrow {}_{7}^{15}N + \ldots$
(B)	β^+ decay	(q)	$U^{238} \rightarrow U^{234} + \ldots$
(C)	Fission	(r)	${}_{83}^{185}Bi \rightarrow {}_{82}^{184}Pb + \ldots$
(D)	Proton emission	(s)	${}_{94}^{239}Pb \rightarrow {}_{57}^{140}La + \ldots$

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C Madical Entrances Gallery

1. The half-life of a radioactive substance is 30 minutes, The time (in minutes) taken between $40\,\%$ decay and $85\,\%$ decay of the same radioactive substance is.

A. 15

B. 30

C. 45

D. 60

Answer: D

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2. The kinetic energy of α-particle emitted in the α-decay of ${}_{88}Ra^{266}$ is [given, mass number of Ra = 222 u]

A. 5.201 Me V

B. 3.301 Me V

C. 6.023 Me V

D. 4.871 Me V

Answer: D

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3. If radius of the ${}_{13}^{27}Al$ nucleus is taken to be R_{AI}, then the radius of ${}_{53}^{125}Te$ nucleus is nearly

A. $\left(\frac{53}{13}\right)^{1/3} R_{Al}$

B. $\frac{5}{3} R_{Al}$

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

D. $\left(\frac{13}{53}\right)^{1/3} R_{Al}$

Answer: B

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4. Two spherical nuclei have mass number 216 and 64 with their radii R_1 and R_2 respectively. The ratio, $\frac{R_1}{R_2}$ is equal to

A. $3:2$

B. $1:3$

C. $1:2$

D. $2:3$

Answer: A

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5. In a nuclear reactor, the number of U^{235} nuclei undergoing fissions per second is 4×10^{20}. If the energy releases per fission is 250 MeV, then the total energy released in 10 h is $\left(1eV = 1.6 \times 10^{-19} J\right)$

A. $576 \times 10^{6} J$

B. $576 \times 10^{12} J$

C. $576 \times 10^{15} J$

D. $576 \times 10^{12} J$

Answer: B

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6. Nuclear fusion is not found in

A. thermonuclear reactor

B. hydrogen bomb

C. energy productin in sun

D. atom bomb

Answer: D

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7. Obtain approx. the ratio of the nuclear radii of the gold isotope $._{79}Au^{197}$ and silver isotope $._{47}Ag^{107}$.

A. $197:107$

B. $47:79$

C. $79:47$

D. $1:1$

Answer: D

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8. A radioactive element X disintegrates successively

$$X \xrightarrow{\beta^-} X_1 \xrightarrow{\alpha} X_2 \xrightarrow{\beta_-} X_3 \xrightarrow{\alpha} X_4$$

If atomic number and atomic mass number of X are respectively, 72 and 180, then what are the corresponding values for X_4 ?

A. $69, 172$

B. $69, 176$

C. $71, 176$

D. $70, 172$

Answer: D

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9. The energy released by the fission of one uranium atom is 200 MeV. The number of fission per second required to prodice 6.4W power is

A. 2×10^{11}

B. 10^{11}

C. 10^{10}

D. 2×10^{10}

Answer: A

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10. How many alpha and beta particles are emitted when uranium $._{92}^{238} U$ decays to lead $._{82}^{206} Pb$?

A. 6 and B

B. 8 and 6

C. 12 and 6

D. 8 and 12

Answer: B

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11. 20% of a radioactive substances decay in 10 days . Calculate the amount of the original material left after 30 days.

A. $78\ \%$

B. $62\ \%$

C. $51\ \%$

D. $48\ \%$

Answer: C

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12. A nucleus splits into two nuclear parts having radii in the ratio $1:2$ Their velocities are in the ratio

A. $4:1$

B. $8:1$

C. $2:1$

D. $6:1$

Answer: B

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13. What is the energy released by fassion of 1 g of U^{235}? (Assume 200 Me V energy is liberated on fission of 1 nucleus)

A. $2.26 \times 10^4 kWh$

B. $1.2 \times 10^4 kWh$

C. $4.5 \times 10^2 kWh$

D. 2.5×10^2 k Wh

Answer: A

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14. The half-life of radium is 1620 yr and its atomic weight is 226 kg per kilo mol. The number of atoms that will decay from its 1g sample per second will be (take, Avogadro's number, $N_A = 6.023 \times 10^{23}$ atom/kilo mol)

