PHYSICS

BOOKS - NEET PREVIOUS YEAR (YEARWISE + CHAPTERWISE)

NUCLEAR PHYSICS

Exercise

1. When an $\alpha -$ particle of mass 'm' moving with velocity 'v' bombards on a heavy nucleus

of charge 'Ze' its distance of closest approach from the nucleus depends on m as :

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

B. $\frac{1}{m^2}$

C. m

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

Answer: D

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

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

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

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

Answer: B

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4. A nucleus of uranium decays at rest into nuclei of thorium and helium. Then :

A. the helium nucleus has more kinetic energy than the thorium nucleus

B. the helium nucleus has less momentum than the thorium nucleus

C. the helium nucleus has more momentum than the thorium nucleus

D. the helium nucleus has less kinetic energy than the thorium nucleus

Answer: A

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5. 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 MeV

B. -2.4 MeV

C. 8.4 MeV

D. 17.3 MeV

Answer: D

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6. 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. $1.96 \times 10^9 yr$

B. $3.92 \times 10^9 yr$

C. $4.20 \times 10^9 yr$

D. $8.40 \times 10^9 yr$

Answer: C

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7. 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. $40yr$

B. $60yr$

C. $80yr$

D. $100yr$

Answer: B

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8. 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 MeV

B. 26.7 MeV

C. 6.675 MeV

D. 13.35 MeV

Answer: C

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9. 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. $60s$

B. $80s$

C. $20s$

D. $40s$

Answer: D

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10. A radioactive nucleus of mass M emits a photon of frequency v and the nucleus recoils. The recoil energy will be

A. $h^2v^2/2Mc^2$

B. zero

C. hv

D. $Mc^2 - hv$

Answer: A

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11. The half-life of a radioactive isotope X is 50 yr. It decays to nother 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 give rock. The age of the rockwas estimated to be

A. $200yr$

B. $250yr$

C. $100yr$

D. $150yr$

Answer: A

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12. Fusion reaction takes place at high temperature because

A. atoms get ionised at high temperature

B. kinetic energy is high enough to overcome the coulomb repulsion between nuclei

C. molecules break up at high temperature

D. nuclei break up at high temperature

Answer: B

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13. A nucleus ${}_{n}^{m}X$ emits one $\alpha -$ particle and two $\beta -$ particles. The resulting nucleus is

A. ${}_{n}^{m-6}Z$

B. ${}_{n}^{m-4}X$

C. ${}_{n-4}^{m-4}Y$

D. ${}_{n-4}^{m-6}Z$

Answer: B

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14. 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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15. 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. $\dfrac{5}{\log_e 2}$

C. $5\log_{10} 2$

D. $5 \log_e 2$

Answer: D

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16. The number of beta particles emitter by radioactive sustance is twice the number of alpha particles emitter by it. The resulting daughter is an

A. isobar of parent

B. isomer of parent

C. isotone of parent

D. isotope of parent

Answer: D

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17. In the nuclear decay given below

$$\cdot_{Z}^{A}X \rightarrow \cdot_{Z-1}\cdot^{A}Y \rightarrow \cdot_{Z-1}^{A-4}B^{*} \rightarrow \cdot_{Z-1}^{A-1}B,$$

the particle emitted in the sequence are

A. β, α, γ

B. γ, β, α

C. β, γ, α

D. α, β, γ

Answer: A

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18. Two radioactive materials X_1 and X_2 have decay constants 5λ and λ respectively. If initially they have the same number of nuclei,

then the ratio of the number of muclei of X_1 to that of X_2 will be $\frac{1}{e}$ after a time

A. λ

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

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

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

Answer: C

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19. 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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20. If radius of the $._{13}^{27}Al$ nucleus is estimated to be 3.6 Fermi, then the radius of $._{52}^{125}Te$ nucleus be nerarly:

A. $6.0fm$

B. $9.6fm$

C. $12.0fm$

D. $4.8fm$

Answer: A

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21. A nucleus ${}_{Z}^{A}X$ has mass represented by $m(A, Z)$. If m_p and m_n denote the mass of proton and neutron respectively and BE the blinding energy (in MeV), then

A.

$$BE = [m(A, Z) - Zm_p - (A - Z)m_n]C^2$$

B.

$$BE = [Zm_p + (A - Z)m_n - m(A, Z)]C^2$$

C. $BE = [Zm_p + Am_n - m(A, Z)]C^2$

D. $BE = m(A, Z) - Zm_p - (A - Z)m_n$

Answer: B

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22. In radioactive decay process, the negatively changed emitted $\beta -$ particle are

