PHYSICS

BOOKS - DISHA PUBLICATION PHYSICS (HINGLISH)

NUCLEI

Jee Main 5 Years At A Glance

1. An unstable heavy nucleus at rest breaks in to two nuclei which move away with velocites oin the ration f 8: 27 The ratio of the radii of the nuclei (assumed to be spherical) is :

A. $8:27$

B. $2:3$

C. $3:2$

D. $4:9$

Answer: C

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2. At some instant, a radioactive sample S_1 having an activity 5 μCi has twice the number of nuclei as another sample S_2 which has an activity of 10 μCi. The half lives of S_1 and S_2 are :

A. 10 years and 20 years , respectively

B. 5 years and 20 years , respectively

C. 20 years and 10 years , respectively

D. 20 years and 5 years , respectively

Answer: B

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3. A solution containing active cobalt $\frac{60}{27}$ Co having activity of $0.8\mu Ci$ and decay constant λ is injected in an animal's body. If $1cm^3$ of blood is drawn from the animal's body after 10hrs of injection , the activity found was 300 decays per minute. What is the volume of blood that is flowing in the body ? ($1Ci = 3.7 \times 10^{10}$ decays per second and at $t = 10$ hrs $e^{-\lambda t} = 0.84$)

A. 8 litres

B. 7 litres

C. 4 litres

D. 5 litres

Answer: D

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4. A nucler reactor delivers a power of 10^9 W. What is the amount of fuel consumed by the reactor in one hour?

A. 0.96 gm

B. 0.8 gm

C. 4×10^{-2} gm

D. 6.6×10^{-5} gm

Answer: C

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5. Two deuterons udnergo nuclear fusion to form a Helium nucleus. Energy released in this process is : (given binding energy per nucleon for deuteron = 1.1 MeV and for helium = 7.0 MeV)

A. 30.2 MeV

B. 32.4 Me V

C. 23.6 Me V

D. 25.8 MeV

Answer: C

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6. A radioactive nucleus A with a half life T, decays into a nucleus B. At t = 0, there is no nucleus B. At sometime t, the ratio of the number of B to that of A is 0.3. Then, t is given by :

A. t = T log (1.3)

B. $t = \frac{T}{\log\ (1.3)}$

C. $t = T\frac{\log 2}{\log 1.3}$

D. $t = \frac{\log 1.3}{\log 2}$

Answer: D

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

A. $1:4$

B. $5:4$

C. $1:16$

D. $4:1$

Answer: B

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8. Let N_β be the number of β particles emitted by 1 gram of Na^{24} radioactive nuclei (half life $= 15$ hrs) in 7.5 hours, N_β is close to (Avogadro number $= 6.023 \times 10^{23}/\text{g. mole}$) :-

A. 6.2×10^{21}

B. 7.5×10^{21}

C. 1.25×10^{22}

D. 1.75×10^{22}

Answer: B

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9. A piece of wood from a recently cut tree shows 20 decays per minute . A wooden piece of same size placed in a

museum (obtained from a tree cut many years back) shows 2 decays per minute . If half life of C^{14} is 5730 years , then age of the wooden piece placed in the museum is approximately :

A. 10439 years

B. 13094 years

C. 19039 years

D. 39049 years

Answer: C

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10. A radioactive nuclei with decay constant 0.5/s is being produced at a constant rate of 100 nuclei/s . If at t = 0 there were no nuclei , the time when there are 50 nuclei is :

A. 1 s

B. $2\ln\left(\frac{4}{3}\right)$ s

C. ln 2 s

D. $\ln\left(\frac{4}{3}\right)$ s

Answer: B

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Exercise 1 Concept Builder

1. M_n and M_p represent mass of neutron and proton respectively. If an element having atomic mass M has $N-$ neutron and Z-proton, then the correct relation will be :

