CHEMISTRY

BOOKS - P BAHADUR CHEMISTRY (HINGLISH)

RADIO ACTIVITY

Exercies

1. Caluculate the density of uranium -235 nucleus. Given $m_n = m_p = 1.67 \times 10^{-27} kg.$

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2. Calucate the density of the nucelus of $._{47}^{107} Ag$ assuming R_{nucleus} is $1.4A^{1/3} \times 10^{-13} cm$. Where A is mass number of nucelsus. Compare its density with density of metallic silver $10.5 gcm^{-3}$

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3. Calculate the binding energy per nucleion of Li isotiope, which has the isotopic mass of $7.016amu$. The indivisulal masses of netutron and proton are $1.008665amu$ and $1.007277amu$, respectively and the mass of electron $= 0.000548amu$.

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4. The aromic mass of $.^{16} O$ is 15.995 amu while the individual masses of proton and neutron are 1.0073 amu and 1.0087 amu respetively. The mass of electron is 0.000548 amu. Calculate the binding energy of the oxygen nucleus.

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5. The isotopic masses of $._1^2 He$ and $_(2)^4 He$ are 2.0141 and 4.0026 amu respectively and the velocity of light in vacumm is $2.998 \times 10^8 m/s$.

Calculate the quantiy of energy (in J) liberated when two mole of $._1^2 H$ undergo fusion to form one mole of $._2^4 He$

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6. What is the charge in mass when 2 mole of hydroghen atoms combine to form 1 mole fo H_2 molecule if: $2H \rightarrow H_2, \Delta E = -436kJ$? Comment on the result.

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7. A radioactive element decays by $\beta -$ emission. If mass of parent and daughter nucliede are m_1 and m_2 respectively, caluclate energy liberated during the emission.

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

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9. In the decay series $._{92} U^{238}$ to $._{82} Pb^{206}$, how many α-paritcles and how many $\beta^{\ominus}$-particles are emitted?

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10. Calculate the no. of $\alpha -$ and $\beta -$ particles given during the change:

$._{93}^{237} Np \rightarrow ._{83}^{209} Bi$

Also report the nature and name of this radioactive series.

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11. Caculalate the mass of $.^{140} LA$ in a sample whose activity is $3.7 \times 10^{10} Bq$ (1 Becquerel, $Bq = 1$ disntegration per second) given that is $t_{1/2}$ is 40 hour.

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12. The half line is $._{38}^{90} Sr$ is 20 year. If the sample of this nuclide has an activity of $8,000$ disintergrations $\min^{-1}$ today, what will be its activity after 80 year.

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13. Two radioactive nuclides A and B have half-lives in the ratio $2:3$ respectively. An experiment is made with one mole of each of them. Calculate the molar ratio of A and B after a time interval of three times of half-line of A.

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14. Two radioactive nuclides A and B have decay constant 10λ and λ respectively. If initially they have same number of nuclei, calculate the ratio of nuclei of A and B after a time $1/9\lambda$

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15. A drug is given intravenously and drug concentrations in blood measured at 1 and 4 hour are 26 and $18\mu g/mL$. What is the half-line of drug and at what time will the level decreases to $10\mu g/mL$

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16. A sample of wooden aircrafts is found to undergo $9dpmg^{-1}$ of $.^{14}C$. What is appoximate age of aircraffts? The half line of $.^{14}_{6}C$ is 5730 year and rate of disintergration of wood recently cut down is $15dpmg^{-1}$ do $.^{14}_{6}C$?

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17. A piece of wood from an archelogical source shows a $.^{14}C$ activity which is 60% of the activity found in fresh wood today. Caculate the age of the archeologival sample. ($t_{1/2}$ for $.^{14}C = 5570$ year)

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18. The $\beta -$ activity of a sample of CO_2 prepared forma contemporarty wood gave a count rate of 25.5 counts per minute (cpm). The same of CO_2 form an ancient wooden stratue gave a count rate of $20.5 cpm$, in the same counter condition. Calculate its age to the nearest 50 year taking $t_{1/2}$ for $.^{14}C$ as 5770 year. What would be the expected count rate of an identical mass of CO_2 form a sample which is 4000 year old?

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19. The radioactive isotope $._{27}^{60}Co$ which has now replaced radium in the treatment of cancer can be made by $a(n, p)$ or (n, γ) reaction. For each

reactio, indicate the apporipriate target nucleus. If the half life of $._{27}^{60}Co$ is 7 year evaluate the decay constant in s^{-1}.

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20. A piece of charcoal from the ruins of a settlement in Japan was found to have $.^{14}C/.^{14}C$ ratio what was 0.617 times that found in living organisms. How old is the piece of charcol? ($t_{1/2}$ for $.^{14}C$ is 5770 year?)

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21. A sample of $._{131}^{53}I$ is iodide ion was admistered to a patient in a carrier consisting of $0.10mg$ of stable iiodide ion. After 4 day 67.7% of initial radioactivity was detected in the throid gland of the patient. What mass of stable iodide ion had migrated to thyroid glad? ($t_{1/2}$ for iodide ion = 8 day)

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22. A solution of 1 litre has $0.6g$ of non-radioactive Fe^{3+} with mass no. 56. To this solution $0.209g$ of radioactove Fe^{2+} is added with mass no. 57 and the following reaction occurred.

$.^{57}Fe^{2+} + .^{56}Fe^{3+} \rightarrow .^{57}Fe^{3+} + .^{56}Fe^{2+}$

At the end of one hour it was found that 10^{-5} moles of non-radioactive $.^{56}Fe^{2+}$ mol $L^{-1}hr^{-1}$. Negalecting any charge in volume, calculate the activity of the sample at the end of $1hr$ ($t_{1/2}$ for $.^{57}Fe^{2+} = 4.62hr$.)

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23. Write the nuclear reactions for the following radioactive decay:

(a) $._{92}U^{238}$ undergoes $\alpha -$ decay.

(b) $._{91}Pa^{234}$ undergoes $B\eta -$ decay.

(c) $._{11}Na^{22}$ undergoes $B\eta^{+}$ decay.

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24. Give the example each of (a) $\alpha -$ emission

(b) $\beta^{+} -$ emission, and (c) $K -$ capture.

write the equation for these nuclear changes.

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25. Complete the following nuclear changes.

(a) $._{42}^{96} Mo(. . , n)._{43}^{97} Tc$

(b) $. . (\alpha, 2n)._{85}^{211} At$

(c) $._{25}^{55} Mn(n, \gamma)...$

(d) $._{96}^{246} Cm + ._{6}^{12} C \rightarrow .... + 4_{0}^{1}n$

(e) $._{13}^{27} Al(\alpha, n). .$

(f) $._{235}^{92} U\left(\alpha, \beta^{-}\right). .$

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26. Complete the equations for the following nuclear processes:

(a)$._{17}^{35} Cl + ._{1}^{0} n \rightarrow ... + ._{2}^{4} He$

(b) $._{92}^{235} U + ._{0}^{1} n \rightarrow ... + ._{54}^{137} Xe + 2_{0}^{1} n$

(c) $._{13}^{27} Al + ._{2}^{4} He \rightarrow ... + ._{0}^{1} n$

(d) $...(n, p)._{16}^{35} S$

(e) $._{94}^{239} Pu(\alpha, \beta^{-})...$

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27. A Piece of wood, reportedly from king Tut's tomb was burnt and $7.32g$ $.^{14} CO_2$ was collected. The total radioacticity in the $.^{14} CO_2$ was 10.8 dis $\overset{-1}{\min}$. How old was the wood sample? $t_{1/2}$ for $.^{14} C$ istope $= 15.3$ dis $\overset{-1}{\min} g^{-1}$.

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28. The half of $.^{238} U$ decomposed to $.^{206} Pb$ in 4.5×10^8 year. What will be the age of rock that contains equal weight of both?

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29. $._{238}^{92}U$ by sucessive radioactive decays changes to $._{82}^{206}Pb$. A sample of uranium ore was analysed and found to contain $1.0g^{238}U$ and $0.1g^{206}Pb$. Assuming that $.^{206}Pb$ has accumlated due to delay of uranium, find out the age of ore.

($t_{1/2}$ for $.^{238}U = 10^9$ year)

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30. The isotopic compostion fo rubidium is $.^{85}Rb - 72$ per cent and $.^{87}Rb - 28$ per cent. $.^{87}Rb$ is weakly radioactive and decay by β^- emission with a decay constant of 1.1×10^{-11} per year. A sample of the mineral pollucite was found to contain $450 mgRb$ and $0.72 mg$ of $.^{87}Sr$. Estimate the age of mineral pollution, starting any assumption made.

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31. A $0.2 mL$ sample of a solution containing 1.0×10^{-7} curie of $._1^3H$ is injected to the blood stream of an animal. After sufficient time for circulatory equilibrium to be esalablished, $0.10 mL$ of blood is found to have an activity of $20 dpm$. Calculate teh volume fo blood in animal, assuming no change in activity of sample during circulatroy equilibrium.

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32. Specific acticvity (activiy per gram) of a sample of $.^{239} Pu$ and $.^{240} Pu$ was found to be 6×10^9 dps. Given that $t_{1/2}(Pu - 239)$ and $t_{1/2}(Pu - 240)$ are 2.44×10^4 year and 6.58×10^3 year respectively, then calcualte the isotopic compostion of mixture.

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Exercies 2

1. Fill in the blanks:

(a) $.^{235}_{92} U + .^{1}_{0} n \rightarrow .^{142}_{55} A + .^{92}_{37} B + \ldots.$

(b) $.^{82}_{34} Se \rightarrow \ldots 2 . _{-1} e^0$

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2. Calculate the number of α- and β-particles emitted when $._{92}U^{238}$ into radioactive $._{82}Pb^{206}$.

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3. Th^{234} disintergrates and emits $6\beta -$ and $7\alpha -$ particles to form a stable product. Find the atomic number and mass number of the stable product and also identify the element.

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4. One of the hazards of nuclear expolsion is the generation of $.^{90}Sr$ and its subsequent incorportion in bones. This nuclide has a half-life of 28.1 year. Suppose one microgram was absorted by a new-born chid, how much Sr^{90} will remain in his bones after 20 year?

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5. What mass fo C^{14} with $t_{1/2} = 5730$ year has activity equal to one curie?

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6. The disntergration rate of a certain radioactive sample at any instant is $4750dpm$. Five minute later, the rate becomes $2700dpm$ Calculate half-line of sample.

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7. A certain radio isotope $._Z X^A$ (half life $= 10$ days) decays to give $._{Z-2} Y^{A-4}$. If $1.0g$ atom of X is kept in a sealed vessel, find the volume of helium accumulated at STP in 20 days ?

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8. 10 g-atoms of an α-active radioisotope are disintegrating in a sealed container. In one hour the helium gas collected at STP is $11.2cm^3$. Calculate the half life of the radioisotope.

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9. How many atoms of $0.1g$-atom of a radioacitve isotope $._Z X^A$ (half life = 5 days) will decay during the 11th day?

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10. $._{84} Po^{210}$ decays with $\alpha -$ particle to $._{82} Pb^{206}$ with a half-line of 138.4 day. If $1.0g$ of $._{84} Po^{210}$ is placed in a sealed tube, how much helium will accumulate in 69.2 day? Express the answer in cm^3 at STP. Also report the volume of He formed if $1g$ of $Po^{210}O_2$ is used.

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11. A sample of U^{238} (half-line $= 4.5 \times 10^9 yr$) ore is found to contain $23.8g$ of U^{238} and $20.6g$ of Pb^{206} Calculate the age of the ore.

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12. (a) On analysis a sample of uranium ore was found to contian $0.277g$ of $._{82} Pb^{206}$ and $1.667g$ of $._{92} Pb^{206}$ and $1.667g$ of $._{92} U^{238}$. The half life period of U^{238} is 4.51×10^9 year. IF all the lead were assumed to have come from decay of $._{92} U^{238}$, What is the age of earth?

(b) An ore of $._{92} U^{238}$ is found to contain $._{92} U^{238}$ and $._{82} Pb^{206}$ in the weight ratio of $1 : 0.1$ The half-life period of $._{92} U^{238}$ is 4.5×10^9 year. Caluculate the age of ore.

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13. In natue a decay chain sereis starts with $._{90} h^{232}$ and finally terminates at $._{82} Pb^{208}$. A throium ore sample was found to contain $8 \times 10^{-5} mL$ of He At STP and $5 \times 10^7 g$ of Th^{232}. Find the age of ore sample assuming that sources of He to be only due to decay of Th^{232} Also assume complete retention of He within the ore, $t_{1/2}$ for $Th^{232} = 1.39 \times 10^{10}$ year.

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14. An experiment requires minimum beta activity produced at the rate of 346 beta particles per minute. The half- life period of $_(42)Mo^{99}$, which is a beta emitter , is 66.6 h . Find the minimum amount of $_(42)Mo^{99}$ required to carry out the experiment in 6.909 h.

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15. A samll amount of solution containing Na^{24} radio nuclide with activity $A = 2 \times 10^{3}$ dps was administered into blood of a patient in a hospital. Afer 5 hour a sample of the blood drawn out form the patient showed an activity of 16 dpm per t$_{1/2}$ for $Na^{24} = 15hr$. Find:

(a) Volume of the blood in the patient.

(b) Activity fo blood sample drawn after a further time fo $5hr$.

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16. The nuclide ratio, $._1^3H$ to $._1^1H$ in a sample of water si $8.0\times10^{-18}:1$ Tritum undergoes decay with a half-line period of $12.3yr$ How much tritum atoms would $10.0g$ of such a sample conatins 40 year after the original sample is collected?

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17. With what velocity should an α paricle travel towards the nucleus of a copper atom so as to arrive at a distance $10^{-13}m$ from the nucleus of the copper atom?

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18. $.^{227}Ac$ has a half-line of 22 year with respect to radiioactive decay. The decay follows two parallel paths, one leading to $.^{227}Th$ and the other leading to $.^{223}Fr$. The percentage yiedls of these two daughter nuclides

are 2% and 98.0% respectovely. What is the rate constant in year^{-1}, for each of the separate paths?

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19. $.^{64}Cu$ (hlaf lifre $= 12.8h$) deacays by β^{-} emission (38%), β^{+} – emission (19%) and electron capute (43%). Write the decay products and calculate partial half-live for each of the decay processes.

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Exercies 3A

1. Two radioactive elements X and Y half-live pf 50 and 100 minute respectiv ely. Intial sample of both the elements have same number of atoms. The ratio of the reamaining number of atoms of X and Y after 20 minute is:

A. 2

B. $1/2$

C. 4

D. $1/4$

Answer: (d)

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2. The human body contains 18% carbon by weight, in which $.^{14}C$ is 1.56×10^{-6} per cent. If the half-life of $.^{14}C$ is 5570 year, then the number of disintengration per mintute in the body of this weight is:

A. 194

B. 1940

C. 19400

D. 28600

Answer: (d)

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3. The radioactive elements A and B have half-lives of 15 and 5 minute respectively. Thew experiment begins with 4 times the number the number of B atoms as A atoms. At which of the followig times does the number fo A atoms left equals the number of B atoms left:

A. 30minute

B. 15minute

C. 10minute

D. 5minute

Answer: (b)

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4. The number of millimoles of $._6^{14}C$ equivalent to one millicuires if $t_{1/2} = 5770$ year and 1 curie $= 3.7 \times 10^{10}$ 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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5. Antineutrion can vbe deteced during the emission of:

A. $\alpha -$ rays

B. $\beta -$ particles

C. protons

D. $X -$ rays

Answer: (b)

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6. Which has magic number of neutrons?