A. 3.61×10^{10}

B. 31.1×10^{15}

C. 3.6×10^{12}

D. 3.1×10^{15}

Answer: A

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15. The relationship between decay constant λ and half-life T of a radioactive substance is

A. $\lambda = \frac{\log_{10} 2}{T}$

B. $\lambda = \frac{\log_e 2}{T}$

C. $\lambda = \frac{\log_2 10}{T}$

D. $\lambda = \frac{\log_2 e}{T}$

Answer: B

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16. The binding energy per nucleon of $._3^7 Li$ and $._2^4 He$ nuclei are 5.60 MeV and 7.06 MeV, respectively. In the nuclear reaction $._3^7 Li + ._1^1 H \rightarrow ._2^4 He + ._2^4 He + Q$, the value of energy Q released is

A. 19.6 Me V

B. -2.4 Me V

C. 8.4 Me V

D. 17.3 Me V

Answer: D

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17. For the stabilty of any nucleus,

A. binding energy per nucleon will be more

B. binding energy per nucleon will be less

C. number of electrons will be more

D. None of the aobve

Answer: A

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

A. $90, 233$

B. $90, 238$

C. $91, 238$

D. $93, 238$

Answer:

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19. A radio isotope X with a half life 1.4×10^9 yr decays of Y which is stable. A sample of the rock from a cave was found to contain X and Y in the ratio $1:7$. The age of the rock is

A. $1.96 \times \ \times 10^9 yr0$

B. $3.92 \times \ \times 10^9 yr$

C. $4.20 \times \ \times 10^9 yr$

D. 8.40×10^9 yr

Answer: C

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20. After 300 days, the activity of a radioactive sample is 5000 dps (disintegrations per sec). The activity becomes 2500 dps after another 150 days. The initial activity of the sample in dps is

A. 20000

B. 10000

C. 7000

D. 25000

Answer: A

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21. For the radioactive nuclei that undergo either α or β decay, which one of the following cannot occur?

A. Isobar of original nucleus is produce

B. Isotop of the original nucleus is produced

C. Nuclei with higher atomic number than that of the original nucleus is produced

D. Nuclei with lower atomic number than that of the original nucleus is produced

Answer: B

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22. In the given reaction

$$._{z}X^{A} \rightarrow ._{z+1}Y^{A} \rightarrow ._{z-1}K^{A-4} \rightarrow ._{z-1}K^{A-4}$$

Radioactive radiations are emitted in the sequence.

A. $\alpha, \beta\gamma$

B. γ, α, β

C. β, α, γ

D. λ, β, α

Answer: C

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23. Control rods of calcium or boron are inserted into the nuclear reactor to absorb neutrons.

A. graphite

B. cadmium

C. uranium

D. barium

Answer: B

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24. The fusion reaction in the sun is a multi-sept process in which the

A. helium is burned into deuterons

B. helium is burned into hydrogen

C. deuteron is burned into hydrogen

D. hydrogen is burned into helium

Answer: D

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25. The nuclear fusion reaction between deuterium and tritium takes place

A. at low temperature and low pressure

B. at very high temperature and very high pressure

C. when the temperature is near absolute zero

D. at ordinary temperature and pressure

Answer: B

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26. The half-life of a radioactive isotope X is $20yr$. It decays to another element Y which is stable. The two elements X and Y were found to be in the ratio $1:7$ in a sample of given rock. The age of the rock is estimated to be

A. 40 yr

B. 60 yr

C. 80 yr

D. 100 yr

Answer: B

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27. A certain mass of hydrogen is changed to helium by the process of fusion. The mass defect in fusion reaction is $0.02866u$. The energy liberated per u is

$(\text{given} \quad 1u = 931MeV)$

A. 2.67 Me V

B. 26.7 Me V

C. 6.675 Me V

D. 13.35 Me V

Answer: C

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28. AU^{235} reactor generated power at a rate of P producting 2×10^{18} fussion per second. The energy released per fission is 185 MeV. The value

of P is

A. 59.2 MW

B. $370 \times 10^{18} MW$

C. $0.59 MW$

D. 370 MW

Answer: A

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29. The purpose of using heavy water in nuclear reactior is

A. to increase the energy released in nuclear fission

B. to cool the rector to room temperature

C. to make the dynamo blades to woek wall

D. to decrease th energy of fast neutrons to the thermal energy

Answer: D

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30. The ratio of volume of nuclei (assumed ot be in spherical shape) with respective mass numbers 8 and 64 is

A. 0.5

B. 2

C. 0.125

D. 0.25

Answer: C

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31. Radioactivity of a sample at T_1 time is R_1 and at time T_2 is R_2. If half-life of sample is T, then in time $(T_2 - T_1)$, the number of decayed atoms is proportional to

A. $R_1T_2 - R_2T_2$

B. $(R_1 - R_2)T$

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

D. $R_1 - R_2$

Answer: B

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32. Which pair is isotonic?