A. $M < [NM_n + ZM_p]$

B. $M > [NM_n + ZM_p]$

C. $M = [NM_n + ZM_p]$

D. $M = N[M_n + M_p]$

Answer: A

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2. If the distance between nuclei is 2×10^{-13} cm , the density of nuclear material is (Assume that nuclear mass is

order of $\left(10^{-27}\right)$

A. $3.21 \times 10^{-12} kg/m^3$

B. $1.6 \times 10^{-3} kg/m^3$

C. $2 \times 10^{9} kg/m^3$

D. $1 \times 10^{17} kg/m^3$

Answer: D

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3. Size of nucleus is of the order of

A. 10^{-10} m

B. 10^{-6} m

C. 10^{-15} m

D. 10^{-13} m

Answer: C

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4. The mass number of He is 4 and that for suphur is 32. The radius of sulphur nuclei is larger than that of helium by

A. $\sqrt{8}$

B. 4

C. 2

D. 8

Answer: C

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5. A nucleus splits into two nuclear parts which have their velocity ratio equal to $5:1$. What will be the ratio of their nuclear radius ?

A. $5^{1/3}:1$

B. $1:5^{1/3}$

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

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

Answer: B

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6. The volume of a nucleus is directly proportional to

A. A

B. A^3

C. $\sqrt{A}$

D. $A^{1/3}$

Answer: A

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7. The set which represents the isotope , isobar and isotone respectively is

A. $\left({}_1H^2, {}_1H^3\right)$, $\left({}_{79}Au^{197}, {}_{80}Hg^{198}\right)$ and $\left({}_2He^3, {}_1H^2\right)$

B. $\left({}_2He^3, {}_1H^1\right)$, $\left({}_{79}Au^{197}, {}_{80}Hg^{198}\right)$ and $\left({}_1H^1, {}_1H^3\right)$

C. $\left({}_2He^3, {}_1H^3\right)$, $\left({}_1H^2, {}_1H^3\right)$ and $\left({}_{79}Au^{197}, {}_{80}Hg^{198}\right)$

D. $\left({}_1H^2, {}_1H^3\right)$, $\left({}_2He^3, {}_1H^3\right)$ and $\left({}_{79}Au^{197}, {}_{80}Hg^{198}\right)$

Answer: D

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8. Outside a nucleus.

A. neutrons 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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9. The mass of neutron is same as that of

A. a proton

B. a meson

C. an epsilon

D. an electron

Answer: A

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10. The nuclei of which one of the following pairs of nuclei are isotons ?

A. ${}_{34}Se^{74}, {}_{31}Ga^{71}$

B. ${}_{38}Sr^{84}, {}_{38}Sr^{86}$

C. ${}_{42}Mo^{92}, {}_{40}Zr^{92}$

D. ${}_{20}Ca^{40}, {}_{16}S^{32}$

Answer: A

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11. If the radius of a nucleus ${}^{256}X$ is 8 fermi , then the radius of ${}^{4}He$ nucleus will be

A. 16 fermi

B. 2 fermi

C. 32 fermi

D. 4 fermi

Answer: B

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12. 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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13. Atomic weight of boron is 10.81 and it has two isotopes $._5 B^{10}$ and $._5 B^{11}$. Then ratio of $._5 B^{10}$ in nature would be.

A. $19:81$

B. $10:11$

C. $15:16$

D. $81:19$

Answer: A

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

A. $10^{20} kg/m^3$

B. $10^{17} kg/m^3$

C. $10^{14} kg/m^3$

D. $10^{11} kg/m^3$

Answer: B

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15. The binding energy per nucleon for ${}_1H^2$ and ${}_2He^4$ are 1.1 MeV and 7.1 MeV respectively. The energy released when two ${}_1H^2$ to form ${}_2He^4$ is ..... MeV.

