CHEMISTRY

JEE (MAIN AND ADVANCED) CHEMISTRY

NUCLEAR CHEMISTRY

Lecture Sheet Level Ii Exercise I Single One Or More Than One Correct Answers

1. Which of the following pairs are isodiapheric pairs ?

A. $_{29}Cu^{65}$ and $_{24}Cr^{55}$

B. $_{29}Cu^{65}$ and $_{24}Cr^{52}$

C. $_{92}U^{235}$ and $_{90}Th^{231}$

D. $_{92}U^{238}$ and $_{90}Th^{231}$

Answer: A::C

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2. Following are the atoms having the number of neutrons and protons as given below :

Atoms	Protons	Neutron
A	8	8
B	8	9
C	8	10
D	7	8
E	7	9

Select correct conclusion (s) :

A. A , B and C, are isotopes

B. A and D are isotones

C. A and E are isobars

D. B and D are isodiaphers

Answer: B::C

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3. The radius of ${}_{Z}M^{A}$ nucleus is (outer most configuration $3s^2 3p^1$ and A + Z = 40)

A. 4.2 FM

B. $1.4 \times \sqrt[340]{FM}$

C. $1.4 \times \sqrt[2]{40}FM$

D. 1.4×40 F M

Answer: A

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4. If the densities of nuclei of ${}_1H^1$ and ${}_{92}U^{238}$ are X and Y respectively ,then correct relation is

A. X = Y

B. $X < Y$

C. Y = 92 X

D. Y = 238 X

Answer: A

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5. Which among these is /are correctly matched ?

A. Position emission : n/p ratio increase

B. K - electron capture : n/p decrease

C. β - decay : n/p ratio decreases

D. α- decay : n/p ratio increases

Answer: A::C::D

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6. Which of the following are doubly magic ?

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

B. ${}_{8}^{16}O$

C. $^{208}_{82}Pb$

D. $^{238}_{92}U$

Answer: A::B::C

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7. The rate of decay per second of a radioactive sample

A. proportional to the life time lived by the nucleus

B. decreases with the life time lived

C. is independent of the life time lived

D. depends upon the total number of radioactive nuclei present in the sample

Answer: B::D

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8. Which of the following statement is/are correct ?

A. The decay constant is independent of external factors like temperature and pressure

B. Nuclear isomers have same number of protons and neutrons

C. The decay constant is independent of the amount of the substance used

D. The value of decay constant generally decreases with the rise in temperature

Answer: A::B::C

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9. Decrease in atomic number is observed during :

A. α-emission

B. β- emission

C. positron emission

D. electron capture

Answer: A::C::D

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10. Which of the following particles can be accelerated in a cyclotron ?

A. Proton

B. Neutron

C. Alpha

D. Positron

Answer: A,C,D

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11. It is observed that only 0.39% of the original radioactive sample remains undecayed after eight hours.Hence:

A. the half-life of that substance is 1 hour

B. the mean life of the substance is $\frac{1}{\ln 2}$ hour

C. decay constant of the substance is (ln2) hour^{-1}

D. if the number of radioactive nuclei of this substance at a given instant is 10^8 then the number left after 30 min would be $\sqrt{2} \times 10^9$

Answer: A::B::C

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12. Select the correct statements:

A. $1Ci = 3.7 \times 10^{10} dis \sec^{-1}$

B. $1Ci = 3.7 \times 10^{10}$ Bq

C. 1Rd = 10^6 dis $\sec^{-1}$

D. Bq (Becquerel) is the S.I. units of radioactivity

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

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13. The isotope $^{235}_{92}U$ decays in a number of steps to an isotope of $^{207}_{87}Pb$. The no of particles emitted in this process will be :

A. 4α

B. 6β

C. 7α

D. 4β

Answer: C::D

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14. Select the correct statements for the following decay chain $A \xrightarrow{-\alpha} B \xrightarrow{-\beta} C \xrightarrow{-\beta} D$

A. A and D are isotopes

B. B , C and D are isobars

C. A and B are isodiaphers

D. A and C are isotones

Answer: A::B::C

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15. In which of the following nuclear process , the electrically neutral atom remains electrically neutral ?

A. α - decay

B. β - decay

C. γ - decay

D. K -electron capture

Answer: C::D

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16. The correct starting material and product of different disintegration series are

A. Th^{232}, Pb^{208}

B. U^{235}, Pb^{207}

C. U^{238}, Pb^{207}

D. Np^{237}, Bi^{209}

Answer: A::B::D

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17. $^{223}_{86}Ra$ is a member of actinium series . Which of the following nuclide belong to the same series ?

A. $^{235}_{91}Pa$

B. $^{232}_{90}Th$

C. $^{238}_{92}U$

D. $^{237}_{88}Ra$

Answer: A::D

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18. Which of the following is/are correct for a nuclear reactor ?