A. ${}_7N^{13}, {}_7N^{14}$

B. ${}_6C^{14}, {}_6C^{12}$

C. ${}_6C^{14}, {}_7C^{14}$

D. ${}_7N^{13}, {}_6C^{12}$

Answer: D

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33. The phenomenon of radioactivity

A. increases on applied pressure

B. is exothermic change which increases or decreases with temperature

C. is nuclear process which does not depend on external force

D. None of the aobve

Answer: C

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34. An atom bomb weighing 1 kg explodes relesing 9×10^{13} J of energy. What percentage of mass is converted into energy ?

A. $0.1\ \%$

B. $1\ \%$

C. 2%

D. 10%

Answer: A

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35. Pick out the correct statements from the following

I. Electron emission during $Brta$-decay is always accompanied by neutrons.

II. Nuclear force is charge independent.

III. Fusion is the chief source of stellar energy.

A. Both I and II are correct

B. Both I and III are correct

C. Only I is correct

D. Both II and III are correct

Answer: D

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36. A radioactive nucleus of mass number A, initially at rest, emits an $\alpha -$ particle with a speed v. What will be the recoil speed of the daughter nucleus ?

A. $\frac{A-4}{4v}$

B. $\frac{4v}{A-4}$

C. v

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

Answer: B

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37. A radioactive substance emit 100 beta particfles in the first 2 s and 50 beta particles in the next 2s. The mean life of the sample is

A. 4 s

B. 2 s

C. $\frac{2}{0.693}s$

D. $2 \times 0.693s$

Answer: C

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38. When alpha particle captures and electron, then it becomes a

A. helium atom

B. hydrogen atom

C. helium ion

D. hydrogen ion

Answer: C

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39. A nucleus ${}_{Z}X^{A}$ emits $9\alpha -$ particles and $5p$ particle. The ratio of total protons and neutrons in the final nucleus is.

A. $\frac{(Z-13)}{(A-36)}$

B. $\frac{(Z-13)}{(A-Z-13)}$

C. $\frac{(Z-13)}{(A-Z-23)}$

D. $\frac{(Z-13)}{(A-Z-23)}$

Answer: D

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40. Half-life of a substance is 10 years. In what time, it becomes $\frac{1}{4}th$ part of the initial amount ?

A. 15 yr

B. 20 yr

C. 25 yr

D. 30 yr

Answer: B

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41. A mixture consists of two radioactive materials A_1 and A_2 with half-lives of $20s$ and $10s$ respectively. Initially the mixture has $40g$ of A_1 and $160g$ of a_2. The amount the two in the mixture will become equal after

A. 60 s

B. 80 s

C. 20 s

D. 40 s

Answer: D

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42. $t_{1/2}$ is the half of a substance then $t_{3/4}$ is the time in which substance

A. substance decays /12

B. substance decays (3/4) th

C. substance remains 1/2

D. substance remains (3/4) th

Answer: B

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43. The half-life of redioactive element is 600 yr. The fraction of sample that would remain after 3000 yr is

A. $1/2$

B. $1/16$

C. $1/8$

D. $1/32$

Answer: D

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44. What is the Q-value of the reaction?

$^1H + {}^7Li \rightarrow {}^4He + {}^4He$

The atomic masses of $^1H, {}^4He$ and ^7Li 1.007825u, 4.0026034u and 7.01600u, respectively.

A. 17.35 Me V

B. 18.06 Me V

C. 177.35 Me V

D. 170.35 Me V

Answer: A

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45. 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. 4.8 Me V

B. 5.4 Me V

C. 5.5Me V

D. 6.8 Me V

Answer: B

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46. A radioactive substance emits n beat particles in the first 2 s and 0.5 n beta particles in the next 2 s. The mean life of the sample is

A. 4 s

B. 2 s

C. $\frac{2}{(1n2)}$

D. 2 (1n 2) s

Answer: C

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