A. 4.4

B. 8.2

C. 24

D. 28.4

Answer: C

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16. In the nuclear fusion reaction

$_{-}(1)^2H + {}_1^3H \rightarrow {}_2^4He + n$

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. $10^7 K$

B. $10^5 K$

C. $10^3 K$

D. $10^9 K$

Answer: D

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17. Two nucleons are at a separation of 1 fermi. 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 the other is a neutron

A. $F_1 > F_2 > F_3$

B. $F_1 = F_3 = F_2$

C. $F_2 > F_1 > F_3$

D. $F_1 = F_2 > F_3$

Answer: B

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18. Nuclear forces are

A. spin dependent and have no non-central part

B. spin dependent and have a non - central part

C. spin independent and have no non-central part

D. spin independent and have a non -central part

Answer: B

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19. From the following equations pick out the possible nuclear fusion reaction:

A. ${}_6C^{13} + {}_1H^1 \rightarrow {}_6C^{14} + 4.3MeV$

B. ${}_6C^{12} + {}_1H^1 \rightarrow {}_9N^{14} + 2MeV$

C. ${}_7N^{14} + {}_1H^1 \rightarrow {}_8O^{15} + 7.3MeV$

D.

$$_{92}U^{235} + {}_{9}n^{1} \rightarrow {}_{54}X^{140} + {}_{38}Si^{94} + {}_{20}n^{1} + \gamma + 200MeV$$

Answer: C

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20. Which of the following statements is true ?

A. $_{78}Pt^{192}$ has 78 neutrons

B. $_{84}Po^{214} \rightarrow {}_{82}Pb^{210} + \beta^{-}$

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

D. $_{90}Th^{234} \rightarrow {}_{91}Pa^{234} + {}_{2}He^{4}$

Answer: C

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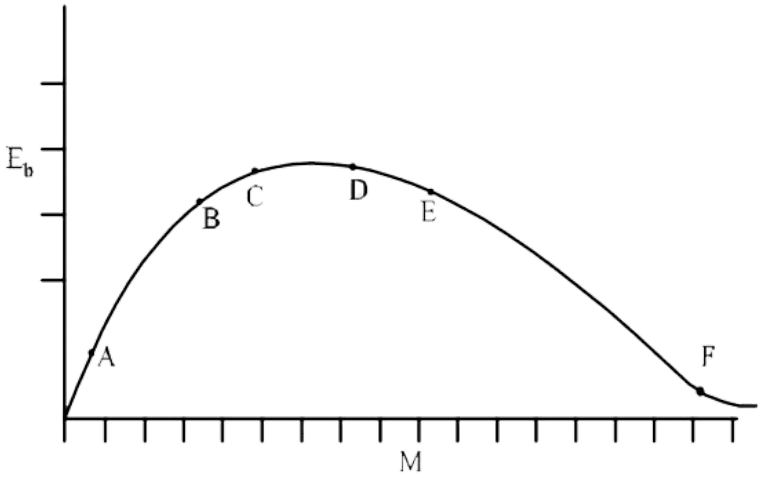

21.

The above is a plate of binding energy per nucleon E_0 against the nuclear mass M, A, B, C, D, E, F correspond to different nuclei Consider four reactions:

A. (i) and (iii)

B. (ii) and (iv)

C. (ii) and (iii)

D. (i) and (iv)

Answer: D

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22. When Uranium is bombarded with neutrons , it undergoes fission . The fission reaction can be written as :

$_{92}U^{235} + {}_0n^1 \rightarrow {}_{56}Ba^{141} + {}_{36}Kr^{92} + 3x + Q$ (energy)

where three particles named x are produced and energy Q is released . What is the name of the particle x ?

A. electron

B. α- particle

C. neutron

D. neutrino

Answer: C

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23. 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. 2000 MeV

B. 200 MeV

C. 2 MeV

D. 200 ke V

Answer: B

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24. Complete the equation for the following fission process

$$._{92}U^{235} + ._0n^1 \rightarrow ._{38}Sr^{90} + \ldots.$$

A. $_{54}X^{143} + 3_0n^1$

B. $_{54}X^{145} + 3_0n^1$

C. $_{57}X^{142} + 3_0n^1$

D. $_{54}X^{142} + {}_0n^1$

Answer: A

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25. Which one of the following statements is true for nuclear forces?

