PHYSICS

BOOKS - MTG-WBJEE PHYSICS (HINGLISH)

NUCLEAR PHYSIC

Wb Jee Workout Category 1 Single Option Correct Type

1. Which of the following statements is correct ?

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

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

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

D. In nuclear fission, energy is released by fragmentation of a very low nucleus.

Answer: A

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2. In nuclear reaction $._4Be^9 + ._2He^4 \rightarrow ._6C^{12} + X$, X will be

A. Electron

B. Proton

C. Photon

D. Neutron

Answer: D

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3. The energy released by the fission of one uranium atom is 200 MeV. The number of fissions per second required to produce 3.2 MW of power is :

A. 10^7

B. 10^{10}

C. 10^{15}

D. 10^{11}

Answer: D

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4. In the nuclear reaction $._{7}^{14}N + X \rightarrow ._{6}^{14}C + ._{1}^{2}H$, the X will be

A. $_{-1}^{0}e$

B. $_{1}^{1}H$

C. $_{1}^{2}H$

D. $_{0}^{1}n$

Answer: D

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5. When radioactive substance emits an $\alpha -$ particle, then its position in the periodic table is lowered by.

A. One place

B. Two places

C. Three places

D. Four places

Answer: B

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6. A radioactive nucleus emits a beta particle. The parent and daughter nuclei are:

A. Isotopes

B. Isotones

C. Isomers

D. Isobars

Answer: D

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

A. $8\alpha, 7\beta$

B. $4\alpha, 7\beta$

C. $4\alpha, 4\beta$

D. $4\alpha, 1\beta$

Answer: D

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8. If ${}_{92}U^{238}$ undergoes successively $8\alpha -$ decays and $6\beta -$ decays, then resulting nucleus is.

A. ${}_{82}U^{208}$

B. ${}_{82}Pb^{206}$

C. ${}_{82}U^{210}$

D. ${}_{82}U^{214}$

Answer: B

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9. A radioactive substance decays to $\left(\frac{1}{16}\right)^{th}$ of its initial activity in 40 days. The half-life of the radioacctive substance expressed in days is

A. 2.5

B. 5

C. 10

D. 20

Answer: C

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

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

A. 4.4 MeV

B. 5.4 MeV

C. 5.6 MeV

D. 6.5 MeV

Answer: B

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11. 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. 2.50 g

B. 3.70 g

C. 6.30 g

D. 1.35 g

Answer: D

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12. A nucleus desintegrated into two nucleus which have their velocities in the ratio of $2:1$. The ratio of their nuiclear sizes will be

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

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

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

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

Answer: D

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13. If a star can convert all the He nuclei completely into oxygen nuclei. The energy released per oxygen nuclei is (Mass of the helium nucleus is 4.0026 amu and mass of oxygen nucleus is 15.9994 amu)

A. 10.24 MeV

B. 0

C. 7.56 MeV

D. 5 MeV

Answer: A

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

A. $R_1 = R_2$

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

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

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

Answer: B

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15. The radius of germanium (Ge) nuclide is measured to be twice the radius of $_{(4)}{}^{9}Be$. The number of nucleons in Ge

A. 72

B. 73

C. 74

D. 75

Answer: A

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16. Find the Q-value of the given β^+ decay.

$_{11}N^{22} \rightarrow {}_{10}Ne^{22} + {}_{+1}e^0$ Given that :

Atomic mass of $_{11}N^{22}$ is 21.994435 u, Atomic

mass of ${}_{11}Ne^{22}$ is 21.991384 u, Mass of ${}_{+1}e^{0}$ is 0.0005486`

A. 2.82 MeV

B. 1.82 MeV

C. 0.82 MeV

D. 3.82 MeV

Answer: B

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

A. 1

B. 2

C. 4

D. 8

Answer: D

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18. The stable nucleus that has a radius $1/3$ that of Os^{189} is-

A. ${}_3Li^7$

B. ${}_2He^4$

C. ${}_5B^{10}$

D. ${}_6C^{12}$

Answer: A

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19. A 280 day old radioactive substances shows an activity of 6000 dps, 140 days later its activity becomes 3000 dps. What was its initial activity ?