A. A typical fission is represented by

$^{235}_{92}U + {}^{1}_{0}n \rightarrow Kr$ + Energy

B. Heavy water (D_2O) is used as moderator in perference to ordianary water (H_2O) becase

hydrogen may capture neutrons , while D would not do that

C. Cadmium rods increase the reactor power when they go in and because when they go outwards

D. Slower neutrons are more effective in causing fission than faster neutrons in the case of ^{235}U

Answer: A::B::D

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19. Successive emission of an α - particle and two β-particles by an atom of an element results in the formation of its :

A. Isodiapher

B. Isobar

C. Isotope

D. Isotone

Answer: C

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20. The halflife of I^{131} is 8 days . Given a sample of I^{131} at t = 0 , we can assert that :

A. No nucleus will decay at t = 4 days

B. No nucleus will decay before t =8 days

C. All nucleus will decay before t = 16 days

D. A given nucleus may decay at any time after (t= 0)

Answer: D

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21. If 50% of a radioactive substance has $t_{1/2} = 14$ hr , 2 g of the same substance will have a $t_{1/2}$ equal to

A. 56 hr

B. 3.5 hr

C. 14 hr

D. 28 hr

Answer: C

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22. Half life period of a radioactive substance is 1600 minutes . What fraction of the substance will remain after 6400 minutes :

A. $1/16$

B. $1/4$

C. $1/8$

D. $1/2$

Answer: A

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23. The half life period of a radioactive nuclide is 3 hour . In 9 hour its activity will be reduced by

A. $1/9$

B. $7/8$

C. $1/27$

D. $1/6$

Answer: B

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24. A wooden article and a freshly cut tree show activity 7.6 counts $\min^{-1}g^{-1}$ and 15.2 counts $\min^{-1}g^{-1}$ of carbon $(t_{1/2} = 5760$ years) respectively . The age of the article is :

A. 5760 years

B. $5760 \times \frac{15.2}{6}$ years

C. $5760 \times \frac{7.6}{15.2}$ years

D. $5760 \times (15.2 - 7.6)$ year

Answer: A

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25. The radioactive decay rate of a radioactive element is found to be 10^3 dps at a certain time . If the half life of element is 1 sec , the decay rate after 1 sec , is ....and after 3 sec , is .....

A. 500 , 125

B. 125500

C. $10^3, 10^3$

D. $100, 10$

Answer: A

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26. The counting rate observed from a radioactive source at t = 0 seconds was 1600 counts / sec and at t = 8 sec it was 100 counts /sec . The counting rate obserbed as count per sec at t = 6 sec will be

A. 400

B. 300

C. 200

D. 150

Answer: C

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27. Select the correct statement (s) :

A. α- particles are simply dipositive helium nucleus

B. γ-rays travel with higher speed as compare to α- particle and have higher ionization power as compared to β- particle

C. A loss of β- particle results in the production of isobars

D. β- particles are considered to be the best bombarding particles

Answer: A:B:C

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28. Select the correct statement(s)

A. SI unit of radioactivity is Becquerel (Bq)

B. $1Ci = 3.7 \times 10^7$ Bq

C. ${}_3Li^7 + {}_1H^1 \rightarrow 2_2He^4$ is (p, α) type reaction

D. The half -life of a particular radioactive isotope is a characteristic constant of that isotope

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

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29. A radioactive material exhibits an intensity of 3.8 mCi at time 't' & an intensity of 1.35 m Ci five minutes later . Calculate the halflife period of the substance .

A. 202.28 Sec

B. 102.28 Sec

C. 3.4 minutes

D. 34 minutes

Answer: A::C

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30. Select the correct statement (s) :

A. On bombarding ${}_7N^{14}$ nuclei with α- particle , the nuclide of the product formed after release of proton would be ${}_8O^{17}$

B. Decay constant is not depend on temperature

C. Nuclide and it's decay product after α - emission are called isodiaphers

D. If half-life of radium is 1580 years . It's average life will be 1097.22 years

Answer: A::B::C

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31. During the fission of ^{235}U , energy of the order of 180 MeV is generated per nucleus fissioned . The amount of energy released by the fission of 0.235 g of ^{235}U is :

A. $1.73 \times 10^{7} kJ$

B. 1.08×10^{25} kJ

C. $1.73 \times 10^{10} J$

D. $1.08 \times 10^{7} kJ$

Answer: A::C

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32. Which of the following statement is/are incorrect ?

A. the end nuclide formed in thorium (4n) series is ${}_{81}Bi^{200}$

B. ${}_{7}N^{15}$ and ${}_{8}O^{16}$ are isobars .

C. ${}_{20}Ca^{40}$ has magic number of protons and magic number of neutrons

D. The radius (R) of a nuclide of mass number A is given by the equation $R = R_0(A)^{1/3}$

Answer: A::B

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33. Which of the following statements is/are incorrect , when the nuclide ${}_{19}K^{40}$ is subjected to K-electron capture ?

A. ${}^{40}Ar$ is produced with emission of β- particle

B. ${}^{40}Ar$ is produced with emission of α- particle

C. ^{40}Ar is produced with emission of radiation

D. ^{40}Ar is produced with emission of X-radiation

Answer: D

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34. Which of the following statements about electron capture is/are correct ?