A. they obey the inverse square law of distance

B. they obey the inverse third power law of distance

C. they are short range forces

D. they are equal in strength to electromagnetic forces

Answer: C

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26. On an average , the number of neutrons and the energy of a neutron released per fission of a uranium atom are respectively

A. 2.5 and 2 ke V

B. 3 and 1 ke V

C. 2.5 and 2 Me V

D. 2 and 2 keV

Answer: C

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27. Which of the following nuclear reaction is not possible?

A. ${}_{6}^{12}C + {}_{6}^{12}C \rightarrow {}_{10}^{20}Ne + {}_{2}^{4}He$

B. ${}_{4}^{9}Be + {}_{1}^{1}H \rightarrow {}_{3}^{6}Li + {}_{2}^{4}He$

C. ${}_{5}^{11}Be + {}_{1}^{1}H \rightarrow {}_{4}^{9}Be + {}_{2}^{4}He$

D. ${}_{3}^{7}Li + {}_{2}^{4}He \rightarrow {}_{1}^{1}H + {}_{4}^{10}B$

Answer: C

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28. The rest energy of an electron is.

A. 510 KeV

B. 931 Ke V

C. 510 Me V

D. 931 Me V

Answer: A

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29. If M_O is the mass of an oxygen isotope $._8O^{17}$, M_p and M_n are the masses of a proton and a neutron, respectively, the nuclear binding energy of the isotope is

A. $(M_O - 17M_N)C^2$

B. $(M_O - 8M_p)C^2$

C. $(M_O - 8M_p - 9M_N)C^2$

D. M_OC^2

Answer: C

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30. Energy released in the fission of a single $._{92}U^{235}$ nucleus is $200MeV$. The fission rate of a $._{92}U^{235}$ fuelled reactor operating at a power level of $5W$ is.

A. $1.56 \times 10^{-10}s^{-1}$

B. $1.56 \times 10^{11}s^{-1}$

C. $1.56 \times 10^{-16}s^{-1}$

D. $1.56 \times 10^{-17}s^{-1}$

Answer: B

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31. The binding energy of deuteron is 2.2 MeV and that of $._2^4He$ is 28 MeV. If two deuterons are fused to form one

$._2^4He$, th n the energy released is

A. 23.6 MeV

B. 19.2 Me V

C. 30.2 Me V

D. 25.8 MeV

Answer: A

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32. If $M(A, Z)$, M_p and M_n denote the masses of the nucleus $._Z X^A$, proton and neutron respectively in units of U (where$1U = 931MeV/c^2$) and B.E. represents its B.E. in MeV, then

A. M(A , Z) = $ZM_p + (A - Z)M_n - BE/c^2$

B. $M(A, Z) = ZM_p + (A - Z)M_n + BE$

C. $M(A, Z) = ZM_p + (A - Z)M_n - BE$

D. $M(A, Z) = ZM_p + (A - Z)M_n + BE/c^2$

Answer: A

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33. The power obtained in a reactor using U^{235} disintergration is $1000kW$. The mass decay of U^{235} per hour is

A. 10 microgram

B. 20 microgram

C. 40 microgram

D. 1 microgram

Answer: C

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34. A reaction between a proton and $._8O^{18}$ that produces $._9f^{18}$ must also liberate

A. $_0n^1$

B. $_1e^0$

C. $_1n^0$

D. $_0e^1$

Answer: A

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35. The energy released in a typical nuclear fusion reaction is approximately

A. 25 Me V

B. 200 Me

C. 800 MeV

D. 1050 MeV

Answer: A

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

(i) ${}_{2}^{4}H$, (ii) $\_(24)^{52}Cr$, (iii) ${}_{62}^{152}Sm$, (iv) ${}_{80}^{100}Hg$, (v) ${}_{92}^{252}Cf$.