A. 9000

B. 24000

C. 12000

D. 18000

Answer: B

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

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

Then, the parenthesis represents

A. photon

B. graviton

C. neutrino

D. antineutrino

Answer: D

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

A. 0.8 Ci

B. 0.4 Ci

C. 0.1 Ci

D. 0.16 Ci

Answer: C

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

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

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

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

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

Answer: C

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

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

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

C. $\frac{1n2}{e}$

D. $1 - \frac{1n2}{e}$

Answer: A

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

A. $\frac{1}{6}$

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

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

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

Answer: C

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25. A and B are isotopes. B and C are isobars. If d_A, d_B and d_C be the densities of nuclei A, B and C respectively then

A. $d_A > d_B > d_C$

B. $d_A < d_B < d_C$

C. $d_A - d_B - d_C$

D. $d_A - d_B < d_C$

Answer: C

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26. The order of magnitude of density of urnaitum nucleus is:

$\left(m_{\text{nucleus}} = 1.67 \times 10^{-27} kg\right)$

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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27. 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. $F_1 = F_2 = F_3$

D. $F_3 > F_2 > F_1$

Answer: C

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28. 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. 2.67 MeV

B. 26.7 MeV

C. 6.675 MeV

D. 13.5 MeV

Answer: C

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29. The half life of I^{131} is 8 day. Given a sample of I^{131} at t=0, we can assert that a)No nucleus will decay at t=4day b)No nucleus will decay before t=8day c)All nucleus will decay before t=16day d)A given nucleus may decay before

A. All nuclei will decay before t = 16 days

B. No nucleus will decay before t = 4 days

C. The given nucleus may decay at any time after $t = 0$

D. No nucleus will decay before $t = 8$ days.

Answer: C

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30. 7/8 of the original mass of a radioactive substance decays in 30 min. What is the half life of the radioactive substance ?

A. 5 min

B. 7.5 min

C. 10 min

D. 15 min

Answer: C

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Wb Jee Workout Category 2 Single Option Correct Type

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

A. 20 min

B. 30 min

C. 40 min

D. 25 min

Answer: C

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2. A radioactive nucleus of mass number A, initially at rest, emits an α -particle with a speed v. The recoil speed of the daughter nucleus will be

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

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

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

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

Answer: C

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3. 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. 6×10^9 yrs

B. 8×10^9 yrs

C. 12×10^9 yrs

D. 16×10^9 yrs

Answer: A

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

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

C. $\frac{1}{3\lambda}$

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

Answer: B

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5. The energy released by fission of one U^{235} atom is 200 MeV. Calculate the energy released in kWh, when one gram of uranium undergoes fission.

A. 2.278×10^8

B. 2.278×10^6

C. 2.278×10^4

D. 2.278×10^{10}

Answer: C

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6. A rock is 1.5×10^9 years old. The rock contains $.^{238}U$ which disintegretes to form $.^{236}U$. Assume that there was no $.^{206}Pb$ in the

rock initially and it is the only stable product fromed by the decay. Calculate the ratio of number of nuclei of $.^{238}U$ to that of $.^{206}Pb$ in the rock. Half-life of $.^{238}U$ is $4.5 \times 10^{9}.\ years.$ (2^(1//3)=1.259)` .

A. 2.85

B. 4.85

C. 0.85

D. 3.85

Answer: D

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

A. 7s

B. 9s

C. 11s

D. 15s

Answer: A

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8. To determine the half life of a radioactive element, a student plots a graph of $1n\left|\frac{dN(t)}{dt}\right|$ versus t. Here $\frac{dN(t)}{dt}$ is the rate of radioactive decay at time t. If the number of radioactive nuclei of this element decreases by a factor of p after 4.16 years, what is the value

of p ?

A. 4

B. 6

C. 8

D. 10

Answer: C

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9. In a uranium reactor whose thermal power is $P = 100MW$, if the average number of neutrons liberated in each nuclear spitting is 2.5. Each splitting is assumed to release an energy $E = 200MeV$. The number of neutrons generated per unit time is-

A. $4 \times 10^{18} s^{-1}$

B. $8 \times 10^{23} s^{-1}$

C. $8 \times 10^{19} s^{-1}$

D. $\frac{125}{16} \times 10^{18} s^{-1}$

Answer: D

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10. A radioactive material of half-life T was kept in a nuclear reactor at two different instants. The quantity kept second time was twice of the kept first time. If now their present activities are A_1 and A_2 respectively, then their age difference equals

A. $\frac{T}{1n2}\left(1n\frac{2A_1}{A_2}\right)$

B. $T\left(1n\frac{A_1}{A_2}\right)$

C. $\frac{T}{1n2}\left(1n\frac{A_2}{2A_1}\right)$

D. $T\left(1n\frac{A_2}{2A_1}\right)$

Answer: A

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11. The binding energy per nucleon of O^{16} is $7.97MeV$ and that of O^{17} is $7.75MeV$. The energy (in MeV) required to remove a neutron from O^{17} is.