A. $._{13}^{27}Al$

B. $._{83}^{209}Bi$

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

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

Answer: (b)

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7. Nuclides having some atomic number and same mass number but different rate of decay are called:

A. isotones

B. isobars

C. nuclear isomers

D. isotopes

Answer: (c)

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8. Neutrinos was predicted to:

A. conserve mass of the nuclear reaction

B. conserve charge of the nuclear reaction

C. conserve spin of the nuclear reaction

D. all of these

Answer: (c)

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9. Half-life-speed of lead is:

A. infinite

B. 1590 day

C. 1590 year

D. zero

Answer: (a)

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10. What is the value of n for the present element of $(4n + 3)$ series?

A. 59

B. 58

C. 57

D. 60

Answer: (b)

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11. $._{84}^{210} Po \rightarrow_{82}^{206} Pb + ._{2}^{4} He$ in this reaciton predict the positon of group of Po when lead is the the IVB group:

A. IIA

B. IVB

C. VIB

D. VIA

Answer: (c)

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12. $._{90} Th$ a member of III group on losing $\alpha -$ particles forms a new element belonging to:

A. I group

B. III group

C. II group

D. IV group

Answer: (c)

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13. Isodiaphers are atoms having:

A. p/n constant

B. $(p-n)$ constant

C. $(n-p)$ constant

D. $(n-p)$ different

Answer: (c)

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14. If two light nuclie are fused together in nuclear reaction, the average energy per nucleon:

A. increaes

B. decreases

C. reamians same

D. none of these

Answer: (b)

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15. $._{92}^{235}U$ belongs to $IIIB$ group of the periodic table, It loses one $\alpha -$ particle, the new element will belong to the group.

A. IB

B. IA

C. IIB

D. VB

Answer: (c)

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16. A small subatojmic particle was passed through large watger tank conatining Cd. The existence of this particles was inferred when two $-\gamma-$ rays were produced and a neutron was captured by Cd. The particle was:

A. proton

B. neutrinos

C. electron

D. none of these

Answer: (b)

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17. Radioacity of naptunium stops, when it is converted to:

A. Th

B. Rn

C. Pb

D. Bi

Answer: (d)

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18. Least branching is found in which of the following radioactive series?

A. $4n+2$

B. $4n$

C. $4n+3$

D. $4n+1$

Answer: (b)

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19. Conservation of energy into mass occurs in:

A. radioactivity

B. pair production

C. chemical change

D. all of these

Answer: (b)

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20. The isotope used to find the age of series:

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

B. $._{6}^{12}C$

C. $._{88}^{226}Ra$

D. $._{6}^{14}C$

Answer: (d)

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21. In the carbon cycle form which hot starts obain their energy, the $._{6}^{12}C$ nuclecus:

A. is completely converted into energy

B. is regenrated at the end of the cycle

C. is broken up into its consituednt protons and neutrons

D. is combined with oxygen to from carbon monoxide

Answer: (d)

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22. The $t_{1/2}$ for $.^{14}C$ in (i) $.^{14}CO_2$, (ii) $.^{14}C_6H_{12}O_6$,

(iii) Coal containing $.^{14}C$,

(iv) Cellulose conatining $.^{14}C$ os:

A. more in $.^{14}CO_2$

B. more in coal containing $.^{14}C$

C. more in $.^{14}C_6H_{12}O_6$

D. Same in all species.

Answer: (d)

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23. The radioactivity of a sample is R_1 at a time T_1 and R_2 at a time, T_2 If the half-line of the secimen is T, the number of atoms that have disintergrated in the time $(T_2 - T_1)$ is proportional to:

A. $(R_1T_1 - R_2T_2)$

B. $(R_2 - R_1)$

C. $(R_2 - R_1)/T$

D. $(R_2 - R_1)T/0.693$

Answer: (d)

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24. Which nuclear raction is not correct?

A. $._{29}^{63}CU(p, ._{1}H^{2}) ._{29}^{62}Cu$

B. $._{4}^{9}Be(\alpha, ._{0}n^{1}) ._{12}^{6}C$

C. $._{5}^{10}B(\alpha, ._{0}n^{1}) ._{13}^{7}N$

D. $._{27}^{59}Co(._{0}n^{1}, ._{1}H^{2}) ._{25}^{62}Mn$

Answer: (d)

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25. The parent nucleus of $(4n+3)$ seires is:

A. $.^{228}Ac$

B. $.^{235}U$

C. $.^{238}U$

D. $.^{237}Th$

Answer: (b)

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26. If $5g$ pf a radioactive substanc ehas $t_{1/2}=12hr$, $20g$ of the same substance will have a $t_{1/2}$ equal to:

A. $56hr$

B. $3.5hr$

C. $14hr$

D. $28hr$

Answer: (c)

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27. A radioactive istope having a half-line of 3 day was received after 12 day. It was found that there were $3g$ the istope when packed was:

A. $12g$

B. $24g$

C. $36g$

D. $48g$

Answer: (d)

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28. Radioactive material is deacign with $t_{1/2} = 30$ days on being, separated into two fractions , one of the fracation, immediately after separation decays with $t_{1/2} = 2$ days. The other fraction, immediately after separation, would show:

A. Constant specific activitty

B. Increaing specific activity

C. Decay with $t_{1/2} = 30$ day

D. Decay with $t_{1/2} = 28$ day

Answer: (b)

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29. A radioactive substance has a constant actity of 2000 disintegraion/mintue. The material is swparated into two fractions, one of which has an initlial activity of 100 disntegration per secound while the other fraction decays with $t_{1/2} = 24$ hour. The total activity in both samples after 48 hour of separation is:

A. 1500

B. 1000

C. 1250

D. 2000

Answer: (d)

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30. The energy released during the fussion of 1 kg uranium is a) 9×10^{23}ergs b)9.0×10^{10}ergs c)9.0×10^{18}ergs d)9.0×10^{8}ergs

A. 9.0×10^{20} erg

B. 9.0×10^{10} erg

C. 9.0×10^{18} erg.

D. 9.0×10^8 erg

Answer: (a)

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31. Consider the following process of decay,

$$._{92}^{234}U \rightarrow ._{90}^{230}Th + ._{2}^{4}He, t_{1/2} = 250000yr$$

$$._{90}^{230}Th \rightarrow ._{88}^{226}Ra + ._{2}(4)He, r_{1/2} = 80000yr$$

$$._{88}^{226}Ra \rightarrow ._{86}^{222}Rn + ._{2}^{4}He, t_{1/2} = 1600yr$$

After the above process has occurred for a long tiem, a state is reached where for every two thorium atoms formed form $._{92}^{234}U$ one decomposes to from $._{88}^{226}Ra$ and for every two $._{88}^{226}Ra$ formed, one decomposes. The ratio of $._{90}^{230}Th$ to $._{88}^{226}Ra$ will be:

A. $\dfrac{25000}{80000}$

B. $\dfrac{80000}{1600}$

C. $\dfrac{250000}{1600}$

D. $\dfrac{250000 \times 1600}{80000}$

Answer: (b)

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32. The nucleus and an atom can be assumed to be spherical. The relation between radius of the nucleus and mass number A is given by $1.25 \times 10^{-13} \times A^{\frac{1}{3}}$.The radius of atom is one $\AA$ if the mass number is 64, the fraction fo the atomic volume that is occupied by the nucleus is:

A. 1.0×10^{-13}

B. 5.0×10^{-5}

C. 2.0×10^{-2}

D. 1.25×10^{-13}

Answer: (d)

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33. A freshly prepared radioactive source to half-life $2hr$, emits radiatiosn of intensity which is 64 times the permissible safe level. The minumum time after which it would be possibleto work safely with the source is:

A. $6hr$

B. $12hr$

C. $24hr$

D. $128hr$

Answer: (b)

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34. Two radio-isotopes P and Q of atomic weight 10 and 20 respetively are mixed ratio is found to be $1:m4$ Isotope P has a half-life of 10 day The half of isotope Q is:

A. Zero

B. 5 day

C. 20 day

D. Infinite

Answer: (d)

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35. Half-life on an element is $'t'$ secound. In $t/2$ second the fraction of the element decayed is:

A. 29%

B. 25%

C. 21%

D. 17%

Answer: (a)

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36. A radiioactive element X, decays by the sequence and with half-lives, given below:

$X[\text{Half-life} = 30\text{min}] \xrightarrow{\lambda_1} Y + \alpha$

$Y[\text{Half-life} = 2\text{day}] \xrightarrow{\lambda_2} Z + 2\beta$

Which of the follwing statements is correct?

A. Disinetration constant $\lambda_2 > \lambda_1$

B. Atomic number of X and Z are same.

C. The mass numner of X and Z are same

D. Y and Z are isotopes.

Answer: (b)

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37. A radioactive element X has an atomic number of 100. It decays directly into an element Y which decays directly into an element Z. In both the processes either one α or one $\beta -$ particle is emitted. Which of the following statement could be true?

A. Y has an atomic number of 102

B. Y has an atomic number of 101

C. Z has an atomic number of 100

D. Z has an atomic number of 37

Answer: (b)

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38. When $._{17}Cl^{35}$ undergoes (n, p) reaction, the radioisotope formed is a)$._{15}P^{32}$ b)$._{16}S^{35}$ c)$._{16}S^{34}$ d)$._{15}P^{34}$

A. $._{15}^{32}P$

B. $._{16}^{35}S$

C. $._{16}^{34}S$

D. $\cdot_{15}^{34} P$

Answer: (b)

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39. A radioactive isotope has initial activity of 28 dpm Its activity is reduced to 14 dpm after half an hour. The initial number of nuclide in sample was:

A. 200

B. 400

C. 600

D. 1211

Answer: (d)

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40. The number of $\beta -$ particle emitted during the change $._{a}X^{c} \rightarrow_{d} Y^{b}$ is

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

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

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

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

Answer: (c)

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41. The nucler reacion,

$._{29}^{63}Cu + ._{2}^{4}He \rightarrow ._{17}^{37}Cl + 14._{1}^{1}H + 16._{0}^{1}n$ represents:

A. Artofoca, radopactivity

B. Induced radioactivity

C. Nuclear fission

D. Spallation reaction

Answer: (d)

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42. The mass number of a nuclide is 64. What is its nuclear radius?

A. 1 fermi

B. 5.2 fermi

C. 6.5 fermi

D. 3.8 fermi

Answer: (b)

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43. In the nuclear chain ractio:

$._{92}^{235}U + ._{0}^{1}n \rightarrow ._{56}^{141}Ba + ._{36}^{92}Kr + 3._{0}^{1}n + E$

The number fo neutrons and energy relaesed in nth step is:

A. $3n, nE$

B. $3^n, nE$

C. $3^n, 3^{n-1}E$

D. none of these

Answer: (c)

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44. One mole of A present in a closed vessel undergoes decay as:

$._{Z}^{A} \rightarrow ._{Z-4}^{m-8}B + 2._{2}^{4}He$. The volume of He collected at NTP after 20 day ($t_{1/2}$ for $A = 10$ day) is:

A. 11.2 litre

B. 22.4 litre

C. 33.6 litre

D. 67.2 litre

Answer: (c)

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45. The half life of $.^{131} I$ is 8day. Given a sample of $.^{131} 1$ at $t = 0$, we can assert that:

A. No mucleus wil decay $t = 4$ day

B. No nucleus will decay before $t = 8$ day

C. All nuclei will decay before $t = 16$ day

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

Answer: (d)

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46. Number of neutrons i8n a parent nucleus X, which gives $._{7}^{14}N$ after two sucessive $\beta-$ emission would be:

A. 6

B. 7

C. 8

D. 9

Answer: (d)

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47. The activity fo a radio nuclide $(.^{100}X)$ is 6.023 cuire. If the disnegration constant is $3.7\times10^{-4}\sec^{-1}$, the mass of radio nuclide is:

A. $10^{-14}g$

B. $10^{-6}g$

C. $10^{-15}g$

D. $10^{-3}g$

Answer: (c)

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48. Sulphur 35(34,96903 amu) emits a $\beta -$ particles but no γ-rays. The product is c hlorine -35 $(34, 96885$ amu),. The maximum energy carried by $\beta -$ particle is:

A. $16.758MeV$

B. $1.6758MeV$

C. $0.16758MeV$

D. $0.016758MeV$

Answer: (c)

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49. A radioactive element A decays with a decay constant λ. The fraction of nuclei that decayed at any time t, if the initial nucle are N_0 is given by:

A. $e^{-\lambda t}$

B. $1 - e^{-\lambda t}$

C. $e^{\lambda t}$

D. $\frac{1}{1 - e^{\lambda t}}$

Answer: (b)

Watch Video Solution

50. Which of the following can show $\gamma -$ emission?

A. $._{937}\big)^{81} Rb + ._{-1}^{0} e \rightarrow ._{36}^{81} Kr + \ldots$

B. $._{6}^{11} C \rightarrow ._{5}^{11} B + \ldots$

C. $._{7}^{14} N + ._{2}^{4} He \rightarrow ._{8}^{17} O + \ldots$

D. $._{27}^{60m} Co \rightarrow ._{27}^{60} Co + \ldots$

Answer: (d)

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51. γ radiations form a radioactive element may be produced:

A. Directly without emission fo α or $\beta -$ particles

B. Simulaneouly with emission of α or $\beta -$ particles

C. Subsequency with emission of α or $\beta -$ particles

D. Never

Answer: (c)

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52. Which of the following statement is wrong?

A. Nuclear radius is often expressed in fremi $\left(1F = 10^{-15}m\right)$

B. Nuclear forces are short range and not strong attractive forces

C. Nuclear forces are about 10^{21} times stronger than coulombic forces

D. Stabililty of nucleus is governed by inverse square law.

Answer: (d)

Watch Video Solution

53. Which of the following statements is wrong?

A. Area of cross-section of nucleas in about 1 barn $\left(1\text{barn} = 10^{-24}cm^2\right)$

B. Elements placed below the belt of stablility shwo positorn emission to increase their $\frac{n}{p}$ ratio

C. Elements placed above the belt of stablility show $\beta -$ emission to decrease their $\frac{n}{p}$ ratio

D. $K-$ electron capture emits γ rays.

Answer: (d)

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54. Which of the following statements is wrong?