A. $E_{(v)} > E_{(iv)} > E_{(iii)} > E_{(ii)} > E_{(i)}$

B. $E_{(i)} > E_{(ii)} > E_{(iii)} > E_{(iv)} > E_{(v)}$

C. $E_{(ii)} > E_{(iii)} > E_{(iv)} > E_{(v)} > E_{(i)}$

D. $E_{(i)} > E_{(ii)} > E_{(iii)} > E_{(iv)} > E_{(v)}$

Answer: C

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37. 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. remains constant with mass number

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

Answer: D

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38. 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 meterial

D. is radioactive

Answer: B

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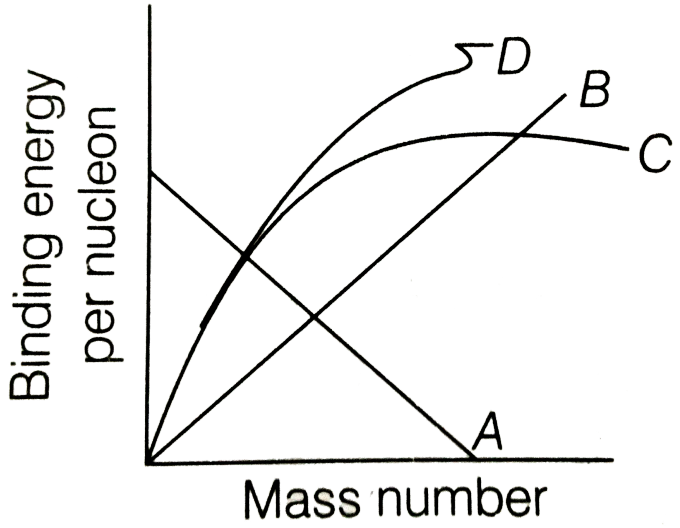
39. Binding energy per nucleon plot against the mass number for stable nuclei is show in the figure. Which curve

is correct ?



A. A

B. B

C. C

D. D

Answer: C

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40. A proton and a neutron are both shot at $100m/s$ towards a $_{(6)}{}^{12}C$ nucleus. which particle,if either is more likely to be absorbed by the nucleus ?

A. The proton

B. The neutron

C. Both particles are about equally likely to be absorbed

D. Neither particle will be absorbed

Answer: B

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41. Calculate the binding energy of the deuteron, which consistss of a proton and a neutron, given that the atomic mass of the deuteron is 2.014102 amu,. Take mass of proton $(m_p) = 1.007825$ amu, mass of a neutron $(m_n) = 1.008665$ amu and 1amu=931.5 MeV

A. 0.002388 MeV

B. 2.014102 Me V

C. 2.16490 Me V

D. 2.224 Me V

Answer: D

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42. Three $\alpha -$ particle and one $\beta -$ particle decaying takes place in series from an isotope $._{88} Ra^{238}$. Finally the isotope obtained will be.

A. $_{84}X^{220}$

B. $_{86}X^{222}$

C. $_{83}X^{226}$

D. $_{83}X^{215}$

Answer: C

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43. In radioactive transformation $_{92}U^{235} \rightarrow {}_{82}Pb^{206}$, the number of α and β particles emitted are

A. $10\alpha, 6\beta$

B. 4 protons , 8 neutrons

C. 6 electrons , 8 protons

D. $6\beta, 8\alpha$

Answer: D

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44. An element X decays into element Z by two -steps process

$X \to Y + He_2^4$

$Y \to Z + 2e$ then

A. A and C are isotopes

B. A and C are isobars

C. B and C are isotopes

D. A and B are isobars

Answer: A

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

$$._0 n^1 \rightarrow ._1 H^1 + ._{-e}^0 + []$$

Then, the parenthesis represents

A. neutrino

B. photon

C. antineutrino

D. gravition

Answer: C

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

A. 2

B. 4

C. between 4 and 6

D. 6

Answer: D

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47. A radioactive sample contains 10^{-3} kg each of two nuclear species A and B with half-life 4 days and 8 days respectively . The ratio of the amounts of A and B after a period of 16 days is