A. the electrons present inside the nucleus

B. the electrons produced as a result of the decay of neutrons inside the nucleus

C. the electrons produced as a result of collisions between atoms

D. the electrons orbiting around the nucleus

Answer: B

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

A. 73

B. 74

C. 75

D. 72

Answer: D

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

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

C. $R_1 = R_2 \left(\frac{t_2}{t_1}\right)$

D. $R_1 = R_2$

Answer: A

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25. 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. 25.8 MeV

B. 23.6 MeV

C. 19.2 MeV

D. 30.2 MeV

Answer: B

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26. In any fission the ratio

$$\frac{\text{mass of fission produts}}{\text{mass of parent nucleus}}$$ is

A. less than 1

B. greater than 1

C. equal to 1

D. depends on the mass of parent nucleus

Answer: A

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27. 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 numbers

C. increases with mass number at low mass numbers

D. decreases with mass number at low mass numbers

Answer: B

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

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

B. $._{42}MO^{92}, ._{40}Ze^{92}$

C. $._{38}Sr^{86}, ._{38}Sr^{86}$

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

Answer: A

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29. 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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30. M_p denotes the mass of a proton and M_n that of a neutron. A given nucleus, of binding energy B, contains Z protons and N

neutrons. The mass $M(N, Z)$ of the nucleus is given by.

A. $m(N, Z) = Nm_n + ZM_p - Bec^2$

B. $m(N, Z) = Nm_n + Zm_p + Bec^2$

C. $m(N, Z) = Nm_n + Zm_p - BE/c^2$

D. $m(N, Z) = Nm_n + Zm_p + BE/c^2$

Answer: C

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31. The half-life of radium is about $1600yr$. Of $100g$ of radium existing now, $25g$ will remain unchanged after

A. $4800yr$

B. $6400yr$

C. $2400yr$

D. $3200yr$

Answer: D

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32. If in a nuclear fusion process the masses of the fusing nuclei be m_1 and m_2 and the mass of the resuktant nucleus be m_3, then

A. $m_3 = m_1 + m_2$

B. $m_3 = |m_1 - m_2|$

C. $m_3 < (m_1 + m_2)$

D. $m_3 > (m_1 + m_2)$

Answer: C

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33. 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. $3.70g$

B. $6.30g$

C. $1.35g$

D. $2.50g$

Answer: C

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34. A nuclear reaction given by

$$1_{Z}X^{A} \rightarrow .(Z+1)Y^{A} + ._{-1}e^{0} + \overrightarrow{p}$$

represents.

A. fusion

B. fission

C. β-decay

D. γ-decay

Answer: C

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35. Solar energy is mainly caused due to

A. fusion of protons during sythesis of heavier elements

B. gravitational contraction

C. burning of hydrogen in the oxygen

D. fission of uranium present in the sun

Answer: A

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36. The mass of proton is $1.0073u$ and that of neutron is $1.0087u$ ($u =$ atomic mass unit). The binding energy of ${}_2He^4$ is (mass of helium nucleus $= 4.0015u$)

A. 28.4 MeV

B. $0.061u$

C. $0.0305J$

D. 0.0305 erg

Answer: A

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37. The mass number of a nucleus is.

A. sometimes equal to its atomic number

B. sometimes less than and sometimes more than its atomic number

C. always less than its atomic number

D. always more than its atomic number

Answer: A

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38. The volume occupied by an atom is greater than the volume of the nucleus by factor of about

A. 10^{10}

B. 10^{15}

C. 10^{1}

D. 10^{5}

Answer: B

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39. When a deuterium is bombarded on $._8 O^{16}$ nucleus, an α-particle is emitted, then the product nucleus is

A. $._7 N^{13}$

B. $._5 B^{10}$

C. $._4 Be^9$

D. $._7 N^{14}$

Answer: D

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40. Which of the following are suitable for the fusion process ?

A. Light nuclei

B. Heavy nuclei

C. Elements lying in the middle of periodic table

D. Elements lying in the middle of binding energy curve

Answer: A

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41. A saample of radioactive elements contains 4×10^{16} active nuclei. If half-life of element is 10 days, then the number of decayed nuclei after 30 days is

A. 0.5×10^{10}

B. 2×10^{10}

C. 3.5×10^{10}

D. 1×10^{10}

Answer: C

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42. In compound $X(n, \alpha) \rightarrow {}_{3}Li^{7}$, the element X is

A. ${}_2He^4$

B. ${}_5B^{10}$

C. ${}_5B^9$

D. ${}_4Be^{11}$

Answer: B

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43. Half-life of a radioactive substance is $12.5h$ and its mass is $256g$. After what time the amount of remaining substance is $1g$?