A. $\alpha-$ decay always produces isodiapher

B. $\beta-$ decay always produces isbar

C. The maximum $\frac{n}{p}$ ratio and maxiumum $\frac{n}{p}$ ratio stands for $H-$ isotoopes

D. Synchroton can accelerate neutron particles.

Answer: (d)

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55. If E_e is the energy needed to remove an electron from atom and E_n be energy needed remove a nucleion, then:

A. $E_n < E_e$

B. $E_n > E_e$

C. $E_n < E_e$

D. $E_n . \gtrless E_e$

Answer: (b)

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56. Nuclear reacations either exoeerge or endoregic shows the exchange of:

A. Kinetic energy

B. Electrical energy

C. Potential energy

D. Heat energy

Answer: (a)

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57. The reaction, $._{13}^{27} Al + ._{2}^{4} He \rightarrow ._{14}^{30} S + ._{1}^{1} H$:

A. Nuclear fission

B. Nulclear fusion

C. Nuclear transmutration

D. Artifical radioactivity

Answer: (c)

Watch Video Solution

58. $._{6}^{11} C$ on decay produces:

A. Positron

B. $\beta -$ particle

C. $\alpha -$ particle

D. $\gamma -$ rays

Answer: (a)

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59. One important source of energy of volacans erruption is:

A. Hot mealn steam trapped in earth

B. The pressure of ice at the earth pole

C. Decay of radioactive matter

D. The petroleum deposits stored under pressure

Answer: (c)

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60. The decay of mass during nuclear fusion and nuclear fission are respectively:

A. $0.1\,\%$, 0.231

B. $0.231\,\%$, $0.1\,\%$

C. $0.2\,\%$, $0.4\,\%$

D. $0.3\,\%$, $0.6\,\%$

Answer: (a)

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61. If equal number of atom of two radioactive elements are consisdered, the most dangerous would be the one with a half-life of:

A. 4.0 million year

B. 100 year

C. $0.01 \sec$

D. 1 sec

Answer: (c)

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62. As an $\alpha -$ paricle approaches $a._7 N^{14}$ nuclesus, the potential energy:

A. Increases as it approaches nuclus

B. Attains maximum value as inernuclear distance is approached

C. Reaches to a minium at the time of fusion.

D. All of the above

Answer: (d)

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63. An alkaline earth metal is radioactive. It and its daughter element decay by emitting 3 α- particles in succession. In what group should the resulting element be formed?

A. 4

B. 6

C. 16

D. 14

Answer: (d)

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64. Two radioactive nuclides A and B have half-lives in the ratio $2:3$ respectively. An experiment is made with one mole of each of them. Calculate the molar ratio of A and B after a time interval of three times of half-line of A.

A. $1:2$

B. $2:1$

C. $1:3$

D. $3:1$

Answer: (a)

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65. The rate of decay of a radioactive species is given by R_1 at time t_1 and R_2 at later time t_2. The mean life of this radioactive species is:

A. $\frac{t_2 - t_1}{\text{In}R_1 - \text{In}R_2}$

B. $\frac{t_2 - t_1}{\text{In}R_2 - \text{In}R_1}$

C. $\frac{t_2 + t_1}{\text{In}R_2 + \text{In}R_1}$

D. $\frac{t_2 - t_1}{\text{In}R_2 + \text{In}R_1}$

Answer: (a)

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66. Two radioactive materials X_1 and X_2 have decay constants 10λ and λ respectively. If initially they have the same numbers of nucle, then the ratio fo the nclie of X_1 to that X_2 will be $1/e$ after a time:

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

B. $\frac{1}{11\lambda0}$

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

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

Answer: (d)

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67. The half life of $.^{215} At$ is $100\mu s$. The time taken for the radioacticity of $.^{215} At$ to decay to $1/16^{th}$ 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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68. 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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69. $.^{22}Ne$ nucleus after absorting energy, decays into two alpha-particles and an unknown nucleus. The nucleus is:

A. N

B. C

C. B

D. O

Answer: (b)

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70. The half-life period of a radioactive element x is same as the mean life time of another radioactive element y. Initially, both of them have the same number of atoms. Then,

(a) x and y have the same decay rate initially

(b) x and y decay at the same rate always

(c) y will decay at a faster rate than x

(d) x will decay at a faster rate than y

A. X and Y have the same decay rate initially

B. X and Y decay at the same rate always

C. Y will decay at a faster rate than X

D. X will decay at a faster rate than Y

Answer: (c)

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71. Consider $\alpha -$, β- particles and $\gamma -$ rays, each having an energy fo $0.5 Mev$ in increasing order f penertation power, the radiations are:

A. α, β, γ

B. α, γ, β

C. β, γ, α

D. γ, β, α

Answer: (a)

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72. During a negative beta decay:

A. An atomic electron is ejected

B. Am electron which is already present in nucleus is ejected.

C. A neutron in the nucleus decay emitting electrons

D. A part of the biniding energy of the nucleus is converted into electron

Answer: (c)

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73. The half-life period of radon is 3.8 days. After how many will only one-twentieth of radon sample be left over?

A. 3.8 day

B. 16.5 day

C. 33 day

D. 76 day

Answer: (b)

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74. The equation: $4._{1}^{1}H^{+} \rightarrow ._{2}^{4}He^{2+} + 2e + 26MeV$ represnets.

A. $\beta -$ decay

B. $\gamma -$ decay

C. Fusion

D. Fission

Answer: (c)

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75. Mases of two isobars $._{29}^{64} Cu$ and $._{930}^{64} Zn$ are 63.9298 amu and 63.9292 amu respectively. It can be concluded form these data that:

A. Both the isobars are stable

B. $.^{64} Zn$ is radioactive, decaying to $.^{64} Cu$ through $\beta -$ decay

C. $.^{64} Cu$ is radioactive, decaying to $.^{64} Zn$ through $\gamma -$ decay

D. $.^{64} Cu$ is radioactive, decaying to $.^{64} Zn$ throgh $\beta -$ decay

Answer: (d)

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76. The deacy time t for radioactive element proceeds to 4 half-lives. The total decay time (t) in terms of average life (T) is given by:

A. $t = 27 \ln 2$

B. $t = 4T \ln 2$

C. $t = 27^4 \ln 2$

D. $\frac{1}{T^2} \ln 2$

Answer: (b)

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77. The half-life of $4.0 mg \beta -$ emitter of $.^{210} X$ is 5 day and the average energy of emitted $\beta -$ particle is $0.34 MeV$. At what rate in watts does the sample emits energy?

A. 2.0

B. 0.1

C. 1.5

D. 1.0

Answer: (d)

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78. In sun and other stars, where temperature is about $10^7 K$ fusion, takes place dominatly by:

A. Proton-nitrogen cycle

B. Proton-proton cycle

C. proton-deuterium cycle

D. proton-lithium cycle

Answer: (b)

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79. In botter star where the temperature is about $10^8 K$, fusion takes place3 and the cyclic is known as:

A. Proton-carbon cycle

B. Proton-proton cycle

C. Carbon-deuterium cylce

D. Nitrogen-oxygen cycle

Answer: (a)

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80. Which radioactive series do not show emanation?

A. $Th -$ series

B. $Np -$ series

C. $U -$ series

D. $Ac -$ series

Answer: (b)

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81. Two elements P and Q have half-line of 10 and 15 minutes repectively. Freshly preapared sample of mixuture containing equal number of atoms is allowed to decay for 30 minutes. The ratio of number of atoms of P and Q in left in mixture is:

A. 0.5

B. 2.0

C. 3.0

D. 4.0

Answer: (a)

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82. If mg of a radioactive species (molar mass M) has decay constant λ The specis activity of sample at $t =$ is given by:

A. $\frac{\lambda. N_A}{M}$

B. $\frac{\lambda. N_A. m}{M}$

C. $\frac{\lambda. m}{M}$

D. $m - Me^{\lambda}$

Answer: (a)

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83. A radioactive nulei has half-life of 1.0 minute. If one of the nuclie decay now, the next nuclei will decay after:

A. 1.0 minute

B. $1/2$ minute

C. any time

D. $1/N$ minute (N is no. of nuclei present at that moment)

Answer: (c)

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84. A graph plotted between log N vs, time gives a slope and intercept equal to:

A. $-\frac{\lambda}{2.303}, \log N_0$

B. $\frac{\lambda}{2.303}, \log N_0$

C. $-\frac{\lambda}{2.303}, N_0$

D. $\frac{\lambda}{2.303}, N_0$

Answer: (a)

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85. A radioactive species undergoes decay for time t where $t = 4t_{1/2}$. The average life (T) of species can therefore be given by:

A. $2t$ in $2 = T$

B. $4t$ in $2 = T$

C. $T = \frac{t}{4\text{In}2}$

D. $T = \frac{t}{2\text{In}2}$

Answer: (c)

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86. The half of a radioactive sample is $2n$ year. The fraction left undecyed after n year is:

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

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

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

D. 2

Answer: (b)

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87. The density of a nucleus varies with the mass number A as:

A. $(A)^2$

B. $(A)^0$

C. $(A)^{1/3}$

D. (A)

Answer: (b)

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88. $._1^3 H$ and $._2^4 He$ are:

A. Nuclear isomers

B. Isotones

C. Isodiaphers

D. Isobars

Answer: (b)

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89. The rate of decay of a radioactive species is given by R_1 at time t_1 and R_2 at later time t_2. The mean life of this radioactive species is:

A. $T = \frac{(t_1 - t_2)}{\text{In}(R_2 / R_1)}$

B. $T = \frac{(t_2 - t_1)}{\text{In}(R_2 / R_1)}$

C. $T = \frac{(t_2 - t_1)}{\text{In}(R_1 / R_2)}$

D. $T = \frac{\text{In}(R_2) / R_1}{(t_2 - t_1)}$

Answer: (a)

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90. Two reactions having their energy of activation E_1 and E_2 temperature coefficients T_{c_1} and T_{c_2} respectively within the temperature

300 and $310K$. The ratio of their temperature coefficient is:

A. e^{E_1/E_2}

B. $e^{(E_1-E_2)\times 10^{-4}/R}$

C. $10^{E_1/E_2}$

D. $e^{(E_1-E_2)/4}$

Answer: (b)

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91. The activity fo a radioactive sample decrases t $1/3$ of the orginal acticity. A_0 in a period of 9 year. After 9 year more, its activity will be:

A. $\frac{A_0}{2}$

B. $\frac{2A_0}{9}$

C. $\frac{3A_0}{9}$

D. $\frac{A_0}{9}$

Answer: (d)

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92. The half line of a radioactive element is $2n$ year. The fraction decayed in n year.

A. 0.10

B. 0.29

C. 1.414

D. 0.414

Answer: (b)

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Exercies 3B

1. Proton rich nuclide often tends to decrease proton count. Ibnall such types of decay which probable decay occurs:

A. Emission of posittion: $._{15}^{29}P \rightarrow ._{14}^{29}Si + ._{+1}^{0}e$

B. Caputre of electron: $._{4}^{7}Be + ._{-1}^{0}e \rightarrow ._{3}^{7}Li$

C. Emission of proton: $._{21}^{43}Sc \rightarrow ._{20}^{42}Ca + ._{+1}^{p} + \gamma$

D. Emisssion of $\alpha -$ particle: $._{6}^{14}C \rightarrow ._{7}^{14}N + ._{-1}^{0}e$

Answer: (a, b, c, d)

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2. Select the correct statements.

A. The diameter of nucleus is of the order $10fm$

B. $._{53}^{137}I$ undergoes decay to give $._{53}^{136}I$ and neutron

C. $K -$ electron capture always followed by $X -$ rays emission

D. Nuclide with higher binding energy can emit $\beta -$ particles in first decay.

Answer: (a, b, c)

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3. The nuclear reaction accompanied with emission of neutron (s) are:

A. $._{13} Al^{17} + ._{2} He^{4} \rightarrow ._{15} P^{30}$

B. $._{6} C^{12} + ._{1} H^{1} \rightarrow ._{7} N^{14}$

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

D. $._{96} Am^{241} + ._{2} He^{4} \rightarrow ._{97} Bk^{244} + ._{+1} e^{0}$

Answer: (a, d)

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4. In breeder reactors:

A. U^{2380} isotpoe can be used to breed the fissionable isotope Pu^{239}

B. Th^{232} isotope can be used to breed the fissionable isotope U^{233}

C. Any radioactive can be used to breeed the fissionable isotope.

D. More fissionable material is produced than it is consumed.

Answer: (a, b, d)

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5. Which of the following statements (s) is (are) correct?

A. $(4n+2)$ series starts from $._{92}U^{238}$ and ends with $._{82}Pb^{206}$

B. $(4n+1)$ series is also called uranium series.

C. Neptunium series consists of man made elements.

D. The mass no. of all the members of $4n+1$ series give 1 (one) when dividied by 4.

Answer: (a, c, d)

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6. A radioactive element X, decays by the sequence and with half-lives, given below,

$$X \xrightarrow[30\text{min}]{\alpha} Y \xrightarrow[2\text{days}]{\beta}$$

Which of the follwing statemetns about this system are correct?

A. After two hours, less than 10% of the initail X si left.

B. Maximum amount of Y present at any time is less than 50% of the initial amount of X

C. Atomic no.of X and Z are same.

D. Mass no. of Y is greater than X.

Answer: (a, c)

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7. The activity of a radioactive substance is R_0 at $t = 0$, R_1 at $t = t$ and R_2 at $t = 2t$. The decay constant of this species is/are given by:

A. $\dfrac{\log_e R_1 - \log_e R_2}{t}$

B. $\dfrac{\log_e R_0 - \log_e R_1}{t}$

C. $\dfrac{\log_e R_2 - \log_e R_1}{2t}$

D. $\dfrac{\log_e R_0 - \log_e R_1}{2t_2}$

Answer: (a, b, d)

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8. Which of the following equactions pick out the possible nuclear fusion reactions?

A. $._{6}C^{13} + ._{1}H^{1} \rightarrow ._{6}C^{14} + \text{energy}$

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

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

D. $._{92}U^{235} + ._{0}n^{1} \rightarrow ._{54}Xe^{140} + ._{38}Sr^{94} + ._{0}n^{1} + ._{0}n^{1} + \text{energy}$

Answer: (b, c)

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9. Which of the following statements are not correct?

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

B. Radioactive absorption due to cosmic radiation is equal to the rate fo radioactive decay, hence the carbon contents remains constant in organism

C. In living organism circularion of C^{14} from attosmphere is high so that carbon content is constant is organism.

D. Carbon dating can be made to find out the age of earth and rocks.

Answer: (a, c, d)

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10. Which statements about radioactive equillibrium are correct?

A. It is also called secular equiliibrium.

B. The equiilbrium is attanied when parent atom has $t_{1/2}$ more than $t_{1/2}$ of daughter element.

C. the equilibrium is attained when λ of parent element is more than daugter element.

D. No equilibrium if $t_{1/2}$ of parent element is less than $t_{1/2}$ of daughter element.

Answer: (a, b, d)

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11. Which of the following nuclie have two magic numbers ?

A. $._8^{16} O$

B. $._2^4 He$

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

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

Answer: (a, b, d)

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12. Select the correct statements.