A. $1:2$

B. $4:1$

C. $1:4$

D. $2:1$

Answer: C

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

A. $1/10\lambda$

B. $1/11\lambda$

C. $11/10\lambda$

D. $1/9\lambda$

Answer: D

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49. If N_0 is the original mass of the substance of half - life period $t_{1/2} = 5year$ then the amount of substance left after 15 year is

A. $N_0/8$

B. $N_0/16$

C. $N_0/2$

D. $N_0/4$

Answer: A

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50. A radioactive sample at any instant has its disintegration rate 5000 disintegrations per minute After 5

minutes , the rate is 1250 disintegration per minute. Then , the decay constant (per minute)

A. 0.4 ln 2

B. 0.2 ln 2

C. 0.1 ln 2

D. 0.8 ln 2

Answer: A

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51. If T is the half-life of a radioactive material, then the fraction that would remain after a time $\frac{T}{2}$ is

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

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

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

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

Answer: C

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52. A nuclear transformation is denoted by $X(n, \alpha) \rightarrow .^{7}_{3} Li$. Which of the following is the nucleus of element X

A. $^{10}_{5}B$

B. $^{12}C_{6}$

C. $^{11}_{4}Be$

D. $\frac{9}{5}B$

Answer: A

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53. Using a nuclear counter the count rate of emitted particles from a radioactive source is measured. At t=0 it was 1600 counts per second and t = 8 seconds it was 100 counts per second. The count rate observed, as counts per seconds, at t=6, seconds is close to :

A. 250

B. 400

C. 300

D. 200

Answer: D

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

A. 2.25×10^9 years

B. 4.5×10^9 ln years

C. $4.5 \times 10^9 \frac{\ln\left(\frac{3}{2}\right)}{\ln 2}$ year

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

Answer: C

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55. A radioactive sample with a half-life of 1 month has the label : 'Activity=

2 microcurie on 1-8-1991'. What would be its avtivity two months earlier?

A. 1.0 micro curie

B. 0.5 micro curie

C. 4 micro curie

D. 8 micro curie

Answer: D

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56. The count rate of a Geiger Muller counter for the radiation of a radioactive material of half-life 30 min decreases to $5s^{-1}$ after $2h$. The initial count rate was

A. $20\,\sec^{-1}$

B. $25\,\sec^{-1}$

C. $80\,\sec^{-1}$

D. $625\,\sec^{-1}$

Answer: C

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

A. $400\mu s$

B. $6.3\mu s$

C. $40\mu s$

D. $300\mu s$

Answer: A

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58. There are n number of radioactive nuclei in a sample that undergoes beta decay. If from the sample, n' number

of β-particels are emitted every $2s$, then half-life of nuclei is

.

A. n/2

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

C. 0.693 ln (2n / n')

D. $0.693 \times$ n/n'

Answer: B

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59. The half life of a radio isotope is 5 years . The fraction which will decay in 15 years , will be

A. $1/16$

B. $3/4$

C. $7/8$

D. $5/8$

Answer: C

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60. In the given reaction

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

Radioactive radiations are emitted in the sequence.

A. α, β, γ

B. β, α, γ

C. β, α, γ

D. γ, β, α

Answer: C

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61. In gamma ray emission from a nucleus

A. only the proton number changes

B. both the neutrons number and the proton number change

C. there is no change in the proton number and the neutron number

D. only the neutron number changes

Answer: C

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62. The ratio of half-life times of two elements A and B is $\frac{T_A}{T_B}$. The ratio of respective decay constant $\frac{\lambda_A}{\lambda_B}$,is

A. T_B / T_A

B. T_A / T_B

C. $\frac{T_A + T_B}{T_A}$

D. $\frac{T_A - T_B}{T_A}$

Answer: A

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63. Consider a radioactive material of half-life 1.0 minute. If one of the nuclei decays now, the next one will decay