A. $75h$

B. $100h$

C. $125h$

D. $150h$

Answer: B

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44. Half-life period of a radioactive substance is $6h$. After $24h$ activity is $0.01\mu C$, what was the initial activity ?

A. $0.04\mu C$

B. $0.08\mu C$

C. $0.24\mu C$

D. $0.16\mu C$

Answer: D

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45. In nuclear fission process , energy is released because

A. mass of products is more than mass of nucleus

B. total binding energy of products formed due to nuclear fission is more than the parent fissionable material

C. Total binding energy of products formed due to nuclear fission is less than parent fissionable material

D. mass of some particles is converted into energy

Answer: B

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46. m_P and m_n are masses of proton and neutron respectively. An element of mass m has Z protons and N neutrons, then

A. $m > Zm_p + Nm_n$

B. $m = Zm_p + Nm_n$

C. $m < Zm_p + Nm_n$

D. m may be greater than, less than or equal to $Zm_p + Nm_n$, depending on nature of element

Answer: C

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47. Which of the following is positively charged?

A. α-particle

B. β-particle

C. γ-rays

D. X-rays

Answer: A

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48. A nuclear decay is expressed as ltbr.

$$_{6}C^{11} \rightarrow {}_{5}B^{11} + \beta^{+} + X$$

Then the unknown particle X is

A. neutron

B. antineutrino

C. proton

D. neutrino

Answer: D

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49. The half-life of radioactive material is $3h$. If the initial amount is $300g$, then after $18h$, it will remain

A. $4.68g$

B. $46.8g$

C. $9.375g$

D. $93.75g$

Answer: A

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50. The relationship between distintegration constant (λ) and half-life (T) will be

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

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

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

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

Answer: B

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51. Nuclear fission can be explained by

A. proton-proton cycle

B. liquid drop model of nucleus

C. independent of nuclear particle model

D. nuclear shell model

Answer: B

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52. After 1α and 2β emissions.

A. mass number reduces by 2

B. mass number reduces by 6

C. atomic number reduces by 2

D. atomic number remains unchanged

Answer: D

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53. Alpha particles are

A. 2 free protons

B. helium atoms

C. singly ionised helium atoms

D. doubly ionised helium atoms

Answer: D

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54. Complete the equation for the following fission process $._{92}U^{235} ._0 n^1 \rightarrow ._{38}Sr^{90} + \ldots .$

A. $._{54}Xe^{143} + 3._0 n^1$

B. $._{54}Xe^{145}$

C. $._{57}Xe^{142}$

D. $._{54} Xe^{142} + ._0 n^1$

Answer: A

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55. A nucleus $._n X^m$ emits one α and one β particles. The resulting nucleus is.

A. $._n X^{m-4}$

B. $._{n-2} Y^{m-4}$

C. $._{n-4} Z^{m-4}$

D. None of these

Answer: A

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56. Atomic weight of boron is 10.81 and it has two isotopes $._5B^{10}$ and $._5B^{11}$. Then ratio of $._5B^{10}$ in nature would be.

A. $19:81$

B. $10:11$

C. $15:16$

D. $81:19$

Answer: A

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57. Half-life of a radioactive substance A and B are, respectively, $20\ \min$ and $40\ \min$. Initially, the samples of A and B have equal number of nuclei. After $80\ \min$, the ratio of the ramaining number of A and B nuclei is

A. $1:16$

B. $4:1$

C. $1:4$

D. $1:1$

Answer: C

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58. In a fission reaction ${}_{\cdot 92}^{236}U \rightarrow {}^{117}X + {}^{117}Y + n + n$, 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. 1 KeV

Answer: B

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

A. a beta particle

B. an alpha particle

C. an antineutrino

D. a neutrino

Answer: C

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60. The satble nucleus that has a radius half that of Fe^{56} is

A. Li^{7}

B. Na^{21}

C. S^{16}

D. Ca^{40}

Answer: A

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61. Which of the following is used as a moderator in nuclear reactors?

A. Plutonium

B. Cadmium

C. Heavy water

D. Uranium

Answer: C

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62. The activity of a radioactive sample is measured as 9750 counts per minute at $t = 0$ and as 975 counts per minute at $t = 5$ minutes. The decay constant is approximately

A. $0.922 / \text{ min}$

B. $0.691 / \text{ min}$

C. $0.461 / \text{ min}$

D. $0.230 / \text{ min}$

Answer: C

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63. The most penetrating radiation out of the following is

A. γ-rays

B. α-particles

C. β-rays

D. X-rays

Answer: A

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64. A nucleus ruptures into two nuclear parts, which have their velocity ratio equal to $2:1$. What will be the ratio of their nuclear size (nuclear radius)?