A. Amount decayed in a half-line depends upon the nature of radioactive species.

B. The fraction of amount deacayed is given by $1 - e^{-\lambda t}$

C. Amoutn decauyed in first half is maximum.

D. None of these

Answer: (a, b, c)

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13. If m_p and m_n are masses of proton and neutron respectively and M_1 and M_2 are masses of $._{10}\, MeNe^{20}$ and $._{20}\, Ca^{40}$ nucleus repectively, then:

A. $M_2 = 2M_1$

B. $M_2 < 2M_1$

C. $M_2 > 2M_1$

D. $M_1 < 10(m_n + m_p)$

Answer: (b, d)

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Exercies 4

1. The intergrated rate equation is

$Rt = \log, C_0 - \log C_t$. The straight line graph is obtained by plotting:

A. t vs log C_t

B. $\frac{1}{t}$ vs log C_t

C. t vs C_t

D. $\frac{1}{t}$ vs log $\frac{1}{C_t}$

Answer: (a)

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2. $\beta -$ particle in radioactivity is emitted by:

A. Coversion of proton to neutron

B. Outermost orbit

C. Conversion of neutron to proton

D. $\beta -$ particle is not emitted

Answer: (c)

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3. The half-life of a radioactive isotope is 3 hour. IF the initial mass of isotope were $256g$ the mass of it remaining undercayed after $18hr$ is:

A. $12g$

B. $16g$

C. $4g$

D. $8g$

Answer: (c)

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4. The radioactive nuclide $._{90}^{234}Th$ shows two successive $\beta -$ decay followed by one $\alpha -$ decay. The atomic number and mass number respectively of the resulting atom is:

A. 90 and 230

B. 92 and 230

C. 92 and 234

D. 94 and 230

Answer: (a)

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5. Consider the follwing nuclear reactions:

$$._{92}^{238}M \rightarrow ._{y}^{x}N + 2._{2}He^{4}$$

$$._{y}^{x}N \rightarrow ._{B}^{A}L + 2\beta^{+}$$

A. 146

B. 144

C. 140

D. 142

Answer: (b)

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6. The half-life of a radioisotoe is four horu. If the initial mass of the isotope was $200g$, the mass left after 24 hour undercayed is:

A. $4.167g$

B. $2.084g$

C. $3.125g$

D. $1.042g$

Answer: (c)

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7. Hydrogen bomb is based on the principle of

A. Nuclear fission

B. Natural radioactivity

C. Nuclear fusion

D. Artifical radioactivity

Answer: (c)

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8. A photon of hard gamma radiations knocks out a proton for $._{12}^{24} Mg$ nucleaus to from:

A. The isotope of parent nucleus

B. The isobar of parent nucleaus

C. The nuclide $._{11}^{23} Na$

D. The isobar of $._{11}^{23} NA$

Answer: (c)

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9. In the transormation fo $._{992}^{238} U$ to $._{92}^{234} U$, if one emission is an $\alpha -$ particle, what should be the other emission(s)?

A. Two β^-

B. Two β^- and one β^+

C. One β^- and one γ

D. One β^+ and one β^-

Answer: (a)

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10. A radioactive element gets spilled over the floor of a room. Its half life period is 30 days. If the initial activity is ten times the permissibel value, after how many days will it be safe to enter the room?

A. $\equiv 1000$ days

B. $\equiv 300$ days

C. $\equiv 10$ days

D. $\equiv 100$ days

Answer: (d)

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11. Which of the follwong nuclear reactiosn will generate an isotope?

A. neutron particle emission

B. position emission

C. $\alpha -$ particle emssion

D. $\beta -$ particle emission

Answer: (a)

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12. $._{13}Al^{27}$ is a stable isotope. $._{13}Al^{29}$ is expected to disintegrate by

A. $\alpha -$ emission

B. $\beta -$ emission

C. postion emission

D. proton emission

Answer: (b)

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13. The number of neutrons accompanying the formation of $._{54} Xe^{139}$ and $._{38} Sr^{94}$ from the absorption of a slow neutron by $._{92} U^{235}$, followed by nuclear fission is

A. 0

B. 2

C. 1

D. 3

Answer: (d)

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14. Decreases in atomic number is observed in:

A. $\alpha-$ emission

B. $\beta-$ emssion

C. positron emssion

D. electron capture

Answer: (a)

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15. $._{}^{23}$ Na is the more stable isotope of Na. Find out the process by which $._{11}^{24}$ Na can undergo radioactive decay.

A. $\beta-$ emssion

B. $\alpha-$ emission

C. β^{+} -emission

D. $K-$ electron capture

Answer: (a)

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16. A positron is emitted from $._{11} Na^{23}$. The ratio of the atomic mass and atomic number of the resulting nuclide is

A. $22/10$

B. $22/11$

C. $23/10$

D. $23/12$

Answer: (c)

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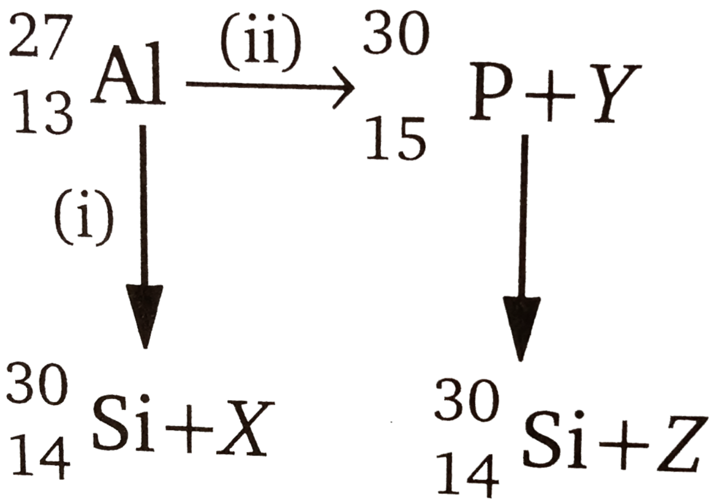
17. Bombaradment of aluminium by $\alpha -$ particle leads to its artifical disinetegration in two ways, (i) and (ii) as shwon. Produces X, Y and Z

respectively are,



A. proton, neutron,positron

B. neutron,positron,proton

C. proton,positron,neutron

D. positron,proton,neutron

Answer: (a)

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Exercies 6

1. Calculate the number of α- and β-particles emitted when $._{92}U^{238}$ into radioactive $._{82}Pb^{206}$.

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2. Co^{60} has half-life of 5.3 years. Find the number of half-lives for $7/8$ of the orignal sample to disintergrate.

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3. Find out the total number of α and $\beta -$ particles in the following disintegration:

$._{90}Th^{228} \rightarrow ._{83}Bi^{212}$

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4. The decay product of tritium is $._{Z}X^{A}$. Find the value of Z.

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5. At radioactive equillibrium, the ratio between two atoms of radioactive element X and Y are $3.1 \times 10^9 : 1$, If half life period of X is 2.17×10^{10} years. Find half life of Y.

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6. Find the number of neutrons in a parent nucleus X, which gaves $._7 N^{14}$ after two succe3ssive $\beta -$ emission.

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7. If $12g$ of a sample is taken, then $6g$ of a sample decays in $1hr$. Find the amount of sample showing decay in next hour.

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8. The activity of a radioactive sample decreases to $1/3$ of the original activity, A_0 in a period of 9 years. After 9 years more, its activity A_0/x. Find the value of x.

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9. The number fo radioactive atoms of a radio isotope fails to 12.5% in 27 day. Calcualate the half-life of isotope.

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10. Radioactive element of alkaline earth metal is succession loses $\alpha-$ and $\beta-$ particles. How many particles it can loose before forming stable element?

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11. The half-life of a radioactive isotope is 3 hour. IF the initial mass of isotope were $256g$ the mass of it remaining undercayed after $18hr$ is:

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12. Two radioactive elements A and B have half life of t and $2t$ respectively. If we start an experiment with 1 mole of each of them, the mole ratio after a time interval of $6t$ so $x:y$. Find the value of $x+y$

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13. The number of neutrons emitteed when $._{92}^{235}U$ undergoes controlled nulclear fission to $._{54}^{142}Xe$ and $._{38}^{90}Sr$ is:

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14. The periodic table consists of 18 grooups. An isotope of copper, on bombardment with protons, undergoes a nuclear reaction yielding element X as shown below. To which group, element X belogns in the periodic table?

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

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Exercies 7

1. The stabiliy of nuclies has been explained in terms of binding energy. Higher is binding energy, more is stabliliy to nucleus. The binding energy is written as $B.E = 931.478 \times \Delta m' MeV$m wehre $\Delta m'$ is mass decayed in amu. If $B.E./\text{nucleon}$ lies below the belt of stablilty, the nucleus undergoes $\alpha -$ emission in order to lower down the energy level of nucleus but its n/p ratio increases. To lower down the energy level of nucleus but is n/p ratio increases. To lower down level of nucleus loses $\beta -$ particles and if stability is not gained, $\gamma -$ emission is noticed. A radioactive element on losing on $\alpha -$ particles shows a loss in its mass number by 4 units and atomic number by 2 units whereas $\beta -$ emission leads to a gain in at.no by one units and mass no. remains same.

Loss in mass during the change.

A. $3.07 \times 10^{-26} g$

B. $3.07 \times 10^{-20} g$

C. $1.86 \times 10^{-2} g$

D. $1.86 \times 10^{-4} g$

Answer: a

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2. The stabiliy of nuclies has been explained in terms of binding energy. Higher is binding energy, more is stabliliy to nucleus. The binding energy is written as $B.E = 931.478 \times \Delta m' MeV$m wehre $\Delta m'$ is mass decayed in amu. If $B.E. /\text{nucleon}$ lies below the belt of stablilty, the nucleus undergoes $\alpha -$ emission in order to lower down the energy level of nucleus but its n/p ratio increases. To lower down the energy level of nucleus but is n/p ratio increases. To lower down level of nucleus loses $\beta -$ particles and if stability is not gained, $\gamma -$ emission is noticed. A radioactive element on losing on $\alpha -$ particles shows a loss in its mass number by 4 units and atomic number by 2 units whereas $\beta -$ emission leads to a gain in at.no by one units and mass no. remains same.

$\underset{(E.S.)}{\cdot_{8}^{19}}O \rightarrow \underset{(G.S.)}{\cdot_{8}^{19}}O + 1.06 \times 10^{8}\text{kcal}/mol$. The two oxygen atoms differ by a mass per mol is:

A. $5 \times 10^{-6}g$

B. $5 \times 10^{-3}g$

C. $5 \times 10^{-4}g$

D. $5 \times 10^{-5}g$

Answer: a

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3. The stabiliy of nuclies has been explained in terms of binding energy. Higher is binding energy, more is stabliliy to nucleus. The binding energy is written as $B.E = 931.478 \times \Delta m' MeV$m wehre $\Delta m'$ is mass decayed in amu. If $B.E. /\text{nucleon}$ lies below the belt of stablilty, the nucleus undergoes $\alpha -$ emission in order to lower down the energy level of nucleus but its n/p ratio increases. To lower down the energy level of nucleus but is n/p ratio increases. To lower down level of nucleus loses $\beta -$ particles and if stability is not gained, $\gamma -$ emission is noticed. A radioactive element on losing on $\alpha -$ particles shows a loss in its mass number by 4 units and atomic number by 2 units whereas $\beta -$ emission leads to a gain in at.no by one units and mass no. remains same.

$._{90}^{228} Th \xrightarrow{-\alpha} A$,If Th belongs to $IIIgp$of periodic table, then $'A'$ belongs to:

A. $Igp.$

B. $IIgp.$

C. $IIIgp.$

D. Zero gp

Answer: `b

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4. The stabiliy of nuclies has been explained in terms of binding energy. Higher is binding energy, more is stabliliy to nucleus. The binding energy is written as $B.E = 931.478 \times \Delta m' MeV$m wehre $\Delta m'$ is mass decayed in amu. If $B.E. /\text{nucleon}$ lies below the belt of stablilty, the nucleus undergoes $\alpha -$ emission in order to lower down the energy level of nucleus but its n/p ratio increases. To lower down the energy level of nucleus but is n/p ratio increases. To lower down level of nucleus loses $\beta -$ particles and if stability is not gained, $\gamma -$ emission is noticed. A radioactive element on losing on $\alpha -$ particles shows a loss in its mass number by 4 units and atomic number by 2 units whereas $\beta -$ emission leads to a gain in at.no by one units and mass no. remains same.

An element having n/p ratio greater than 1 will show:

A. $\alpha -$ emission

B. $\beta -$ emission

C. $\gamma -$ emission

D. Positron emission

Answer: b

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5. The stabiliy of nuclies has been explained in terms of binding energy. Higher is binding energy, more is stabliliy to nucleus. The binding energy is written as $B.E = 931.478 \times \Delta m' MeV$m wehre $\Delta m'$ is mass decayed in amu. If $B.E./\text{nucleon}$ lies below the belt of stablilty, the nucleus undergoes $\alpha -$ emission in order to lower down the energy level of nucleus but its n/p ratio increases. To lower down the energy level of nucleus but is n/p ratio increases. To lower down level of nucleus loses $\beta -$ particles and if stability is not gained, $\gamma -$ emission is noticed. A radioactive element on losing on $\alpha -$ particles shows a loss in its mass number by 4 units and atomic number by 2 units whereas $\beta -$ emission leads to a gain in at.no by one units and mass no. remains same.

An element having n/p ratio lesser than 1 and lying below the belt of stabiiliy shows:

A. $\alpha -$ emission

B. $\beta -$ emission

C. $\gamma -$ emission

D. Positron emission

Answer: d

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6. The stabiliy of nuclies has been explained in terms of binding energy. Higher is binding energy, more is stabliliy to nucleus. The binding energy is written as $B.E = 931.478 \times \Delta m' MeV$m wehre $\Delta m'$ is mass decayed in amu. If $B.E./\text{nucleon}$ lies below the belt of stablilty, the nucleus undergoes $\alpha -$ emission in order to lower down the energy level of nucleus but its n/p ratio increases. To lower down the energy level of nucleus but is n/p ratio increases. To lower down level of nucleus loses

$\beta -$ particles and if stability is not gained, $\gamma -$ emission is noticed. A radioactive element on losing on $\alpha -$ particles shows a loss in its mass number by 4 units and atomic number by 2 units whereas $\beta -$ emission leads to a gain in at.no by one units and mass no. remains same.

Durting $K -$ electron capture, the emission is always in the region of:

A. UV

B. IR

C. $\gamma -$ emission

D. Positron emission

Answer: d

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7. The stabiliy of nuclies has been explained in terms of binding energy. Higher is binding energy, more is stabliliy to nucleus. The binding energy is written as $B.E = 931.478 \times \Delta m' MeV$m wehre $\Delta m'$ is mass decayed in amu. If $B.E. /\text{nucleon}$ lies below the belt of stablilty, the nucleus undergoes $\alpha -$ emission in order to lower down the energy level of nucleus but its n/p ratio increases. To lower down the energy level of nucleus but is n/p ratio increases. To lower down level of nucleus loses $\beta -$ particles and if stability is not gained, $\gamma -$ emission is noticed. A radioactive element on losing on $\alpha -$ particles shows a loss in its mass number by 4 units and atomic number by 2 units whereas $\beta -$ emission leads to a gain in at.no by one units and mass no. remains same.

Total number of $\alpha -$ and $\beta -$ particles emitted during radioactive emssion of $._{92}^{235}U$ to attain stabilty is:

A. $7\alpha, 4\beta$

B. $6\alpha, 7\beta$

C. $4\alpha, 3\beta$

D. $3\alpha, 4\beta$

Answer: a

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8. Radioactive disintergation always follow I order kinetics and is independent of all external factors and is represented by the relation $N = N_0 e^{-\lambda t}$ where λ is decay constant and N atoms are left at time t. The radioactive nature of element is expressed in terms of average life numerically equal to decay constant $(1/\lambda)$ however all the radioactive do not lose their radioactive nature in thier average life. The radioactive emission involves α, β particles as well as $\gamma -$ rays.The penertrating power order is $\alpha < \beta < \gamma$. The emissions can perntrate even thick steel walls but are however unable to penttrate Pb blocks. The S unit fo rate of decay is dps.