A. after 1 minute

B. after $\frac{1}{\log e_2}$ minute

C. after $\frac{1}{N}$ minute , where N is the number of nuclei present at that moment

D. after any time

Answer: D

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

A. 6.30 gm

B. 1.35 gm

C. 2.50 gm

D. 3.70 gm

Answer: B

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65. α-particles and γ-rays are all having same energy . Their penetrating power in a given medium in increasing order

will be

A. β, γ, α

B. γ, α, β

C. α, β, γ

D. β, α, γ

Answer: C

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Exercise 2 Concept Applicator

1. A neutron of energy 1 MeV and mass 1.6×10^{-27} kg passes a proton at such a distance that the angular

momentum of the neutron relative to the proton approximately equals $10^{-33} Js$. The distance of closest approach neglecting the interaction between particles si

A. 0.44 nm

B. 0.44 mm

C. 0.44 Å

D. 0.44 fm

Answer: D

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2. 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. 28.4 Me V

B. 20.8 MeV

C. 27.3 Me V

D. 14.2 Me V

Answer: A

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3. A neutron travelling with a velocity v and kinetic energy E collides perfectly elastically head on with the nucleus of

an atom of mass number A at rest. The fraction of the total kinetic energy retained by the neutron is

A. $[(A-1)/(A+1)]^2$

B. $[(A+1)/(A-1)]^2$

C. $[(A-1)/A]^2$

D. $[(A+1)/A]^2$

Answer: A

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4. A heavy nuleus having mass number 200 gets disintegrated into two small fragmnets of mass numbers 80 and 120. If binding energy per nulceon for parent atom is

$6.5MeV$ and for daughter nuceli is $7MeV$ and $8MeV$, respectivley , then the energy released in the decay will be.

A. 3

B. 4

C. 2

D. 1

Answer: C

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5. The half life of radioactive Radon is $3.8days$. 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. 13.8 days

B. 16.5 days

C. 33 days

D. 76 days

Answer: B

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6. The inteisity of gamma radiation from a given source is I_0 . On passing throug 37.5 mm of lead it is reduced to $I_0/8$. the thickness of lead which will reduce It to $I_0/2$ is -

A. $(37.5)^{1/3}$ mm

B. $(37.5)^{1/4}$ mm

C. $37.5/3$ mm

D. $(37.5/4)$ mm

Answer: C

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7. 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. 6 hr

B. 12 hr

C. 24 hr

D. 128 hr

Answer: B

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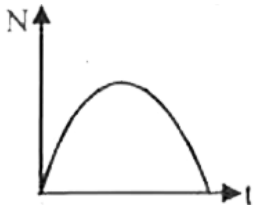
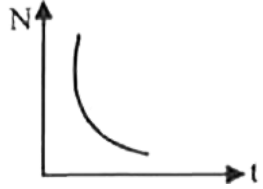
8. Radioactive element decays to form a stable nuclide, then the rate of decay of reactant $\left(\frac{dN}{dt}\right)$ will vary with time (t) as shown in figure.

A.



B.

C.



D.

Answer: C

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9. Radium ^{226}Ra , spontaneously decays to radon with the emission of an α- particle and a γ-ray . If the speed of the α particle upon emission from an initially stationary radium nucleus is 1.5×10^7 m/s, what is the recoil speed of the resultant radon nucleus ? Assume the momentum of γ ray is negligible compared to that of α particle

A. 2.0×10^5 m/s

B. 2.7×10^5 m/s

C. 3.5×10^5 m/s

D. 1.5×10^7 m/s

Answer: B

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10. A gamma ray photon creates an electron-positron pair. If the rest mass energy of an electron is $0.5MeV$ and the total $K.E.$ of the electron-position pair is $0.78MeV$, then the energy of the gamma ray photon must be.

A. 0.78 MeV

B. 1.78 MeV

C. 1.28 MeV

D. 0.28 MeV

Answer: B

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11. 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. 40 minute

B. 10 minute

C. 15 minute

D. 20 minute

Answer: D

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12. A radioactive nucleus undergoes $\alpha -$ emission to form a stable element. What will be the recoil velocity of the daughter nucleus is V is the velocity of α-emission and A is the atomic mass of radioactive nucleus ?