A. 3.64

B. 3.52

C. 7.86

D. 4.23

Answer: D

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12. If M_o is the mass of an oxygen isotope ${}_8O^{17}$, M_p and M_N are the masses of a

proton and neutron respectively, the nuclear binding energy of the isotope is:

A. M_0C^2

B. $(M_0 - 8M_P)C^2$

C. $(M_0 - 17M_N)C^2$

D. $(M_0 - 8M_P - 9M_N)C^2$

Answer: D

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13. 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. $\log_e\left(\frac{2}{5}\right)$

B. $5\log_{10} 2$

C. $5\log_e 2$

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

Answer: C

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14. 99% quantity of a radioactive substance decays between

A. 8 and 9 half lives

B. 7 and 8 half lives

C. 9 and 10 half lives

D. 6 and 7 half lives

Answer: D

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

A. 5

B. 4

C. 3

D. 2

Answer: C

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Wb Jee Workout Category 3 One Or More Than One Option Correct Type

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

A. Angular momentum conservation hold good in any nuclear reaction.

B. Linear momentum conservation holds good in any nuclear reaction.

C. The kinetic energy of emitted β-particle is varying continuously to a maximum value.

D. None of these

Answer: A::B::C

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

A. N = Z + A

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

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

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

Answer: B::C::D

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3. If a nucleus $._{Z}^{A}x$ emits one α-particle and one β (negative β) particle in succession, then the daughter nucleus will have which of the following configurations?

A. A - 4 nucleons

B. A - 3 nucleons

C. A - Z - 3 neutrons

D. Z - 2 protons

Answer: A::C

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

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

B. The half-lives of the samples are different

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

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

Answer: A::C

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5. The heavier nuclei tend to have larger N/Z ratio because

A. a neutron is heavier than a proton

B. a neutron is an unstable particle

C. a neutron does not exert electric repulsion

D. Coulomb forces have longer range compared to the nuclear forces.

Answer: C::D

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6. In which of the following decays the atomic number decreases?

A. α-decay

B. β^+-decay

C. β^--decay

D. γ-decay

Answer: A::B

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7. For nuclei with $A > 100$,

A. the binding energy of the nucleus decreases on an average as A increases

B. the binding energy per nucleon decreases on an average as A increases

C. if the nucleus breaks into two roughly equal parts, energy is released

D. if two nuclei fuse to form a bigger nucleus, energy is released.

Answer: B::C

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

A. 200Ω

B. 400Ω

C. 600Ω

D. 800Ω

Answer: A

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9. Equal masses of two samples of charcoal A and B are burnt separately and the resulting carbon dioxide are collected in two

vessels. The radioactivity of $\hat{}\ 14C$ is measured for both the gas samples. The gas from the charcoal A gives $2100 counts$ per week and the gas from the charcoal A gives 2100 counts per week and the gas from the charcoal B gives 1400 counts per week. Find the age difference between the two samples. Half-life of $\hat{}\ 14C = 5730y.$

A. 3737 y

B. 8327 y

C. 7823 y

D. 2378 y

Answer: D

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

A. decay constant will be $2.9 \times 10^{-6}s^{-1}$

B. average life is 3.9 days

C. the number of atoms of 1 mg of $.^{198}Au$ is 6×10^{23}

D. the activity of 1.00 mg of $.^{198}Au$ is 238 Ci

Answer: A::B::D

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Wb Jee Previous Years Questions Category 1 Single Option Correct Type

1. An alpha particle $\left(.^{4}He\right)$ has a mass of 4.00300 amu. A proton has a mass of 1.00783 amu and a neutron has a mass of 1.00867 amu respectively. The binding energy of alpha particle estimated from these data is the closest to

A. 27.9 MeV

B. 22.3 MeV

C. 35.0 MeV

D. 20.4 MeV

Answer: A

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Wb Jee Previous Years Questions

1. The number of atoms of a radioactive substance of half-life T is N_0 at t = 0. The time necessary to decay from $N_0/2$ atoms to $N_0/10$ atoms will be

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

B. T 1n 5

C. $T1n\left(\frac{5}{2}\right)$

D. $T\frac{1n5}{1n2}$

Answer: C

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

A. Isobar of original nucleus is produced.

B. Isotope 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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3. Radon-222 has a half-life of 3.8 days. If one starts with 0.064 kg of Radon-222 the quantity of Radon-222 left after 19 days will be -

(A) 0.002 kg.

(B) 0.062 kg.

(C) 0.032 kg.

(D) 0.024 kg.

A. 0.002 kg

B. 0.062 kg

C. 0.032 kg

D. 0.024 kg

Answer: A

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4. If the half life of a radioactive nucleus is 3 days nearly, what fractions of the initial number of nuclei will decay on the 3rd day? (Given that $\sqrt{0.25} = 0.63$)

A. 0.63

B. 0.5

C. 0.37

D. 0.13

Answer: D

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5. A parent nucleus X undergoes α-undergoes α-decay with a half-life of 75000 years. The daughter nucleus Y undergoes β-decay with a half-life of 9 months. In a particular sample, it

is found that the rate of emission of β-particles is nearly constant (over several months) at $10^7/\text{hour}$. What will be the number of α-particles emitted in an hour ?

A. 10^2

B. 10^7

C. 10^{12}

D. 10^{14}

Answer: B

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