The percentage of atoms decayed in average life of a radioactive element is:

A. $36.78\ \%$

B. $63.22\ \%$

C. $3.678\ \%$

D. $6.322\ \%$

Answer: d

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9. Radioactive disintergation always follow I order kinetics and is independent of all external factors and is represented by the relation $N = N_0 e^{-\lambda t}$ where λ is decay constant and N atoms are left at time t. The radioactive nature of element is expressed in terms of average life numerically equal to decay constant $(1/\lambda)$ however all the radioactive do not lose their radioactive nature in thier average life. The radioactive emission involves α, β particles as well as $\gamma -$ rays.The penertrating power order is $\alpha < \beta < \gamma$. The emissions can perntrate even thick steel walls but are however unable to penttrate Pb blocks. The S unit fo rate of decay is dps.

The completion of radioactive emission from a species takes place in:

A. Average life

B. Half-life

C. $\frac{1}{2} \times$ average life

D. Infinity

Answer: d

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10. Radioactive disintergation always follow I order kinetics and is independent of all external factors and is represented by the relation $N = N_0 e^{-\lambda t}$ where λ is decay constant and N atoms are left at time t. The radioactive nature of element is expressed in terms of average life numerically equal to decay constant $(1 / \lambda)$ however all the radioactive do not lose their radioactive nature in thier average life. The radioactive emission involves α, β particles as well as $\gamma -$ rays.The penertrating power order is $\alpha < \beta < \gamma$. The emissions can perntrate even thick steel walls but are however unable to penttrate Pb blocks. The S unit fo rate of decay is dps.

Which one cause more damage to humain tissue if exposed to radioacitve emission out of α or $\beta -$ paricles?

A. $\alpha-$ particles

B. $\beta-$ particles

C. Equal

D. None of these

Answer: a

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11. Radioactive disintergation always follow I order kinetics and is independent of all external factors and is represented by the relation $N=N_0e^{-\lambda t}$ where λ is decay constant and N atoms are left at time t. The radioactive nature of element is expressed in terms of average life numerically equal to decay constant $(1/\lambda)$ however all the radioactive do not lose their radioactive nature in thier average life. The radioactive emission involves α, β particles as well as $\gamma-$ rays.The penertrating power order is $\alpha < \beta < \gamma$. The emissions can perntrate even thick steel walls but are however unable to penttrate Pb blocks. The S unit fo rate of decay is dps.

Report the wrong realation:

A. Amount decayed after n halves $= \frac{N_0[2^n - 1]}{2}$

B. Av. Life $= t_{1/2} \times \frac{1}{0.693}$

C. Fraction of nuclie decayed $= 1 - e^{-\lambda t}$

D. None of these

Answer: d

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12. Radioactive disintergation always follow I order kinetics and is independent of all external factors and is represented by the relation $N = N_0 e^{-\lambda t}$ where λ is decay constant and N atoms are left at time t. The radioactive nature of element is expressed in terms of average life numerically equal to decay constant $(1/\lambda)$ however all the radioactive do not lose their radioactive nature in thier average life. The radioactive emission involves α, β particles as well as $\gamma -$ rays.The penertrating power order is $\alpha < \beta < \gamma$. The emissions can perntrate even thick steel walls but are however unable to penttrate Pb blocks. The S unit fo rate of decay is dps.

The number of $\beta -$ particles emitted during the change, $._a^c X \rightarrow ._d^b Y$ is:

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

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

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

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

Answer: c

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13. Radioactive disintergation always follow I order kinetics and is independent of all external factors and is represented by the relation $N = N_0 e^{-\lambda t}$ where λ is decay constant and N atoms are left at time t. The radioactive nature of element is expressed in terms of average life numerically equal to decay constant $(1/\lambda)$ however all the radioactive do not lose their radioactive nature in thier average life. The radioactive emission involves α, β particles as well as $\gamma -$ rays.The penertrating power order is $\alpha < \beta < \gamma$. The emissions can perntrate even thick steel walls but are however unable to penttrate Pb blocks. The S unit fo rate of decay is dps.

The half-life of $3g$ of sample of a radioactive species $.^{14}CO_2$ is 2 minute. If $10g$ sample of $.^{14}CO_2$ is taken, the half-life would be:

A. 2 minute

B. 1 minute

C. $\frac{46}{30}$ minute

D. $\frac{30}{46}$ minute

Answer: a

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14. Radioactive disintergation always follow I order kinetics and is independent of all external factors and is represented by the relation

$N = N_0 e^{-\lambda t}$ where λ is decay constant and N atoms are left at time t. The radioactive nature of element is expressed in terms of average life numerically equal to decay constant $(1/\lambda)$ however all the radioactive do not lose their radioactive nature in thier average life. The radioactive emission involves α, β particles as well as $\gamma -$ rays.The penertrating power order is $\alpha < \beta < \gamma$. The emissions can perntrate even thick steel walls but are however unable to penttrate Pb blocks. The S unit fo rate of decay is dps.

The mass of $.^{14}C$ with $t_{1/2} = 5730$ year having activity equal to 1 curies si:

A. $0.0043g$

B. $2.243g$

C. $22.43g$

D. $224.3g$

Answer: a

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15. Rutherford studied the first nuclear reaction $\left[._{7}^{14}N(\alpha, p)._{8}^{17}O\right]$ which take place with a change in energy equivalent to $1.193 MeV$. Later on various types of nuclear reactions such as artifical radioactivity, artifical transmutatoon , nuclear fission, nuclear fussion, spallation reactions etc. were studied.

The reaction $._{97}^{14}N + ._{2}^{4}He + ._{8}^{17}O + ._{1}^{1}H$ may be carried out by bombaring N atoms with $\alpha -$ particles of energy:

A. $= 1.193 MeV$

B. $> 1.193 MeV$

C. $< 1.93 MeV$

D. $\leq 1.93 MeV$

Answer: b

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16. Rutherford studied the first nuclear reaction $\left[._7^{14} N(\alpha, p)._8^{17} O\right]$ which take place with a change in energy equivalent to $1.193 MeV$. Later on various types of nuclear reactions such as artifical radioactivity, artifical transmutatoon , nuclear fission, nuclear fussion, spallation reactions etc. were studied.

The reaction, $._{33}^{75} As + ._1^2 H \rightarrow ._{25}^{56} Mn + 9._1^1 H + 12._0^1 n$ is called nuclear reaction or:

A. Spallation reaction

B. Induced radioactivity

C. Nuclear fusion

D. Artifical radioactivity

Answer: a

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17. Rutherford studied the first nuclear reaction $\left[._7^{14}N(\alpha, p)._8^{17}O\right]$ which take place with a change in energy equivalent to $1.193MeV$. Later on various types of nuclear reactions such as artifical radioactivity, artifical transmutatoon , nuclear fission, nuclear fussion, spallation reactions etc. were studied.

Nuclear fusion reactions is not:

A. Uncontrolled reaction

B. used in formation of H bomb

C. Thermo nuclear reactions

D. Carried out at low temperature

Answer: d

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18. Rutherford studied the first nuclear reaction $\left[._7^{14}N(\alpha, p)._8^{17}O\right]$ which take place with a change in energy equivalent to $1.193MeV$. Later on various types of nuclear reactions such as artifical radioactivity, artifical transmutatoon , nuclear fission, nuclear fussion, spallation reactions etc. were studied.

Which one is correct?

A. Nuclear fusion involves 0.231% of mass decay

B. Nuclear fission involves 0.1% of mass decay

C. $.^{238}U$ does not undergo nuclear fission

D. $.^{239}Pu$ is non-fissionable nuclei

Answer: d

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19. Carbon 14 is used to determine the age of organic material. The procerdure is based on the formation of $.^{14}C$ by neutron capture in the upper atmosphere.

$.^{14}_{7}N + .^{1}_{0}n \rightarrow .^{14}_{6}C + ._{1}n^{1}$

$.^{14}C$ is abosorbed by living organisms during phostosythesis. The $.^{14}C$

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

$.^{14}_{6}C \rightarrow .^{14}_{7}C + \beta^{-}$

The half-life period of $.^{14}C$ is 5770 years. The decay constant (λ) can be calculated by using the following formula $\lambda = \frac{0.693}{t_{1/2}}$

The comparison fo the β^{-} activity fo the dead matter with that of the carbon still in circulation enables measurement of the period of the isolation the materail form the living cycle. The method however, ceases to be accurate ever periods longer than $30,000$ years. The proportaion of $.^{14}C$ to $.^{12}C$ living matter is $1:10^{12}$.

Which fo the following option is correct?

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

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

C. Radioactive absoption due to cosmic radiation is equal to the rate of radioactive decay, hence the carbon content remains constant in living organisms.

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

Answer: c

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20. Carbon 14 is used to determine the age of organic material. The procerdure is based on the formation of $.^{14}C$ by neutron capture in the upper atmosphere.

$.^{14}_7N + .^1_0n \rightarrow .^{14}_6C + ._1n^1$

$.^{14}C$ is abosorbed by living organisms during phostosythesis. The $.^{14}C$ content is constant in living organisms once the plant or animal dies, the uptake of carbon dioxide by it ceases and the level of $.^{14}C$ in the dead being, falls due to the decay which $.^{14}C$ undergoes.

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What should be the age of fossil for meainingful determination of its age?

A. 6 years

B. 6000 years

C. $60,000$ years

D. It can be used to calcualte any age

Answer: b

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21. Carbon 14 is used to determine the age of organic material. The procerdure is based on the formation of $._{}^{14}C$ by neutron capture in the upper atmosphere.

$._{7}^{14}N + ._{0}^{1}n \rightarrow ._{6}^{14}C + ._{1}n^{1}$

$.^{14}C$ is abosorbed by living organisms during phostosythesis. The $.^{14}C$ content is constant in living organisms once the plant or animal dies, the uptake of carbon dioxide by it ceases and the level of $.^{14}C$ in the dead being, falls due to the decay which $.^{14}C$ undergoes.

$._{6}^{14}C \rightarrow ._{7}^{14}C + \beta^{-}$

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A nulcear explosion has taken place leading to increases in conventration of $\hat{}\ (14)C$ in nearly areas. $\hat{}\ (14)C$ concentration is C_1 in nearby areas and C_2 in areas far away. If the age of the fossil is detemined to be T_1 and T_2 at the places respectively, then:

A. The age of the fossil will increases at the place where explosion has taken and

$$T_1 - T_2 = \frac{1}{\lambda} \text{In} \frac{C_1}{C_2}$$

B. The age of the fossill will decrease at the place where explosion has taken place and

$$T_1 - T_2 = \frac{2}{\lambda} \text{In} \frac{C_1}{C_2}$$

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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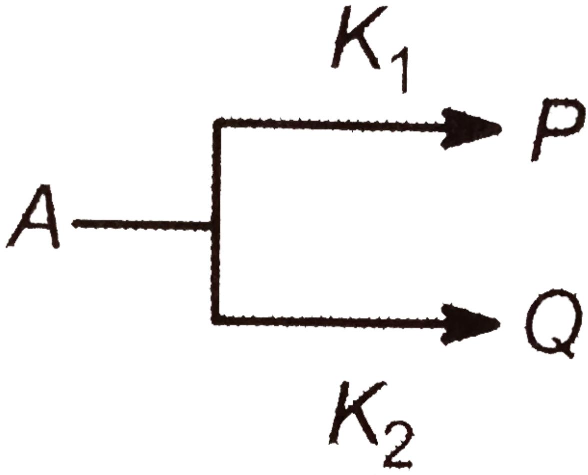
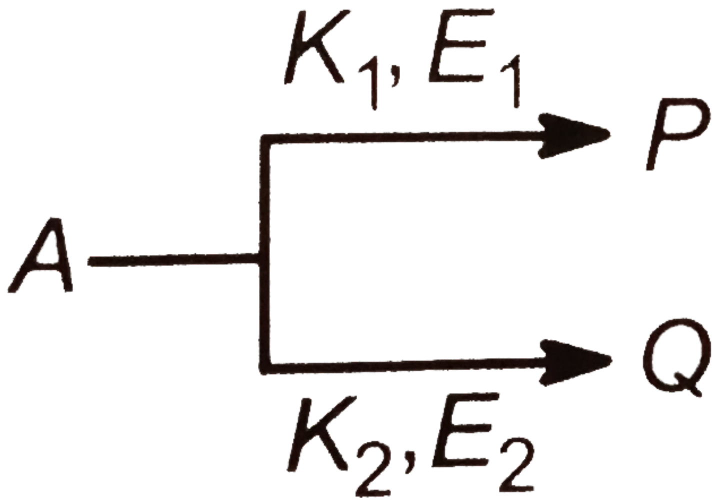
22. Some times a reacant undergoes chemical/radioactive changes following two or more different paths to yield two or more different produces respectively. Such reactions are called parallel path reactions. If K_1 and K_2 are rate constans for the reaction of A follwing two parallel paths, then



Then $K_{av} = K_1 + K_2$



For if E_1 and E_2 are energy fo activations, then

A. $E_{\text{Total}} = E_1 + E_2$

B. $E_{\text{Total}} = E_1 - E_2$

C. $E_{\text{Total}} = K_1E_1 + K_2E_2$

D. $E_{\text{Total}} = \dfrac{K_1E_1 + K_2E_2}{K_1 + K_2}$

Answer: d

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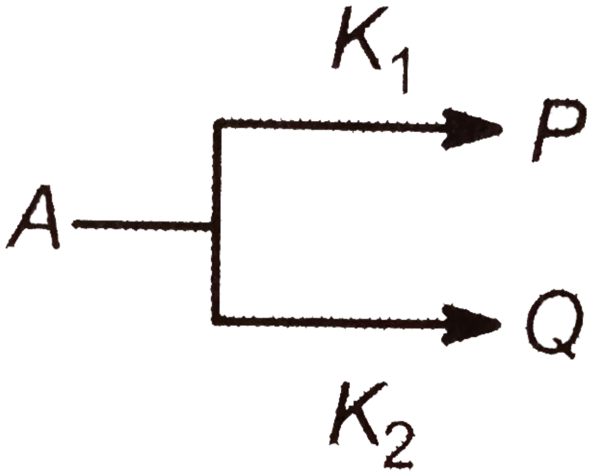
23. Some times a reacant undergoes chemical/radioactive changes following two or more different paths to yield two or more different produces respectively. Such reactions are called parallel path reactions. If K_1 and K_2 are rate constans for the reaction of A follwing two parallel paths, then



Then $K_{av}=K_1+K_2$

If average life of A for p is T_1 and for Q is T_2 then:

A. $T_{av}=T_1+T_2$

B. $T_{av}=\dfrac{T_1T_2}{T_1+T_2}$

C. $T_{av}=\dfrac{T_1+T_2}{T_1T_2}$

D. $T_{av}=K_1T_1+K_2T_2$

Answer: b

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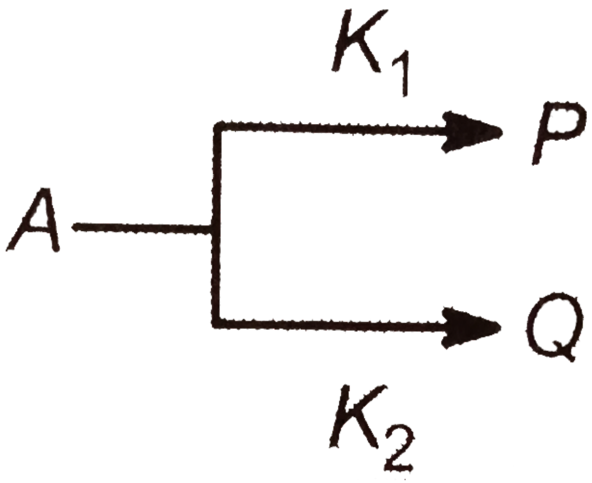
24. Some times a reacant undergoes chemical/radioactive changes following two or more different paths to yield two or more different produces respectively. Such reactions are called parallel path reactions. If K_1 and K_2 are rate constans for the reaction of A follwing two parallel paths, then



Then $K_{av} = K_1 + K_2$

Which one of the following is correct for the above reaction:

A. Fractionl yield of $p = \frac{K_1}{K_2}$

B. Fractional yield of $p = \frac{K_1 + K_2}{K_{av}}$

C. Fractional yeild of $p = \frac{K_1}{K_{av}}$

D. Fractional yield of $p = \frac{K_2}{K_{av}}$

Answer: c

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Exercies 8

1. Statement: $._{26}^{56}Fe$ is most stable nucleus.

Explanation: Binding energy per nucleon is maximum for $._{926}^{56}Fe$

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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2. Statement: Neutron decay result in $\beta -$ emission and emission of neutrino.