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

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

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

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

Answer: B

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65. 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. $20s^{-1}$

B. $25s^{-1}$

C. $80s^{-1}$

D. $625s^{-1}$

Answer: C

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66. What is the respective number of α and β particles emitted in the following radioactive decay

$$._{90}X^{200} \rightarrow ._{80}Y^{168}.$$

A. 6 and 8

B. 6 and 6

C. 8 and 8

D. 8 and 6

Answer: D

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

A. to control energy released in the reactor

B. to absorb neutrons and stop chain reaction

C. to cool the reactor

D. to slow down the neutrans to thermal energies

Answer: D

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69. If the binding energy per nucleon in $._3 Li^7$ and $._2 He^4$ nuclei are respectively 5.60 MeV and 7.06 MeV, then the energy of proton in the reaction $._3 Li^7 + p \rightarrow 2._2 He^4$ is

A. 19.6 MeV

B. 2.4 MeV

C. 8.4 MeV

D. 17.3 MeV

Answer: D

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

A. $._2He^4$

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

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

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

Answer: B

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72. 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. γ, α, β

C. β, α, γ

D. γ, β, α

Answer: C

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73. The mass density of a nucleus varies with mass number A as

A. A^2

B. A

C. constant

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

Answer: C

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74. The energy equivalent of one atomic mass unit is

A. $1.6 \times 10^{-19} J$

B. $6.02 \times 10^{23} J$

C. 931 MeV

D. 9.31 MeV

Answer: C

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75. Solar energy is mainly caused due to

A. fusion reaction

B. fission reaction

C. combustion reaction

D. chemical reaction

Answer: A

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76. If the nuclear force between two protons, two neutrons and between proton and neutron is denoted by F_{pp}, F_{nn} and F_{pn} respectively, then

A. $F_{pp} \approx F_{nn} \approx F_{pn}$

B. $F_{pp} \neq F_{nn}$ and $F_{pp} = F_{nn}$

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

D. $F_{pp} \neq F_{nn} \neq F_{pn}$

Answer: C

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77. In the nucleus of $._{11} Na^{23}$, the number of protons, neutrons and electrons are

A. $11, 12, 0$

B. $23, 12, 11$

C. $12, 11, 0$

D. $23, 11, 12$

Answer: A

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78. The half-life period of radium is 1600 years. The fraction of a sample of radium that would remain after 6400 years is.

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

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

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

D. $\frac{1}{16}$

Answer: D

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79. The constituents of atomic nuclei are believed to be

A. neutrons and protons

B. protons only

C. electrons and protons

D. electrons, protons and neutrons

Answer: A

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80. $._{6}^{12}C$ absorbs an energenic neutron and emits beta particles. The resulting nucleus is.

A. $._{7}N^{14}$

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

C. $._5 B^{13}$

D. $._6 C^{13}$

Answer: B

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81. The ratio of the radii of the nuclei $._{13}^{27} Al$ and $._{52} Te^{125}$ is approximately-

A. $6:10$

B. $13:52$

C. $40:177$

D. $14:73$

Answer: A

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82. Which 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 electromagntic forces

Answer: C

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83. The nuclei $._6C^{13}\&._7N^{14}$ can be described as

A. isotones

B. isobars

C. isotopes of carbon

D. isotopes of nitrogen

Answer: A

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

A. 8 MeV

B. 8 eV

C. $8J$

D. 8 erg

Answer: A

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

$A \rightarrow B + {}_2He^4$

$B \rightarrow C + 2e^-$

Then.

A. A and C are isotopes

B. A and C are isobars

C. A and B are isotopes

D. A and B are isobars

Answer: A

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86. A radioactive element has half-life period $800yr$. After $6400yr$, what amount will remain?

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

B. $\frac{1}{16}$

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

D. $\frac{1}{256}$

Answer: D

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87. The nucleus $._{48}^{115}Cd$ after two successive β^- decays will give.

A. $._{46}Pa^{115}$

B. $._{49}\ln^{114}$

C. $._{50}Sn^{113}$

D. $._{50}Sn^{115}$

Answer: D

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88. 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 microcurie

B. 0.5 microcurie

C. 4 microcurie

D. 8 microcurie

Answer: D

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89. What is the radius of iodine atom (at no. 53 , mass number 126)?

A. $2.5 \times 10^{-11} m$

B. $2.5 \times 10^{-9} m$

C. $7 \times 10^{-9} m$

D. $7 \times 10^{-6} m$

Answer: A

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