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

B. $\frac{2v}{A-4}$

C. $\frac{4v}{A+4}$

D. $\frac{2v}{A+4}$

Answer: A

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

A. 11460 years

B. 17190 years

C. 22920 years

D. 45840 years

Answer: C

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

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

A. 172 and 69

B. 174 and 70

C. 176 and 69

D. 176 and 70

Answer: A

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15. 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:

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

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

A. 10^6 s

B. 10^8 s

C. 10^{12} s

D. 10^{16} s

Answer: C

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16. The rest mass of a deuteron is equivalent to an energy of $1876MeV$, that of a proton to $939MeV$, and that of a neutron to` 940 MeV. A deutron may disintegrate to a proton and neutron if

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

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

C. emits an X -ray photon of energy 3 Me V

D. captures an X - ray photon of energy 3 Me V

Answer: D

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17. The compound unstable nucleus ${}_{92}^{236}U$ oftendecays in accordance with the following reaction ${}_{92}^{236}U \rightarrow {}_{54}^{140}Xe + {}_{38}^{94}Sr$ + other particles

In the nuclear reaction presented above , the "other particle" might be

A. an alpha particle

B. two protons

C. one protons and neutron

D. two neutrons

Answer: D

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

A. 45 megawatt

B. 58.46 megawatt

C. 72 megawatt

D. 92 megawatt

Answer: B

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

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

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

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

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

Answer: A

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

A. $(R_1T_1 - R_2T_2)$

B. $(R_1 - R_2)$

C. $(R_1 - R_2)T$

D. $(R_1 - R_2)T$

Answer: D

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21. The mass of a $._3^7 Li$ nucleus is $0.042u$ less than the sum of the masses of all its nucleons. The binding energy per nucleon of $._3^7 Li$ nucleus is nearly

A. 46 MeV

B. 5.6 MeV

C. 3.9 MeV

D. 23 MeV

Answer: B

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

A. $\log_e 2/5$

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

C. $5 \log_{10} 2$

D. $5 \log_e 2$

Answer: D

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23. A radioactive nucleus (initial mass number A and atomic number Z) emits 3α-particles and 2 positrons. The ratio of number of neutrons to that of protons in the final nucleus will be

A. $\frac{A-Z-8}{Z-4}$

B. $\frac{A-Z-4}{Z-8}$

C. $\frac{A-Z-12}{Z-4}$

D. $\frac{A-Z-4}{Z-2}$

Answer: B

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24. The half-life of a radioactive isotope X is 50 years. It decays to another element Y which is stable. The two elements X and Y were found to be in the ratio of $1:15$ in a sample of a given rock. The age of the rock was estimated to be

A. 150 years

B. 200 years

C. 250 years

D. 100 years

Answer: B

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25. 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. $3N_0$

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

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

D. $2N_0$

Answer: B

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26. 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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27. 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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28. Assume that a neutron breaks into a proton and an electron. The energy released during this process is (mass of neutron = 1.6725×10^{-27} kg, mass of proton = $1.6725 \times 10^{-27} kg$, mass of electron $= 9 \times 10^{-31} kg$)

A. 0.73 MeV

B. 7.10 MeV

C. 6.30 Me V

D. 5.4 Me V

Answer: A

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29. A certain mass of hydrogen is changes to helium by the process of fusion. The mass defect in fusion reaction is $0.02866u$. The energy liberated per u is (given $1u = 931MeV$)

A. 26.7 MeV

B. 6.675 Me V

C. 13.35 MeV

D. 2.67 MeV

Answer: B

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30. Radioactive material 'A' has decay constant $'8\lambda'$ and material 'B' has decay constant 'lamda'. Initial they have same number of nuclei. After what time, the ratio of number of nuclei of material 'B' to that 'A' will be $\frac{1}{e}$?

A. $\frac{1}{7\lambda}$

B. $\frac{1}{8\lambda}$

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

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

Answer: A

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