Explanation: Higher values of n/p ratio give rise to neutron decay.

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: b

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3. Statement: $K -$ electron capture leads to emission of neutron and $X -$ rays.

Explanation: The vacancy created in $K -$ shell is filled by electrons form higher levels and thus $X -$ rays are given out.

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: b

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4. Statement: Binding energy per nucleons becomes almost constant at 7.6 for elements beyond Pb and onwards.

Explanation: The lower value of binding energy/nucleons is responsible for decay of transuranic elements.

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: d

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5. Statement: Yukawa predicted the existence of $\pi -$ mesons.

Explanation: $\pi -$ mesons have their mass about 237 times more than electrons.

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: d

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6. Statement: parent element of $(4n+1)$ series is Plutonim -241

Explanation: It decays to give 8α and 5β particles.

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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7. Statement: Rutherfored studied the firest nuclear reaction:

$._7^{14}N + ._2^4He \rightarrow ._8^{17}O + ._1^1H + 1.193MeV$

Explanation: $\alpha -$ particels lesser than energy $7.6MeV$ were found ineffective.

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: d

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8. Statement: The first man-made atom produced by artifical transmulation was Tc.

Explanation: The phenolmenon of converting a stable nuclei into radioactive one is called artifical radioactivity.

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: d

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9. Statement: $t_{1/2}$ of $.^{14}C$ is same whether it is CO_2 or in cellulose or in coal.

Explanation: The rate of decay of an element is independent of all external factors.

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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10. Statement: The neutrons are better initiater of nuclear reactions than protons, deutrons, deutrons or $\alpha -$ particles.

Explanation: Neutrons being uncharged particles, not exert repulsive forces form nucleus.

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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11. Statement: $500mg$ of an isotope becomes $250mg$ in 120 minute. Therefore $100mg$ of the isotpe will becomes $50mg$ in 24 minute.

Explanation: The process fo radioactive decay follows first order kinetics.

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: b

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12. Statement: Nuclear fusion involves more energy change than nuclear fission.

Explanation: 0.23% of mass undergoes decay in nulclear fusion whereas only 0.1% in nuclear fission.

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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13. Statement: Rate of reaction of $._1^2H$ is more than rate of $._1^1H$ in a simple reaction.

Explanation: Lighter isotopes are more reactive at the same temperature.

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: b

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14. Statement: It is the oxygen of H_2IO coming out during photo-synthesis.

Explanation: $6nCO_2 + 5nH_2O^{18} \rightarrow (C_6H_{10}O_5)_n + 6nO_2^{18}$

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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15. Statement: H_3PO_3 is dibasic and H_3PO_4 s tribasic acid.

H_3PO_3 and H_3PO_4 on reacting with D_2O gives HD_2PO_3 and D_3PO_4 respectively.

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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16. Statement: Nuclide $._{13}^{30}Al$ is less stable than $._{20}^{40}Ca$

Explanation: Nuclides having odd number of protons and neutrons are general unstable.

A. S is correct but E is wrong.

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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Exercies 9

1. How much energyh must a $\gamma -$ ray photon have to produce and anti-proton each having kinetic energy $10MeV$? ($m_p = 1.007825$ amu. Assumwe 1 amu $= 391MeV$.)

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2. The sun radiates energy at the rate of 4×10^{26} joule $\sec^{-1}$. If the energy of fusion process

$4._1^1 H \rightarrow ._2^4 He + 2._1^0 e$

is $27MeV$, calculated amount of hydrogen atoms that would be consumed per day for the given process.

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3. Calcualte the energy released (in joule and MeV) in the follwing nulcear reaction:

$._1^2 H + ._1^2 H \rightarrow ._2^3 He + ._0^1 n$

Assume that the masses of $._1^2 H, ._2^3 He$ and neutron (n) are 2.0141, 3.0160 and 1.0087 respectively in amu.

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4. Consider an $\alpha -$ particle just in contact with a $._{92}U^{238}$ nucleus. Calculate the coulombic repulsion energy (i.e., the height fo coulombic barrier between U^{238} and $\alpha -$ particle.)Assume that the distance between them is equal to the sum of their radii.

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5. Natural nitrogen atoms has found to exist in two isotopic forms, $._7N^{14}$ with mass 14.0031 and $._7N^{15}$ with mas 15.0001 amu. Which isotope is more stable? Assume mass of n and p to eb 1.00893 and 1.00757 amu.

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6. $._{92}U^{238}$ is a neutral $\alpha -$ emitter. After $\alpha -$ emission, the residual nucleus callled UX_1 in turns emits $a\beta^{-1}$ particle to produce another nucleius UX_2 Find out the atomic and mass numbers of UX_1 and UX_2. Also if uranium belongs to $IIIgp$ to which group UX_1 and UX_2 belong.

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7. How much heat would be developed per hour form 1 curie of C^{14} source, if all the energy of beta decay were imprisoned? Atomic masses of C^{14} and N^{14} are 14.00324 absd 14.00307 amu respectively.

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8. In a nuclear reactor, U^{235} undergoes fission libertaing $200MeV$ of energy. The reactor has a 10% efficiency and produces $1000MW$ power.

If the reactor is to function for 10 years, find the total mass of urnaium needed.

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9. $\alpha -$ particles of $6MeV$ energy is scattered back form a silver foil. Calculate the maximum volume in which the entire positive charge fo the atom is supposed to be concentrated. (Z for silver $= 47$)

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10. The activity of a radioactive isotope falls to 12.5% in 90 days. Compute the half life and decay constatn of isotope.

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11. A mixture is to eb anlysed for peniclin. You add $10.0mg$ fo peniclin labelled with $.^{14}C$ that has a specific activity of $0.785\mu Cimg^{-1}$. From this mixture you are able to isotlate only $0.42mg$ of pure penicllin. The specific activity of the isolated pen,om od $0.102\mu Cimg^{-1}$. How much penicllin was in the original mixture?

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12. An archeological speciment containing $.^{14}C$ gives 40 counts in 5 mintues per gram of carbon. A specimen of freshly cut wood gives 20.3 counts per gram of carbon per minute. The counter used recorded a background count of 5 counts per mintue in absence of any $.^{14}C$ containing sample. What is the age of the speciment? (T_{50} of $.^{14}C = 5668$ year)

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13. Upon irradiating californium with neutrons, a scientist discovered a new nuclide having mass scientist discovered a new nuclide having mass number of 250 and a half-life of $0.50hr$. Three hours after the irradiation the observated radioactivity due to the nuclide was $10 dis / \min$. How many atoms of the nuclide were perepared initially?

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14. Equal masses of two samples of charcoal A and B are burnt separately and the resulting carbon dioxide is collected in two vessels. The radioacitivity of $.^{14}C$ is measured for both the gas samples. The gas from the charcoal A gives 1400 counts per week. Find teh age difference between the two samples.

(Half-life $.^{14}C = 5730 yr$)

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15. One gram of $._{79}Au^{198}(t_{1/2} = 65 hr)$ decays by $\beta -$ emission to produce stable Hg.

(a) Write nuclear reaction for process.

(b) How much Hg will be present after $260 hr$?

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16. $1gRa^{226}$ is placed in an evacused tube whose volume is 5, Assuming that each Ra nucleus yields for He atoms which are retained in the tube, what will be the pressure of He preoduced at $27^{\circ}C$ after the end of 1590 year? ($t_{1/2}$ for Ra is 1590 year)

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17. The activity of the hair of an egyptain mummy is 7 disinetgration minute^{-1} of of C^{14}. Find the age of mummy. Given $t_{0.5}$ of C^{14} is 1570 year and disintegration rate of fresh sample of C^{14} is 14 disntegration minute^{-1}.

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18. The decay constant for an $\alpha -$ decay of Th^{232} is $1.58 \times 10^{-10} \text{sec}^{-1}$. Find out the no. of $\alpha -$ decays that occur form $1g$ sample in 365 days.

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19. Two reacants A and B are present such that $[A_0] = 4[B_0]$ and $t_{1/2}$ of A and B are 5 and 15 mintute respectively. If both decay folliwing I order, how much time later will concentrations of both of them would be equal?

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20. Two ratio-isotopes P and Q atomic weight 100 and 200 respectively are mixed in equal amount by weight. After 20 days their weight ratio is found to be $1:4$ if $t_{1/2}$ for P is 10 day calculate $t_{1/2}$ for Q.

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21. The rate of decay of a radioactive sample is R_1 at time t_1 and R_2 at time t_2. Calculate the mean liffe of sample.

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22. $1g$ atom of Ra^{226} is placed in an evacuated tube of volume 5 liter. Assuming that each $._{88}Ra^{226}$ nucleus is an $\alpha-$ emitter and all the contents are present in tube, calculate the total pressure of gases and partial pressure of He collected in tube at 27° after the end of 800 year. Neglect volume occupied by undecayed Ra.

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23. A sample of $.^{14}CO_2$ was mixed with ordinary $.^{12}CO_2$ for stuyding a biological tracer experiment. The $10mL$ of ths mixture at STP possess the rate of 10^4 disintegration per minute. How many milli-curie of radioactive carbon is needed to prepare 60 litre of such a mixture?

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24. A solution contains 1 milli-curie fo $L-$ phenyol alanine C^{14} (unifromly labellled) in $2.0mL$ solution. The activity of labelled sample is given as 150 milli-curie/milli-mole. Calculatate:

(a) The concentration of sample in the solution in mol/litre.

(b) The actitivity of the solution in terms of counting per minute/mL at a counting efficiency of 80%.

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25. A sample of pithchbelen is found to contain 50% uranium and 2.425% lead. Of this lead only 93% was Pb^{206} isotope. If the disintegration constant is $1.52 \times 10^{-10} yr$ how old could be the pithblende deposits?

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26. The half-life of $.^{32}P$ si 14.3 day. Calculate the specific activity of a phosphours containing seciment having 1.0 part per million $.^{32}P$ (Atomic weight of $p = 31$)

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27. A mixture of Pu^{239} and Pu^{240} has a specific acticity of 6×10^9 sps per g sample. The half lives of the isotopes are 2.44×10^4 year and 6.58×10^3 years respectively. Calcualte the composition of mixture.

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28. $54.5mg$ of Na_3po_4 contains p^{32} $(15.6\%$ of sample) and P^{31} atoms. Assuming only P^{32} $(15.6\%$ of sample) and P^{31} atoms. Assuming only P^{32} atoms radioactive caculate the rate of decay for the given sample of Na_3PO_4 (Half-life period for $p^{32} = 14.3$ days mol. we of $Na_2PO_4 = 161.2$)

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29. The isotopic composition of rubidism is $.^{85} Rb, 72\%$ and $.^{87} Rb28\%$ is weakly radioactive and $.^{87} Rb, 28\%$. $.^{87} Rb$ si weakly radioactive and decays by $\beta-$ emission with a decay constant of 1.1×10^{-11} per year. A sample of the minearl pollucite was found to contain $450 mgRb$ and $0.72 mg$ of $.^{87} Sr$. Estimate the age of polluucite.

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30. A sample contains two radioactive nuclie x and y with half-lives 2 hour and 1 hour respectively. The nucleus x-decays to y and y-decays into a stable nucelus z.At t = 0, the activates of the components in the same were equal. Find the ratio of the number of the active , nuclei of y at $t = 4$ hours to the number at $t = 0$.

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31. Tritium, $._1 T^3$ (an isotope of H) combine wityh flurine to form a weak acid TF whch ionises to give T^+ prepared dilute aquios solution of TF has a pt (euivalent of pH) fo 1.7 and frezze at $-0.372^\circ C$. If $600 mL$ of freshly prapared soltuion were allowed to stand for 24.8 years, calculate:

(i() Ionisation constation of TE

(ii) Charge carried by $\beta -$ particles emitted by tritium in faraday.

Given: K_f for $H_2O = 1.86, t_{1/2}(T) = 12.4 yrs.$

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32. A solution contains a mixture of isotopes of $X^A(t_{1/2} = 14$ days) and X^{A_2} $(t_{1/2} = 25$ days(. Total acticity is 1 curie at $t = 0$. The activity reduces by 50% in 20 days. Find:

(a) The initial activitites of X^{A_1} and X^{A_2}

(b) The ratio of their initial no.of nuclei.

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33. The mean lives of radioactive substance are 1620 year and 405 year for $\alpha -$ emission and $\beta -$ emission respectively. Find out the time during which three fourth of a sample will decay, if it is decaying both by $\alpha -$ emission and $\beta -$ emission simulaneously.

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34. For the following sequential reaction,

$$A \xrightarrow{K_1} B \xrightarrow{K_2} C$$

Find out the concentraion of C at tiem $t = 1$ day. Given that $K_1 = 1.8 \times 10^{-5} s^{-1}$ and $K_2 = 1.1 \times 10^{-2} s^{-1}$ and initial molar concentration of A is 1.8

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35. A radioactive isotope decays as

$$\cdot_Z A^m \to \cdot_{Z-2} B^{m-4} \to \cdot_{Z-1} C^{m-4}$$

The half lives of A and B are 6 months respectively. Assuming that initially only A was present, will it be possibel to achieeve radioactive equilibrium fo B? If so, what would be the ratio ot A and B? If so, what would happen if the half-lives for A and B were 10 months adn 6 months respectively?

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36. A radioactive isotope decays as

$$._{Z}A^{m} \rightarrow ._{Z-2}B^{m-4} \rightarrow ._{Z-1}C^{m-4}$$

The half lives of A and B are 6 months respectively. Assuming that initially only A was present, will it be possibel to achieeve radioactive equilibrium fo B? If so, what would be the ratio of nuclei A and B? If so, what would happen if the half-lives for A and B were 10 months adn 6 months respectively?

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37. The half life of Pb^{212} is 10.6 hour. It undergoes decay to its daughter (unstable) element Bi^{212} of half-,ofe 60.5 mintue. Calcualte the time at which daughter element wil have maximum activity.