A. An outer shell valence electron is used

B. The electron is used to convert a proton to a neutron

C. In electron capture decay , the mass number remains unchanged

D. In electron capture decay , the atomic number decreases by one

Answer: B::C::D

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35. β- decay from a radioactive nuclide leads to :

A. the formation of isobar of parent element

B. the increase in atomic number by one unit

C. the decrease in number of neutrons by one unit

D. the change in atoms mass by one unit

Answer: A::B::C

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36. The number of millimoles of $^{14}_{6}C$ equivalent to one milicurie , if $t_{1/2} = 5570$ year and 1 curie = 3.7×10^{10} dps is

A. 1.56×10^{-2}

B. 3.12×10^{-2}

C. 4.34×10^{-2}

D. 7.80×10^{-2}

Answer: A

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Lecture Sheet Level Ii Exercise Ii Linked Comprehension Type Questions

1. Radioactive decay is a statisticle process i.e., we cannot precisely predict the timing of a particular

radioactivity of a particular nucleus . The nucleus can disintegrate immediately or it may take infinite time . Simply the probability of the number of nuclei being disintegrated at any instant can be predicted . the rate at which a particular decay process in a radioactive sample is directly proportional to the number of radioactive nuclei present and thus obeys first order kinetics . the factor dN/N expresses the fraction of nuclei decayed in time dt.$t_{1/2}$ is the time in which half of the atoms are decayed and average life is the time for the nucleus to survive before decay .

Which of the following relation is correct ? $\left(t_{1/2}\right.$

and $t_{3/4}$ are time required to complete half and 3/4 decay respectively)

A. $t_{1/2} = 2 \times t_{3/4}$

B. $t_{1/2} = 3 \times t_{3/4}$

C. $t_{3/4} = 2 \times t_{1/2}$

D. $t_{3/4} = 3 \times t_{1/2}$

Answer: C

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2. Radioactive decay is a statisticle process i.e., we cannot precisely predict the timing of a particular

radioactivity of a particular nucleus . The nucleus can disintegrate immediately or it may take infinite time . Simply the probability of the number of nuclei being disintegrated at any instant can be predicted . the rate at which a particular decay process in a radioactive sample is directly proportional to the number of radioactive nuclei present and thus obeys first order kinetics . the factor dN/N expresses the fraction of nuclei decayed in time dt.$t_{1/2}$ is the time in which half of the atoms are decayed and average life is the time for the nucleus to survive before decay .

A freshly prepared radioactive source of half period 2 hour emits radiations on intensity which is 64

times of the permissible safe level. The minimum time after which it would be possible to work with this source is :

A. 16 hrs

B. 12 hrs

C. 20 hrs

D. 24 hrs

Answer: B

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3. Radioactive decay is a statisticle process i.e., we cannot precisely predict the timing of a particular radioactivity of a particular nucleus . The nucleus can disintegrate immediately or it may take infinite time . Simply the probability of the number of nuclei being disintegrated at any instant can be predicted . the rate at which a particular decay process in a radioactive sample is directly proportional to the number of radioactive nuclei present and thus obeys first order kinetics . the factor dN/N expresses the fraction of nuclei decayed in time dt.$t_{1/2}$ is the time in which half of the atoms are decayed and average life is the time for the nucleus to survive

before decay .

75 atoms of a radioactive species are decayed in 2 half lives $\left(t_{1/2} = 1 \text{ hr }\right)$ if 100 atoms are taken initially . Number of atoms decayed if 200 atoms are taken in 2 hr are :

A. 75

B. 150

C. 50

D. 200

Answer: B

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4. The emission of penetraing α, βparticle $\left({}_{2}^{4}He\right.$ and ${}_{-1}^{0}e$ respectively) along with γ- radiation (hv) was noticed from unstable nuclei . All elements having $Z > 82$ show this phenomenon . The emission was explained in terms of low binding energy (giving α-decay) high n/p ratio (neutron decay) , γ from a radioactive nuclide is secondary emission.

An element of group III with At. no. 90 and mass number of 238 undergoes decay of one α- particle . The newly formed element belongs to :

A. I

B. II

C. III

D. IV

Answer: B

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5. The emission of penetraing α, βparticle $\left({}_{2}^{4}He\right.$ and ${}_{-1}^{0}e$ respectively) along with γ- radiation (hv) was noticed from unstable nuclei . All elements having $Z > 82$ show this phenomenon . The emission was explained in terms of low binding energy (giving α-decay) high n/p ratio (neutron decay) , γ from a

radioactive nuclide is secondary emission

The emission of penetrating rays from a radioactive species can be shielded by

A. Bi blocks

B. Pb blocks

C. C blocks

D. Mg blocks

Answer: B

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6. The emission of penetraing α, βparticle $\left({}_{2}^{4}He\right.$ and ${}_{-1}^{0}e$ respectively) along with γ- radiation (hv) was noticed from unstable nuclei . All elements having $Z > 82$ show this phenomenon . The emission was explained in terms of low binding energy (giving α-decay) high n/p ratio (neutron decay) , γ from a radioactive nuclide is secondary emission

The binding energy of the hydrogen nucleus is :

A. zero

B. 13.6 eV

C. > 13.6 eV

D. < 13.6 eV

Answer: A

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7. It has been estimated that the total power radiated by the sun is 3.8×10^{26} J per second . The source of energy of stars is a thermonucleur fission reaction . Energy released in the process of fusion is due to mass defect . Q = Δmc^2

B.E. per nucleon of ${}_{1}^{2}H$ and ${}_{2}^{4}He$ and 1.1 MeV and 7 MeV respectively . If two deutrons nuclei react to form a single helium nucleus , then the energy released is :

A. 13.9 Mev

B. 26.9 Mev

C. 23.6 Mev

D. 19.2 Mev

Answer: C

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8. It has been estimated that the total power radiated by the sun is 3.8×10^{26} J per second . The source of energy of stars is a thermonucleur fission reaction . Energy released in the process of fusion is

due to mass defect . Q = Δmc^2

Mass equivalent to energy 931 Mev is

A. 6.023×10^{-27} kg

B. 1.66×10^{-27} kg

C. 16.66×10^{-27} kg

D. 16.02×10^{-27} kg

Answer: B

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9. It has been estimated that the total power radiated by the sun is 3.8×10^{26} J per second . The

source of energy of stars is a thermonucleur fission reaction . Energy released in the process of fusion is due to mass defect . Q = Δmc^2

In a nuclear reaction , ${}_1^2H + {}_1^2H \rightarrow {}_2^3He + {}_0^1n$. if the masses of ${}_1^2H$ & ${}_2^3He$ are 2.014741 amu and 3.016977 amu respectively . then the Q-value of the reaction is nearly :

A. 0.00352 Me v

B. 3.63 Me v

C. 0.082 Mev

D. 2.45 Mev

Answer: B

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Lecture Sheet Level Ii Exercise Iii Match The Following Questions

1. Match the Column - I Radio-isotope with Column - II medicinal use and select correct matching :

COLUMN - I	COLUMN - II
A) ^{60}Co	p) Leucaemia
B) ^{131}I	q) Anaemia
C) ^{59}Fe	r) Cancerous tumours
D) ^{31}P	s) Disorders of thyroid gland

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2. Match the Column - I Radio-isotope with Column - II medicinal use and select correct matching :

COLUMN - I	COLUMN - II (Characteristic Use)
A) ^{32}P	p) Location of tumour in brain
B) ^{24}Na	q) Location of blood clot and circulatory disorders
C) ^{60}Co	r) Radiotherapy
D) ^{131}I	s) Agriculture research

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3. Match the Column - I Radio-isotope with Column - II medicinal use and select correct matching :

COLUMN - I	COLUMN - II
A) Only β-emitter	p) $^{14}_{6}C$
B) Maximum n/p ratio	q) $^{3}_{1}H$
C) Positron emitter	r) $^{11}_{6}C$
D) α,β-emitter	s) $^{235}_{92}U$

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Lecture Sheet Level Ii Exercise Iv Integer Answer Type Questions

1. A sample contains two radioactive substances A and B in the ratio of $4:1$. If their half lives are 24 and 16 hours respectively , then after two days what will be the ratio of A and B?

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2. A radioactive sample had an initial activity of 56 dpm . After 69.3 minutes , it was found to have an

activity of 28 dpm , the number of atoms in a sample having an activity of 100 dpm is 10^x . The value of x is .....

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3. Upon irradiating californium with neutrons , a scientist discovered a new nuclide having mass number of 250 and a half-life of 30 min . 90 min after the irradiation, the observed radioactivity due to nuclide was 100 dis/min . If 3.46×10^x atoms of the nucleide were present initially . Then x is .....

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4. Na^{22} has half life of 2.68 years . It decays both by positron emission and electron capture with a ratio of 86% of the former to 14% of the later . The half life for positron emission in years (nearly) is .....

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5. Iron -49 decay by positron emission with a half-life of 0.08 seconds . Nuclide produced in this decay has atomic number x^2. Find x .

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6. No. of nuclei among the following which undergo radioactive decay (based on number of protons only) Silicon - 30 , Germanium - 72 , Barium - 130 , Radon - 216

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7. Number of α - particles produced during the decay process of U - 235 to Pb - 207

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8. In how many way among the following , a nucleus with high n/p ratio is expected to decay α- decay , β- decay , positron decay , electron capture .

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9. The periodic table consists of 18 groups. An isotope of copper, on bombardment with proton, undergoes a nuclear reaction yielding element as shown below. To which group element X belongs in the periodic table?

$$^{63}_{29}Cu + ^{1}_{1}H \rightarrow 6^{1}_{0}n + \alpha + 2^{1}_{1}H + X$$

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Practice Sheet 1 Single Or More Than One Option Questions

1. The triad of nuclei that represents isotopes is :

A. ${}_6C^{14}, {}_7N^{14}, {}_9F^{19}$

B. ${}_6C^{12}, {}_7N^{14}, {}_9F^{19}$

C. ${}_6C^{14}, {}_6C^{13}, {}_6C^{12}$

D. ${}_6C^{14}, {}_7N^{14}, {}_9F^{17}$

Answer: C

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2. The triad of nuclei that represents isotones is :

A. ${}_6C^{12}, {}_7N^{14}, {}_9F^{19}$

B. ${}_6C^{14}, {}_7N^{15}, {}_9F^{17}$

C. ${}_6C^{14}, {}_7N^{14}, {}_9F^{17}$

D. ${}_6C^{14}, {}_7N^{14}, {}_9F^{19}$

Answer: B

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3. The 4n series starts from Th - 232 and ends at

A. Pb - 208

B. Bi-209

C. Pb- 206

D. Pb- 207

Answer: A

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4. The activity of a radionuclide $\left(X^{100}\right)$ is 6.023 curie . If the disintegration constant is $3.7 \times 10^4 \sec^{-1}$, the mass of the radionuclide is :