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38. A very small amoutn of radioactive isotope of Pb^{213} was mixed with a non-radioactive lead salt containg $0.01g$ of Pb (atomic mss 207). The whole lead was brought into solution and lead chromate was prcipitated by addition of a soluabolr chromate. Evaporation of $10cm^3$ fo the supernatent liquid gave a residue having a radioactivity $\frac{1}{24000}$ of that of the original quanity if Pb^{213} caculate the solubility of lead chromate in mol dm^{-3}.

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39. The nuclei of two radioactive isotopes of same substance A^{236} and B^{234} are present in the ratio of $4:1$ in an ore obtained form some other planet. Their half-lives are 30 and 60 minutes respectibvely. Both isotopes are alpha emitters and acitity of isotope A^{236} si 1 rutherford $(10^6 dps)$. Calcualte:

(a) After how much time their activities will becomes identical?

(b) The time required to bring the ratio of their atoms to $1:1$

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40. Detemine the oxidation no. of the folliwing elements given in bold letters:

(a) $KmnO_4$, (b) H_2SO_5

(c) $H_2S_2O_8$m (d) NH_4NO_3

(e) $K_4Fe(CN)_6$, (f) OsO_4

(g) HCN, (h) HNC

(i) HNO_3, (j) KO_2

(k) Fe_3O_4, (l) KI_3

(m) N_3H, (n) $Fe(CO)_5$

(o) $Fe_{0.94}O$, (p) NH_2NH_2

(q) $FeSO. (4). (NH_4)_2SO_46H_2O$

(r) $Na_2[Fe(CN)_5NO]$, (u) $[Fe(NO)(H_2O)_5]SO_4$

(v) $Na_2S_4O_6$

(v) $Na_2S_2O_3$

(w) Dimethyl sulphoxide or $(CH_3)_2SO$

(x) $Na_2S_2O_3$, (y) CrO_5 or $CrO(O_2)_2$

(z) $CaOCl_2$

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41. Determine the oxidation number of following elements given in bodl letters.

(i)CuH, (ii) $Na_2S_3O_6$

(iii) N_2O, (iv) Ba_2XeO_6

(v) $C_{93})O_2$, (vi) $V(BrO_2)_2$

(vii) $Ca(clO_2)_2$, (viii) $Cs_4Na(HV_{10}O_{28})$

(ix) $LiAlH_4$

(x) $K\left[Co(C_2O_4)_2(NH_3)_2\right]$

(xi) $\left[Ni(CN)_4\right]^2$, (xii) Na_2S_2

(xiii) $Fe(CO)_5$, (xiv) $[OCN]^-$

(xv) $S_2O_4^{2-}$, (xvi) $S_2O_8^{2-}$

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42. Predict the highest and lowest possible oxidation state of each of the following elements:

(a) Ta, 9b) Te, (c) Tc, (d)Ti, (e) Tl

(f) N, (g) P, (h)F, (i)Cl, (j)Zn(k)C`.

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43. Select the types of redox reaction form the following on the basis of type of tedox changes:

(a) intermolecular redox, (b) intramolecular redox

(c) auto redox. If none, write none.

(i) $C_6H_5CHO \xrightarrow{NaOH} C_6H_5CH_2OH + C_6H_5COONa$

(il) $Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$

(iii) $2Mn_2O_7 \rightarrow 4MnO_2 + 3O_2$

(iv) $NO_3^- + H_2S + H_2O + H^+ \rightarrow NH_4^+ + HSO_4^{\pm}$

(v) $Fe + N_2H_4 \rightarrow NH_3 + Fe(OH)_2$

(vi) $2KOH + Br_{92}) \rightarrow KBr + KBrO$

(vii) $2Cu^+ \rightarrow Cu + Cu^{2+}$

(viii) $Ag(NH_3)_2^+ \xrightarrow{2H^+} Ag^+ + 2NH_4^+$

(ix) $5KI + KIO_3 + 6HCl \rightarrow 3I_2 + 6KCI + 3H_2O$

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44. Select the oxidant/reducant atoms in the following change. Also report the number of electrons involved in redox change.

$As_2S_3 + HNO_3 \rightarrow H_3AsO_4 + H_2SO_4 + NO$

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45. In the reaction $Al + Fe_3O_4 \rightarrow Al_2O_3 + Fe$

(a) Which element is oxidized and which is reduced?

(b) Total no. of elecetros transferred during the change.

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46. Identify the substance acting as oxidant or reductatant if any in the following:

(i) $AlCl_3 + 3K \rightarrow Al + 3KCl$

(ii) $SO_2 + 2H_2S \rightarrow 3S + H_2O$

(iii) $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$

(iv) $3I_2 + 6NaOH \rightarrow NaIO_3 + 5NaI + 3H_2O$

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47. Find out the value of n in: $MnO_4^- + 8H^+ + \text{ne} \rightarrow Mn^{2+} + 4H_2O$

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48. Both VO_2^+ and VO^{2+} are known as vandyl ion.

(a) Determine the oxidation number of vandium in each.

(b) Which one of them is oxovanadium(iv) ion and which are is dioxovanadium(v) ion?

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49. One mole of N_2H_4 loses 10 mole electrons to form a new compound Y. Assuming that all the N_2 appears in new compound, what is oxidation state of N in Y ?

There is no charge in oxidant state of H.

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50. HNO_3 acts only as as oxidant whereas, HNO_2 acts as reducant and oxidant both.

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51. Balance the following equactions:

(a) $BaCrCO_4 + KI + HCI \rightarrow BaCl_2 + I_2 + KCl + CrCl_3 + H_2O$

(b) $SO_2 + Na_2CrO_4 + H_2SO_4 \rightarrow Na_2SO_4 + Cr_2(SO_4)_3 + H_2O$

(c) $C_2H_5OH + I_2 + PH^- \rightarrow CHI_3 + HCO_2^- + H_2O + \underset{(\text{Basic})}{I^-}$

(d) $As_2S_3 + HNO_3 \rightarrow H_3AsO_4 + H_2SO_4 + \underset{(\text{Acid})}{NO}$

(e) .... $+ HC_2O_4 \rightarrow CO_3^{2+} + CI^-$

(f) $HgS + HCl + HNO_3 \rightarrow H_2HgCl_4 + NO + S + H_2O$

(g) $Mn_2O_7 \rightarrow MnO_2 + O_2$

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52. $KMnO_4$ oxidises NO_2^- to NO_3^- in basic medium. How many moles of NO_2^- are oxidised by $1 mol$ of $KMnO_4$?

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53. Calculate the equivalent weight of each oxidant and reducant in:

(a) $FeSO_4 + KCl_3 \rightarrow KCl + Fe_2(SO_4)_3$

(b) $Na_2SO_3 + Na_2CrO_4 \rightarrow Na_2CrO_4 \rightarrow Na_2SO_4 + Cr(OH)_3$

(c) $Fe_3O_4 + KMnO_4 \rightarrow Fe_2O_3 + MnO_2$

(d) $KI + K_2Cr_2O_7 \rightarrow Cr^{3+} + 3I_2$

(e) $Mn^{4+} \rightarrow Mn^{2+}$

(f) $NO_3^- \rightarrow N_2$

(g) $N_2 \rightarrow NH_3$

(h) $Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$

(i) $FeC_2O_4 \rightarrow Fe^{3+} + CO_2$

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54. $20mL$ fo $0.2MMbnSO_4$ are completely oxidiz3d by $16mL$ of $KMnO_4$ of unknown normaliity each froming Mn^{4+} oxidation state. Find out the normality and molarity of $KMnO_4$ solution.

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55. An element A in conmpound ABD has an oxidation no. A^{n-}. It is oxidisides by $Cr_2O_7^{2-}$ in acid medium. In an experiment 1.68×10^{-3} mole of $K_2Cr_2O_7$ was required for 3.26×10^{-3} moel of the compound ABD. Calculate new oxidation state of A.

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56. $KMnO_4$ oxidizes X^{n+} ion to XO_3^- itself changing to Mn^{2+} in acid solution. 2.68×10^{-3} moel of $K_2Cr_2O_7$ was required 1.61×10^{-3} mole of MnO_4^-. What is the value of n ? Also calcualte the atomic mass of X, if the weight of $1g$ equivalent of XCl_n is 56

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57. Mg can reduce NO_3^- to NH_3 in basic solution:

$NO_3^- + Mg_{(s)} + H_2O \rightarrow Mg(OH)_{2(s)} + OH^-_{(aq.)} + NH_{3(g)}$

A $25.0mL$ sample of NO_3^- solution was treated with Mg. The $NH_{3(g)}$ was passed into $50mL$ to $0.15NHCl$. The excess HCl required $32.10mL$ of $0.10MNaOH$ for its neutralisation. What was the molarity of NO_3^- ions in the original sample?

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58. Hydroxylamine reduces iron III according to the equaction, $4Fe^{3+} + 2NH_2OH \rightarrow N_2O + H_2O + 4Fe^{2+} + 4H^+$. Orpm II thus produced is estimatedf by tiration with standard $KMnO_4$ solution. The reaction is $MnO_4^- + 5Fe^{2+} + 8H^+ \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$. A $10mL$ of hydroxyamine solution was diluted to one litere. $50mL$ of this diluted soltuion was boiled with an excess of Fe^{3+} solution. The resulting solution required $12mL$ of $0.02MKMnO_4$ solution for complete oxidation of Fe^{2+}. Calculate the weight of NH_2OH in one litre of orignal solution.

View Text Solution

59. A solution is containing $2.52 g litre^{-1}$ of a reductant, $25 mL$ of this solution required $20 mL$ of $0.01 M KMnO_4$ in acid medium for ocidation. Find the mol. Wt of reducant. Given that each of the two atoms which undergo oxidation per molecule of reducant, suffer an increase in oxidation state by one unit.

View Text Solution

60. Two solutions of $0.1 M cr_2O_7^{2-}(aq.)$ and $0.1 M MnI_4^{-}(aq.)$ are to be used to titatre (titrating solution) be required for a given solution of $fe^{2+}(aq.)$

(b) If a given titration requires $24.50 mL$ of $0.100 M Cr_2O_7^{2-}(aq.)$,how many mL of $0.100 M MnO_4^{-}(aq.)$ would have been required if it had been used instead?

View Text Solution

61. $KMnO_4$ solution is to be standaridised by titration against $AsO_3(s)$. A $0.1097g$ sample of As_2O_3 requires $26.10mL$ of the solution for its titration. What are the molarity and normally of the $KMnO_4$ solution?

View Text Solution

62. A steel sample is to be analysed fo rCr and Mn simultaneously. By suitable treatment the Cr is oxidised to $Cr_2O_7^{2-}$ and the Mn to MnO_4^- . A 10.00g sample of steel is used to produce $250.0mL$ of a solution containing$Cr_2O_7^{2-}$ and MnO_4^-

(a) A $10.00mL$ portion of this solution is added to a $BaCl_2$ solution and by proper adjument of the acidity, the chromimum is completeley precipitated as $0.0549gBaCrO_4$.

(b) A second $10.00mL$ portion of this soltuion requires exactily $15.95mL$ of $0.0750M$ standard Fe^{2+} solution for its titaration (in acid solution).

Calculate the % of Cr in the steel sample. $(Cr = 52, Mn = 55, Ba = 137)$

View Text Solution

63. A $200mL$ sample of a citrus fruit drinks containing ascorbic acid (vitamin $C, mol. We176.13$) was acidified with H_2SO_4 and $10mL$ of $0.250MI_2$ was added. Some of the iodine was reduced by the ascorbic acid to I^-. The excess of I_2 required $4.6mL$ of $0.01MNa_2S_2O_3$ for reduction. What was the vitamin C content of the drink in mg vitamin per mL drink?

The reactions are:

$C_6H_8O_6 + I_2 \rightarrow C_6H_6O_6 + 2HI$

$5H_2O + S_2O_3^{2-} + 4I_2 \rightarrow 2SO_4^{2-} + 8I^- + 10H^-$

View Text Solution

64. An acid solution of $KReO_4$ sample containing $26.83mg$ of combined rhenium was reduced by passage through a column of granulated zinc.

The effulent solution including the washings from the column, was then titrated with $0.5 N KMnO_4$. $11.45 mL$ of the standard $KMnO_4$ was required for the reoxidation of all the rhendium of all the rehniuym to the perryhentate ion $Re_O \_ (4)^-$. Assuming that rhenium was the only element reduced, what is the oxisation state to which rhenium was reduced by the zinc column?

View Text Solution

65. $2.480 g$ of $KcIO_3$ are dissolved in conc. HCl and the solution was boiled. Chorine gas evolved in the reaction was then passed through a solution of Ki and libeerated iondine was titrated with $100 mL$ of hypo $12.3 mL$ of same hypo solution required $26.6 mL$ of $0.5 N$ idone for complete neutralization. Calculate $\%$ purity of $KCIO_3$ sample.

View Text Solution

66. $1 g$ of moist sample of KCI and $KCIO_3$ was dissolved in water to make $250 mL$ solution, $25 mL$ of this solution was treated with SO_2 to reduce chlorirate to chloride and excess of SO_2 was removed by boiling. The total chloride was precipitaed as silver chloride. the weight of precipitate was $0.1435g$. In another experiment, $25mL$ of original solution was heated with $30mL$ of $0.2N$ ferrous sulphate solution and unreached ferrous sulphate required $37.5mL$ of $0.8N$ solution of an oxidant for complete oxidation. Caculate the molar ratio of chlorate int eh given mixture. Fe^{2+} reacts with CIO_3^- accroding to equaction,

$$CIO_3^- + 6Fe^{2+} + + 6H^+ \rightarrow CI^- + 6Fe^{3+} + 3H_2O$$

View Text Solution

67. $0.84g$ iron are containing X per cent of iron was taken in a solution containg all the iron in ferrous state. The solution required Xml of a porassium dichromate soltuion for oxidation of iron content to ferric state. Calculate the strength of potassium dichromate solution.

View Text Solution

68. $0.5g$ sample of iron containg mineral mainly in the form of $CuFeS_2$ was reduced suitably to vonvert all the ferruic ions into ferrous ions $(Fe^{3+} \rightarrow Fe^{2+})$ and was obtained as solution. In the absence of any interferring radical, the solution. In the absence of any interfeerring radical, the solution required $42mL$ of interferring radical, the solution required $42mL$ of $0.1MK_2Cr_2O_7$ for tirtration. Calculate $\%$ of $CuFeS_2$ in sample.

View Text Solution

69. $0.2828g$ of iron wire was dissolved in excess dilute H_2SO_4 and the solution was made up to $100mL$. $20mL$ of this solution required $30mL$ of $N/30K_2Cr_2O_7$ doluyion for exact oxidation. Calculate $\%$ purity of Fe in wire.

View Text Solution

70. A substance of crude copper is boiled in H_2SO_4 till all the copper has reacted. The impurites are inert to acid. The SO_2 liberated in the reaction is passed into $100mL$ of $0.4M$ acidified $KMnO_3$. The solution of $KMnO_4$ after passage of SO_2 is allowed to react with oxalic acid and requireds $23.6mL$ of $1.2M$ oxalic acid. IF the purity of copper is 90% what was the weight of sample?

View Text Solution

71. What mass of $K_2Cr_2O_7$ is required to produce 5.0 litre CO_2 at $75^{\circ}C$ and 1.07 atm pressure from excess of oxlaic acid? Also report the volume of $0.1NNaOH$ required to neutralise the CO_2 evolved.