A. 10^{-14}g

B. 10^{-6} g

C. 10^{-15} g

D. 10^{-3} g

Answer: C

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5. If N_0 is the initial number of nuclie , number of nuclei remaining undecayed at the end of nth half life is :

A. $2^{-n}N_0$

B. $2^{n}N_0$

C. $n^{-2}N_0$

D. $n^{2}N_0$

Answer: A

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6. The half life of a radioactive isotope is 2.5 hour . The mass of it that remains undecayed after 10 hour is (If the mass of the isotope was 16 g) :

A. 32 g

B. 16 g

C. 4 g

D. 1 g

Answer: D

7. If 75% quantity of a radioactive isotope disintegrates in 2 hour , its half-life would be :

A. 1 hour

B. 45 minutes

C. 30 minutes

D. 15 minutes

Answer: A

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8. A radioactive substance has a halflife of 50 days . Fraction of the material left behind after 100 day will be :

A. 0.5

B. 0.75

C. 0.125

D. 0.25

Answer: D

9. The half life period of a radioactive element is 140 days . After 560 days , 1 g of the element will reduce to

A. 0.5 g

B. 0.25 g

C. 1/8 g

D. 1/16 g

Answer: D

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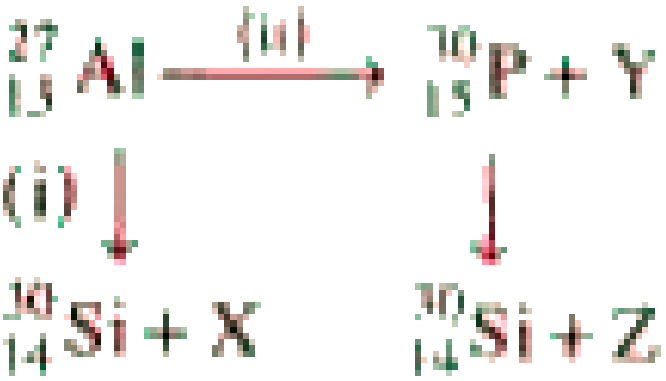
10. Bombardment of aluminium by α- particles leads to its artificial disintegration in two ways , (i) and (ii)

as shows . Product X , Y and Z respectively are .



A. proton , neutron , positron

B. neutron , positron , proton

C. proton , positron , neutron

D. positron , proton , neutron

Answer: A

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11. Which among these is /are correctly matched ?

A. Position emission : n/p ratio increase

B. K-electron capture : n/p decreases

C. β- decay : n/p decreases

D. ${}_{92}U^{238}$ and ${}_{90}Th^{231}$: n/p ratio decreases

Answer: A::C

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12. Nuclear reactions accompared with emission of neutron are :

A. ${}_{13}^{27}Al + {}_{2}^{4}He \rightarrow {}_{15}^{30}P$

B. ${}_{6}^{12}C + {}_{1}^{1}H \rightarrow {}_{7}^{13}N$

C. ${}_{15}^{30}P \rightarrow {}_{14}^{30}Si + {}_{+1}^{0}e$

D. ${}_{96}^{243}Am + {}_{2}^{4}He \rightarrow {}_{97}^{244}Bk + {}_{1}^{1}H$

Answer: A::D

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13. In case of radioactive radiations :

A. some are not deviated by electric and magnetic field

B. some carry negative charge

C. all are electromagnetic waves

D. all produce X- rays with when suddenly stopped .

Answer: A::B

14. Radon undergoes decay by α- emission

$$^{222}_{86}Rn \xrightarrow{t_{1/2}=3.8\text{days}} {}^{218}_{84}Po + {}^{4}_{2}He$$

Which of the following statements will be true for this decay process ?

A. If the initial amount of radon was 1 mg , the amount of radon left after 11.4 days will 0.125 mg

B. Activity of radon after 7.6 days will be $N_0 \times \left(5.3 \times 10^{-7}\right) s^{-1}$ where N_0 is the original number of atoms of the radon

C. The decay constant of radon is $2.1 \times 10^{-6} S^{-1}$

D. 60% of the radon will decay in 5 days approximately

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

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15. Which of the following emissions do not cause the emission of X-ray ?

A. α- decay

B. β- decay

C. Positron decay

D. K-electron capture

Answer: A::B::C

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Practice Sheet 1 Linked Comprehension Type Questions

1. Radioactive disintegration is a first order reaction and it's rate depends only upon the nature of nucleus and does not depend upon external factors

like temperature and pressure . The rate of radioactive disintegration (Activity) is represented as $-\frac{dN}{dt} = \lambda N$, Where λ = decay constant , N number of nuclei at time t , N_0 = initial no. of nuclei.

The above equation after integration can be represented as $\lambda = \frac{2.303}{t}\log\left(\frac{N_0}{N}\right)$

Half-life period of U^{232} is 2.5×10^5 years . In how much time will the amount of U^{237} remaining be only 25% of the original amount ?