View Text Solution

72. Calculate the mass of oxalic $(H_2C_2O_4.2H_2O)$ which can be oxidised to CO_2 by $100mL$ of MnO_4^- (acidic) solution, $10mL$ of which are capable of oxidising $50.0mL$ of $1.0mI^-$ to I_2. Also calculate the weight of FeC_2O_4 oxidised by same amount of MnO_4^-.

View Text Solution

73. The calcium contained in a solution of $1.048g$ of a substance being analysed was precipitated with $25mLH_2C_2O_4$. The excess of $C_2O_4^{2-}$ in one fourth of filrtate was back titrated with $5mL$ of $0.1025NKMnO_4$. To determine the conc. of $H_2C_2O_4$ soloution, it was diluted foru folds and titration of $25mL$ of same $KmnO_4$ solution. Calculate $\%$ of Ca in substance.

View Text Solution

74. $100mL$ solution of FeC_2O_4 and $FeSO_4$ is compleltely oxidized by $60mL$ of $0.2MKMnO_4$ in acid medium. The resulting soltuion is then reduced by Zn and dil. The reduced soltuion is again oxidized completely by $40mL$ of $0.2MKMnO_4$. Calculate normality of FeC_2O_4 and $FeSO_4$ in mixture.

View Text Solution

75. $25mL$ of a solution containing Fe^{2+} and Fe^{3+} sulphate acidifed with H_2SO_4 is reduced by $3g$ of metalllic zinc. The dsolution required $34.25mL$ of $N/10$ solution of $K_2Cr_2O_7$ for oxidation. Before reduction with zinc, $25mL$ of the same solution. Calculate the strength of $FeSO_4$ and $Fe_2(SO_4)_3$ in solution.

View Text Solution

76. A sample of ferrous sulphate and ferrous oxalate was dissolved in dil. H_2SO_4 the complete oxidation of reaction mixture required $40mL$ pf $N/15KMnO_4$. After the oxidation, the reaction mixture was reduced by Zn and H_2SO_4. On again oxidation by same $KMnO_4$, $25mL$ were required. Calucate the ratio of fe in ferrous sulphate and oxalate.

View Text Solution

77. A soltuion contains mixture of H_2SO_4 and $H_2C_2O_4$, $25mL$ of $N/10NaOH$ for neutralization and $23.45mL$ fo $N/10KMnO_4$ for oxisation. Calcualte:

(i) Normality of $H_2C_2O_4$ and H_2SO_4

(ii) Strength of $H_2C_2O_4$ and H_2SO_4.

Assume molecular weight of $H_2C_2O_4 = 126$

View Text Solution

78. A compound is known to be hydrated doubel salt of potassium oxalate and oxalic acid of the tuype $aK_2C_2O_4$, $bH_2C_2O_4$, cH_2O, where a, b and c are unknown. When $1.613g$ of this compound is dissolved in water and solution is neutralised by $19.05mL$ of $0.1N$ alkali and reduces $25.40mL$ of this solution. What is the formula of the salt?

View Text Solution

79. $30mL$ of a soltuion containg $9.15g/\text{litre}$ of an oxalte $K_XH_Y(C_2O_4)_Z.nH_2O$ are required for titrating $27mL$ of $0.12NNaOH$

and $36 mL$ of $0.12 N KMnO_4$ separalty. Calculalte X, Y, Z are in the simple ratio of g atoms.

View Text Solution

80. On igniion, Rochelle salt $NaKC_4H_4O_6 . 4H_2O$ (mol. Wt 282) is converted into $NaKCO_3(molwt. 122).0.9546g$ sample of the rochelle salt on ignition gives $NaKCO_3$ which is titrated wih $41.72 mL. H_2SO_4$. From the follwing data, find the percentage purtiy of the rochelle salt. The solution after neutralisation requires its $1.91 mL$ of $0.1297 N NaOH$. The H_2SO_4 used for the neutralisation requires its $10.27 mL$ aganist $10.35 mL$ of $0.1297 N NaOH$

View Text Solution

81. $25 mL$ of a solution of ferric alum $Fe_2(SO_4)_3(NH_4)_2(SO_4) / 24H_2O$ containing $1.25g$ of the salt was boiled with iron when the reaction $Fe + Fe_2(SO_4)_3 \rightarrow 3FeSO_4$ occurred treated with $0.107 N KMnO_4$ in acid medium. What is titre value? If Cu has been used in place of Fe what would have been titre value?

View Text Solution

82. A $2.5g$ sample containing $As_2O_5Na_2HAsO_3$ and inert substance is dissolved in water and the pH is adjusted to neutral with excess of $NaHCO_3$. The solution is titrated with $0.15MI_2$ solution, requiring $11.3mL$ to just reach the end point, then the solution is acidified with HCl, KI is added and the liberated iodine requires $41.2mL$ fo $0.015MNa_2S_2O_3$ under basic conditions where it converts to SO_4^{2-}. Calculate per cent compositon of mixture.

View Text Solution

83. Calculate the weight of MnO_2 and the volume fo HCI of specific gravity $1.2gmL^{-1}$ and 4% nature by weight , needed to produce 1.78 litre of Cl_2 at STP by the reaction:

$MnO_2 + 4HCI \rightarrow MnCl_2 + 2H_2O + CI +_2$

View Text Solution

84. Chile saltpetre, a source of $NaNO_3$ also contains $NalO_3$. The $NalO_3$ can be used as a source of iodine, produced in the follwng reactions:

$IO_3^- + 3HSO_3^- \rightarrow I^- + 3H^+ + 3SO_4^{2-}$ ....(1)

$5I^- + IO_3^- + 6H^+ \rightarrow 3I_{2(s)} + 3H_2O$ ....(2)

One litre of chile salphere soltuion containg $5.08 g NaIO_3$ is treated with stochiometric quanity of $NaHSO_3$. Now an additional amount of same solution is added to reactiion mixture to bring about the secound reaction. How many grams of $NaHSO_3$ are required in step i and what additional volume of chile salphetre must be added in step II to bring in complete conversion of I^- to I_2?

View Text Solution

85. (a) $CusO_4$ reacts with KI in acidic medium to liberate I_2:

$2CuSO_4 + 4KI \rightarrow Cu_2I_2 + 2K_2SO_4 + I_2$

(b) Merrcuric per isodate $Hg_5(IO_6)_2$ reacts with a mixture of KI and

HCI follwing the equaction:

$$Hg_5(10_6)_.(2) + 34KI + 24HCI \rightarrow 5K_2HgI_4 + 8I_2 + 24KCI + 12H_2O$$

(c) The liberted iodine s titrated against $Na_2S_2O_3$ solution. One mL of whcih is equivalent to $0.0499g$ of $CuSO_4.5H_2O.\ 5H_2O$. What volume in mL of $Na_2S_2O_3$ solution will be required to react with I_2 liberated from $0.7245g$ of $Hg_5(10_6)_2$? $M.\ wt,$ of $Hg_5(10_6)_2 = 1448.5$ and $M.\ wt$ of $CuSO_4.\ 5H_2O = 249.5$

View Text Solution

86. Calculate the amont of SeO_4^{2-} in solution on the basic of the following data. $20mL$ of $M/60$ solution of $KBrO_3$ was added to a define volume of SeO_3^{2-} solution. The bromic evolved was removed by boiling and excess of $KBrO_3$ was back titrated with $5.1mL$ of $M/25$ solution fo $NaAsO_2$. The reaction are given below:

(a) $SeO_3^{2-} + BrO_3^- + H^+ \rightarrow SeO_4^{2-} + Br_2 + H_2O$

(b) $BrO_3^- + AsO_2^- + H_2O \rightarrow Br^- + AsO_4^{3-} + H^+$

View Text Solution

87. A mixture containg As_2O_3 and As_2O_5 and required $20.10mL$ of $0.05N$ iodine for titration. The resulting solution is then acidified and excess fo KI was added. The liberated iondine required $1.1113g$ hypo $(Na_2S_2O_35H_2O)$ for complete reaction. Calculate mass of mixture. The reactions are:

$$AsO_3 + 3l_2 + 2H_2O \rightarrow As_2O_5 + 4H^+ + 4I^-$$

$$As_2O_5 + 4H^+ + 4l^- \rightarrow As_2O_3 + 2l_2 + 2H_2O$$

View Text Solution

88. In a quality control analysis for sulphur impurity $5.6g$ steel sample was burnt in a stream of oxygen and sulphur was converted into SO_2 gas. The SO_2 was then oxidized to sulphate by using H_2O_2 solution to which has been added $30mL$ of $0.04MNaOH$. The equation of the reaction is:

$$SO_{2(g)} + H_2O_{(aq.)} + 2OH^-_{(aq.)} \rightarrow SO^{2-}_{4(aq.)} + 2H_2O_{(l)}$$

$22.48mL$ of $0.024MHCI$ was required to neutralize the base remaining after oxidation reaction. Calculate $\%$ sulphur in given sample.

View Text Solution

89. $0.108g$ of finely divided copper was treated with an excess of ferric sulphate solution until copper was comnpletely dissolved. The solution after the addition of excess dilute sulphuric acid required $33.7mL$ of $0.1NKMnO_4$ for complete oxidation. Find the equaction which represents the reaction between metallic copper and ferric sulphate solution. At wt. of $Cu = 63.6$ and $Fe = 56$.

View Text Solution

90. $1.249g$ of a sample fo pure $BaCO_3$ and impure $CaCO_3$ containing some Cao was treated with dil.HCI and it $BaCrO_4$ was precipitaate was dissolvbed in dilute H_2SO_4 and with KI solution libetared iodine which required exactly $20mL$ of $0.05NNa_2S_2O_3$. Calculate percentage of CaO in the sample.

View Text Solution

91. A $10g$ mixture of Cu_2S and CuS was treated with $200mL$ of $075MMnO_4^-$ in acid solution producing SO_2, CU^{2+} and Mn^{2+}. The SO_2 was boiled off and the excess of MnO_4^-. The SO_2 was boiled off and the excess of MnO_4^- was titrated with $175mL$ of $1MFe^{2+}$ solution. Caculaate $\%$ fo CuS in original mixture.

View Text Solution

92. For estimating ozone in the air, a ceratin volume of air is passed through an acidified or neutral KI solution when oxygen is evolved and iodide is oxidised to give iodine. When such a solution is acidified, free iodine is evolved which can be be titrated with standard $Na_2S_2O_3$ solution. In an experiment 10 litre of air at1 atm and $27^\circ C$ were passed through an alkaline KI solution, at the end, the iodine entrapped in a solution on titration as above required $1.5mL$ of $0.01NNa_2S_2O_3$ solution. Calculate volume $\%$ fo O_3 in sample.

View Text Solution

93. A forensic chemist needed to determine the conventration of HCN in the blood of a suspected homicle victim and decided to titrate a diluted sample fo the blood with iodine, using the reaction,

$$HCN_{(aq.)} + I_3^- \rightarrow ICN_{(aq.)} + 2I^-_{(aq.)} + H^+_{(aq.)}$$

A diluted blood sample of volume $15mL$ was titrated to the stoihometric point with $5.21mL$ of an I_3^- aolurion. The molarity of I_3^- in the solution was determined by titrating it against arsenci (III) oxide, which in solution forms arenious acid, $H_{93})As)_3$. It was found that $10.42mL$ of the tri-iodide solution was needed to reach teh stoichmetric point with a $10mL$ sample of $0.1235MH_3AsO_3$ in the reaction.

$$H_3AsO_{3(aq)} + vI^-_{3(aq)} + H_2O_{(l)} \rightarrow H_3AsO_{4(aq)} + 3I^-_{(aq.)} + 2H^+_{(aq.)}$$

(a) What is the normally of tri-iodie ions in the initlal solution?

(b) What is the molar concentration of HCN in the blood sample?

View Text Solution

94. A mixture of two gases, H_2S and SO_2 is passes throgh three beakers successivly. The first beaker contains Pb^{2+} ions, which absobs all H_2S to form PbS. The second beaker contains $25mL$ of $0.0396NI_2$. Which ocidises all SO_2 to SO_4^{2-} . The third beaker contains $10mL$ of $0.0345N$ thisulphate solution ti retain any I_2 carried over from the second absorber. The solution from first absorber was made acidic and treated with $20mL$ of $0.0066MK_2Cr_2O_7$, acidic and treated with $20mL$ of $0.006MK_2Cr_2O_7$ which converted S^{2-} to SO_2. The excess dichromate was reacted with solid KI and the liberated iodine required $7.45mL$ of $0.0345NNa_2S_2O_3$ solution. The solution in the second and thrid absorbers were combined and the resulatant iodide was treated with $2.44mL$ fo the same solution of thisulphate. Calculate the conventrations fo SO_2 and H_2S in $\frac{mg}{\text{litre}}$ of the sample.

View Text Solution

95. A $0.141g$ sample of phosphorus containing compound was digested in a mixture of HNO_3 and H_2SO_4 which resulant in formnation of CO_2, H_2O and H_3PO_4. Addition of ammounium molybdate yielded a solid having the composition $(NH_4)_3PO_4.12MoO_3$. The precipitate was filtered, washed and dissolved in $50.0mL$ of $0.20MNaOH$.

$(NH_4)_3PIO_4.12MoO_{3(s)} + 26OH^- \rightarrow HPO_4^{2-} + 12MoO_4^{2-} + 14H_2O$ -

After boiling the solution to remove the NH_3, the excess of $NaOH$ was titrated with $14.1mL$ of $0.174M, HCl$. Calculate the percentage of phosprous in the sample.

View Text Solution

96. $1g$ of a sample of $NaOH$ was dissolved in $50mL0.33M$ alkaline solution of $KMnO_4$ and refulxed till all the cycanide was converted into OCN^-. The reaction mixture was cooled and tis $5mL$ portion was acidified by adding H_2SO_4 in excess an dtehn titrated to end point against $19.0mL$ of $0.1MFeSO_4$ solutio. Calculate% purity of $NaCN$ sample.

View Text Solution

97. How many mole of $FeCl_3$ can be prepared by the reaction of $10g$ pf $KMnO_4 10.07$ mole of $FeCl_2$ and $500mL$ of $3MHCl$ follwing the reaction:

$5FeCl_2 + KMnO_4 + 8HCI \rightarrow 5FeCl_3 + KCl + MnCl_2 + 4H_2O$

View Text Solution

98. A steel sample is to be analysed fo rCr and Mn simultaneously. By suitable treatment the Cr is oxidised to $Cr_2O_7^{2-}$ and the Mn to MnO_4^-. A 10.00g sample of steel is used to produce $250.0mL$ of a solution containing $Cr_2O_7^{2-}$ and MnO_4^-.$10mL$ of this solution is added to $BaCl_2$ solution and by prooper adjument of the pH, the chromium is completely precipitate as $BaCrO_4(0.0549g)$. The second $10mL$ solution protion requires exactly $15.95mL$ of $0.0750M$ standard for complete reduction of this solution. Calculate $\%$ of Mn and Cr in this sample.

View Text Solution

99. A define amount of impure sample of P_4O_6 is treated with $20mL$ of $XMKMnO_4$ in acidic medium to produce H_3PO_4 and $MnCl_2$. $20mL$ of same $KMnO_4$ on treatement with $0.2MFeSO_4$ requires exctly $10mL$ of

$FeSO_4$ solution. What is amount of pure P_4O_6? If $1g$ sample is taken calculate $\%$ purity of P_4O_6.

View Text Solution