A. 2.5×10^5 years

B. 1.25×10^5 years

C. 5×10^5 years

D. 10^6 years

Answer: C

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2. Radioactive disintegration is a first order reaction and it's rate depends only upon the nature of nucleus and does not depend upon external factors like temperature and pressure . The rate of radioactive disintegration (Activity) is represented as $-\frac{dN}{dt} = \lambda N$, Where λ = decay constant , N number of nuclei at time t , N_0 = initial no. of nuclei. The above equation after integration can be represented as $\lambda = \frac{2.303}{t}\log\left(\frac{N_0}{N}\right)$

Calculate the half-life period of a radioactive element which remains only 1/16 of it's original amount in 4740 years :

A. 1185 years

B. 2370 years

C. 52.5 years

D. none of these

Answer: A

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3. Radioactive disintegration is a first order reaction and it's rate depends only upon the nature of nucleus and does not depend upon external factors like temperature and pressure . The rate of radioactive disintegration (Activity) is represented as $-\frac{dN}{dt} = \lambda N$, Where λ = decay constant , N number of nuclei at time t , N_0 = initial no. of nuclei.

The above equation after integration can be represented as $\lambda = \frac{2.303}{t}\log\left(\frac{N_0}{N}\right)$

What is the activity in Ci (curie) of 1.0 mole of Plutonium - 239 ? ($t_{1/2} = 24,000$ years)

A. 1.49 Ci

B. 14.9 Ci

C. $5.513 \times 10^{11} Ci$

D. none of these

Answer: B

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4. Carbon - 14 is used to determine the age of organic material . The procedure is based on the formation of ^{14}C by neutron capture in the atmosphere . $T_1 - T_2 = \frac{1}{\lambda} \log \frac{C_1}{C_2}$

^{14}C is absorbed by living organisms during

photosynthesis . The ^{14}C content is constant in living organism once the plant or animal dies , the uptake of carbon dioxide by it increases and the level of ^{14}C in the dead being falls due to the decay which C^{14} undergoes .

${}^{14}_{6}C \rightarrow {}^{14}_{7}N + \beta^{-} \left({}^{0}_{-1}e\right)$. The half- life period of ^{14}C is 5770 years . The decay constant (λ) can be calculated using the formula $\lambda = \dfrac{0.693}{t_{1/2}}$.

The comparison of the b^{-} activity of the dead matter with that of the carbon still in circulation enables measurement of the period of the isolation of the material from the living cycle . the method , however , ceases to be accurate over period longer than 30,000 years . The proportion of ^{14}C to ^{12}C in

living matter is $1:10^2$

Which of the following options is correct ?

A. In living organisms , circulation of ^{14}C from atmosphere is high so the carbon content is constant in organism

B. Carbon dating can be used to find out the age of earth crust of rocks

C. Radioactive material absorption is equal to its rate of decay , hence the carbon content remains constant in living organism.

D. Carbon dating cannot be used to determine concentration of ^{14}C in dead being .

Answer: C

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A nuclear explosion has taken place leading to increase in concentration of C^{14} is C_3 nearby areas and C_2 in areas far away . If the age of the fossil is determined to be T_1 and T_2 at the places respectively then

A. the age of the fossil will increase at the place where explosion has taken place and $T_1 - T_2 = \frac{1}{\lambda}\log\frac{C_1}{C_2}$

B. the age of the fossil will decreases at the place where explosion has taken place and $T_1 - T_2 = \frac{1}{\lambda}\log\frac{C_1}{C_2}$

C. the age of fossil will be determined to be same

D. $\frac{T_1}{T_2} = \frac{C_1}{C_2}$

Answer: A

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6. What should be age of fossil for meaningful determination of its age ?

A. 6 years

B. 6000 years

C. 60,000 years

D. it can be used to calculate any age

Answer: B

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Practice Sheet 1 Match The Following Questions

1. Match the following columns

COLUMN - I	COLUMN - II
A) Isotones	p) $_{91}Pa^{234}$ and $_{90}Th^{234}$
B) Isobars	q) $_{6}C^{12}$ and $_{6}C^{14}$
C) Isotopes	r) $_{19}K^{39}$ and $_{9}F^{19}$
D) Isodiaphers	s) $_{18}Ar^{39}$ and $_{19}K^{40}$
COLUMN - I	COLUMN - II

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2. Match the following columns

COLUMN - I	COLUMN - II
A) Proton rich nuclides	p) K-electron capture
B) Artificially prepared element	q) Proton emission
C) $^{11}_{6}C$	r) Positron emission
D) C - N cycle	s) $^{97}_{43}Tc$

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Practice Sheet 1 Integer Answer Type Questions

1. In the nuclear reaction ${}_3Li^7 + {}_1H^1 \rightarrow 2_2He^4$. The mass loss is nearly 0.02 amu . Hence the energy released in the process is $x \times 10^2$ million kcal l mole . (nearly) . Then 'x' is ____

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2. Number of β particles emitted during the decay of $^{235}_{92}U$ to $^{207}_{82}Pb$

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3. The Charge of gama particle is _____

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4. The half-life of a radioactive element is 100 minutes . The time interval between the stages 50%

and 87.5 % decay will be $x \times 40$ min . The value of x is _____

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5. If B.E. per nucleon of B 11 ,(the atomic mass of B-11 is 11.00931 u). , is $(0.1 \times y)$ approximately , then what is the value of 'y'

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6. How many types of particles among the following are emitted during the decay of sulphur-35 nucleus ,

β - emmission , e^- capture , positron emission , neutron emission

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7. The number of neutrons emitted when $^{235}_{92}U$ undergoes controlled nuclear fission to $^{142}_{54}Xe$ and $^{90}_{38}Sr$ is

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Practice Sheet 2 Single Or More Than One Option Questions

1. In the sequence of the following nuclear reaction

$$^{238}_{98}X \xrightarrow{-\alpha} Y \xrightarrow{-\beta} Z \xrightarrow{-\beta} L \xrightarrow{n\alpha} {}^{218}_{90}M$$

What is the value of n

A. 3

B. 4

C. 5

D. 6

Answer: B

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2. The $^{235}_{92}U$ disintegrates to give 4α and 6α particles

. The atomic number of the end product is

A. 92

B. 96

C. 84

D. 90

Answer: D

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3. Which one of the following nuclear reaction is correct :

A. ${}_6C^{13} + {}_1H^1 \rightarrow {}_7N^{13} + {}_{-1}\beta^0 + \gamma$

B. ${}_{11}Na^{23} + {}_1H^1 \rightarrow {}_{10}Ne^{20} + {}_2He^4$

C. ${}_{13}Al^{23} + {}_0n^1 \rightarrow {}_{11}Na^{23} + {}_{-1}e^0$

D. ${}_{12}Mg^{24} + {}_2He^4 \rightarrow {}_{13}Al^{27} + {}_0n^1$

Answer: B

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4. The binding energy of an element is 64 MeV . If BE/nucleon is 6.4 the number of nucleons are :

A. 10

B. 64

C. 16

D. 6

Answer: A

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5. Decrease in atomic number is observed during :

A. Alpha emission

B. Electron capture

C. positron emission

D. all

Answer: D

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6. The number of $\alpha -$ and β- particles emitted during the transformation of $^{232}_{90}Th$ to $^{208}_{82}Pb$ is respectively

A. 2,2

B. 4,2

C. 6,4

D. 8,6

Answer: C

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7. The number of β - particle emitted during the change ${}_aX^c \rightarrow {}_aY^b$ is :

A. $\frac{a-b}{4}$

B. $d + \left[\frac{a-b}{2}\right]$

C. $d - a + \left[\frac{c-d}{2}\right]$

D. $d + \left[\frac{a-b}{2}\right] - c$

Answer: C

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8. A radioactive substance (parent) decays to its daughter element the age of radioactive substance (t) is related to the daughter (d) parent (p) ratio by the equation :

A. $t = \frac{1}{\lambda}\ln\left(1 + \frac{p}{d}\right)$

B. $t = \frac{1}{\lambda}\ln\left(1 + \frac{d}{p}\right)$

C. $t = \frac{1}{\lambda}\ln\left(\frac{d}{p}\right)$

D. $t = \frac{1}{\lambda}\ln\left(\frac{p}{d}\right)$

Answer: B

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9. Ac^{227} has a half - life of 22 years . The decay follows two parallel paths . What are the decay

constants (λ) for Th and Fr respectively ?

A. 0.03087 , 0.00063

B. 0.00063 , 0.03087

C. 0.02 , 0.98

D. none of these

Answer: B

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10. ${}_{92}^{238}U$ is the element of III B group , it undergoes decay as follows ,

${}_{92}^{238}U \xrightarrow{-\alpha} A \xrightarrow{-\alpha} B \xrightarrow{-\beta} C$ Which of the following statements is/are correct ?

A. A will be of III B group

B. A will be of 1 B group

C. B will of II A

D. C is the isotope of ${}_{92}^{238}U$

Answer: A::C

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11. For nuclide ${}_{Z}^{A}X$, which of the following changes take place in respectively decay ?

A. Both A and Z decreases in α- decay

B. Both A and Z do not Change in γ -decay

C. A does not change but Z decreases by one unit in positron decay or K - electron capture

D. Both A and Z increases in β- decay

Answer: A::B::C

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12. From the following equations pick up the possible fusion reactions :

A. ${}_{6}^{13}C + {}_{1}^{1}H + {}_{0}^{1}e + 4.3MeV$

B. ${}_{6}^{12}C + {}_{1}^{1}H \rightarrow {}_{7}^{13}N + 2MeV$

C. ${}_{7}^{14}N + {}_{1}^{1}H \rightarrow {}_{8}^{15}O + 7.3MeV$

D.

${}_{92}^{235}U + {}_{0}^{1}n \rightarrow {}_{54}^{140}Xe + {}_{38}^{94}Sr + {}_{0}^{1}n + \gamma + 200MeV$

Answer: B::C::D

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13. Temperature of stars is several times that of sun . Which of the following cycles are reponsible for the stellar energy of stars ?

A. Porton- porton cycle

B. Proton-nitrogen cycle

C. Carbon-nitrogen cycle

D. Proton-deutron cycle

Answer: C::D

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14. Which of the following particles can be accelerated in a cyclotron ?

A. electron

B. Neutron

C. Beta

D. Proton

Answer: D

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Practice Sheet 2 Linked Comprehension Type Questions

1. To detect bombs that may be smuggled into airplanes , the Federal Aviation Administration (FAA) will soon require all major airports in the United States to install thermal neutrons analysers . The thermal neutron analyser will bombared baggage with low-energy neutrons , converting some of the nitrogen -14 nuclei to nitrogen -15 , with simultaneous emission of γ rays . Because nitrogen content is usually high in explosive , detection of a high dosage of γ rays will suggest that a bomb may

be present .

Nuclear process mentioned above involves reaction :

A. ${}_7N^{14} + {}_0n^1 \rightarrow {}_7N^{15}$

B. ${}^{14}_7N + {}^1_0n \rightarrow {}^{14}_6C + {}^1_1H$

C. ${}^{14}_7N \rightarrow {}^{14}_6C + {}^1_0e$

D. ${}^{14}_7N \rightarrow {}^{15}_7C + {}^{-1}_0e$

Answer: A

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2. To detect bombs that may be smuggled into airplanes , the Federal Aviation Administration (FAA)

will soon require all major airports in the United States to install thermal neutrons analysers . The thermal neutron analyser will bombared baggage with low-energy neutrons , converting some of the nitrogen -14 nuclei to nitrogen -15 , with simultaneous emission of γ rays . Because nitrogen content is usually high in explosive , detection of a high dosage of γ rays will suggest that a bomb may be present .

Nuclear process mentioned above involves reaction :

A. 3 and 4

B. 1 and 2

C. 1 , 3 and 4

D. 1 , 2 , 3 and 4

Answer: D

3. To detect bombs that may be smuggled into airplanes , the Federal Aviation Administration (FAA) will soon require all major airports in the United States to install thermal neutrons analysers . The thermal neutron analyser will bombared baggage with low-energy neutrons , converting some of the nitrogen -14 nuclei to nitrogen -15 , with simultaneous emission of γ rays . Because nitrogen

content is usually high in explosive , detection of a high dosage of γ rays will suggest that a bomb may be present .

The sensitivity of the neutral activation analysis depends on the :

A. neutron flux available for irradiation

B. availability of nucleus to absorb a neutron

C. energy of decay process

D. all of the above are correct

Answer: D

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4. One of the products of radiation fall out from atmospheric bomb testing or nuclear accidents at Chernobyl is iodine-131 . People living in a region where Iodine-131 was known to have been deposited were encouraged to use table salt enriched with non-radioactive isotope of iodine .

Non-radioactive isotope prescribed in the table salt is :

A. I-131

B. I-127

C. I-132

D. I-129

Answer: B

5. One of the products of radiation fall out from atmospheric bomb testing or nuclear accidents at Chernobyl is iodine-131 . People living in a region where Iodine-131 was known to have been deposited were encouraged to use table salt enriched with non-radioactive isotope of iodine .

The rate of iodine uptake by the thyroid is :

A. dependent upon the iodine concentration

B. dependent upon pressure of iodine

C. follows second - order kinetics

D. independent of iodine concentration

Answer: A

6. One of the products of radiation fall out from atmospheric bomb testing or nuclear accidents at Chernobyl is iodine-131 . People living in a region where Iodine-131 was known to have been deposited were encouraged to use table salt enriched with

non-radioactive isotope of iodine .

By use of non-radioactive iodine isotope in common salt :

A. rate of iodine - 131 uptake is sharply reduced compared to uptake of iodine -127

B. a new non-radioactive isotope is formed

C. taste of table salt becomes better

D. iodine -131 being water soluble is eliminated from tissue .

Answer: A

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Practice Sheet 2 Match The Following Questions

1. Match the following columns

COLUMN - I	COLUMN - II
A) 4n	p) Pu -233
B) 4n + 1	q) Th - 232
C) 4n + 2	r) U - 235
D) 4n + 3	s) U - 238
COLUMN - I	COLUMN - II

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2. Match the following columns

COLUMN - I	COLUMN - II
A) $^{60}_{27}Co$	p) γ-emiter
B) $^{233}_{90}Th$	q) Cancer therapy
C) $_{13}Al^{29}$	r) β-emitter
D) $^{232}_{90}Th$	s) α-emitter

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Practice Sheet 2 Integer Answer Type Questions

1. The difference between number of α and β particles emitted during the conversion of $U_{92}^{238} \rightarrow Pb_{82}^{206}$ is

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2. $^{210}_{84}Po \rightarrow {}^{206}_{82}Pb + {}^{4}_{2}He$. In the reaction , the position of Po in the periodic table is ___ A group when lead belongs to IV A

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3. After the emission of an α - particle from the atom $_{92}^{238}X$, the number of neutrons in the atom will be xyz , Y is___

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4. The number of α particle in the nuclear reaction $_{90}^{238}Th \rightarrow {}_{81}^{212}Bi$ are : ____

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5. The $^{238}_{92}U$ disintegrates to give 4α and 6β-particles . The atomic number of daughter element obtained is 10 x. x is ___

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6. Assuming the age of the earth to be 10^{th} years , if the percentage of original amount of U^{238} still in existance on earth is x% (nearly) ($t_{1/2}$ of U^{238} is 4.5×10^9 years) . Then 'x/10' is ____

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7. One mole of radioactive nuclide , X with half life of ten days decays as ${}_{Z}^{A}X \rightarrow {}_{Z-4}^{A-8}Y + 2{}_{2}^{4}He$. If the no. of moles of Helium formed in 20 days is 0.25 x then x = ...

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8. A,B and C are isodiapher, while C,D and E are isobars. Calculate the difference of protons between A and E ${}_{82}^{206}A \rightarrow B \rightarrow C \rightarrow D \rightarrow E$

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