# PHYSICS

# BOOKS - CENGAGE PHYSICS (HINGLISH)

# NUCLEI

Question Bank

**1.** The half lives of radioactive elements $X$ and $Y$ are $3$ minute and $27$ minute respectively. If the activities of both are same, then calculate the ratio of number of atoms of X and Y.

Watch Video Solution

**2.** The radius of gemanium (Ge) moclide is measund w be

View Text Solution

**3.** Initial ratio of active nuclei in two different sample is 2: 3 their half lives are 2 hr and 3hr respectively . Ratio of their activities at the end of 12 hr is :

Watch Video Solution

**4.** The radii of NUCLEI of two atoms are in ratio $\frac{3}{2}$. Assuming them to be hydrogen like atom, the ratio of their orbital radius for $(K)$ shell is m/n .$F \in d$(m+n) .$\left(As \sum evmberofpro \to n=\right.$` Number of neutron for each atom)

View Text Solution

**5.** The fraction of a radioactive material which reamins active after time t is $9/16$. The fraction which remains active after time $t/2$ will be .

Watch Video Solution

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

Watch Video Solution

**7.** The half-life of a radioactive isotope $X$ is $50$ years. It decays to another element $Y$ which is stable. The two elements $X$ and

$Y$ were found to be in the ratio of $1:15$ in a sample of a given rock. The age of the rock was estimated to be

Watch Video Solution

**8.** Obtain the amount of $()_{27}^{60}(Co)$ (in $\mu(g)$ ) necessary to provide a radioactive source of $8.0(\sim m)(Ci)$ strength. The half life of $()_{27}^{60}(Co)$ is $5.3$ years. (Give answer in integer value)

View Text Solution

**9.** The binding energy per nucleon of $\underset{3}{\overset{7}{Li}}$ and $\underset{2}{\overset{4}{He}}$nuclet are $5.60MeV$ and $7.06MeV$, respectively. In the nuclear reaction $\underset{3}{\overset{7}{Li}} + \underset{1}{\overset{1}{H}} \rightarrow$ underset(4)overset(2)He , $thevalueofe \neq rgy$Q` (in MeV) released is

View Text Solution

**10.** In the process of nuclear fission of $1g$ of uranium, the mass lost is $0.90mg$. The efficiency of fission reactor of power house is $20\,\%$. To obtain $400MW$ power from the power house, how much uranium (in gram) is required per hour?

View Text Solution

**11.** $200(MeV)$ of energy can be obtained per fission. In a reactor generating $1000kW$, the number of NUCLEI under going the fission per second is $3.125 \times 10^n$. Find $n$.

View Text Solution

**12.** A nucleus of mass number 220 , initially at rest, emits an $\alpha$ - particle. If the $Q$ value of the reaction is $5.5MeV$, the energy (in MeV) of the emitted $\alpha$ -particle will be

View Text Solution

**13.** A radioactive material decays by simulataneous emission of two particle from the with respective half - lives $1620$ and $810$ year . The time , in year , after which one - fourth of the material remains is

Watch Video Solution

**14.** In an $\alpha$ -decay, the kinetic energy of $\alpha$-particles is $48MeV$ and $Q$ value of the reaction is $50MeV$. The mass number of the

mother nucleus is (assume that daughter nucleus is in ground state)

Watch Video Solution

**15.** The distance of closest approach of a certain nucleus is 7.2 fm and it has a charge of $1.28 \times 10^{-17}$ C. The number of neutrons inside the nucleus of an atom is

Watch Video Solution

**16.** The activity of a fresh radioactive solution of volume 1 litre is $1200Bq$. A volume $\Delta V$ of the same liquid has an activity $120Bq$ after three half lives. Then $\Delta V$ (in cc) must be

View Text Solution

**17.** Two' radioactive samples $X$ and $Y$ having half life 3 years and 2 years, respectively, havė been decaying for many years. Today both samples have equal number of atoms. After how many years the number of atoms in the sample $X$ will be twice of the number of atoms in the sample $Y$ ?

View Text Solution

**18.** Radioactive NUCLEI $A$ and $B$ with half lives $T$ and 21 , respectively, disintegrate into $C$. At $t = 0$, number of NUCLEI of each $A$ and $B$ is $x$. The number of NUCLEI of $C$ when rate of disintegration of $A$ and $B$ are equal is $\alpha x$.

View Text Solution

**19.** Geiger counter reading of a radioactive sample is initially 6800 counts per minute. The same sample gives a reading of 425 counts per minute $10h$ later. The half life of sample is $\alpha$ hours. Find $2\alpha$.

View Text Solution

**20.** A sample of $\beta$ active NUCLEI has a half life of $1.00$ min. Initially, there are $10^{13}\beta$ active NUCLEI. Assuming that all the $\beta$ particles emitted leave the sample, what is the charge (in $\mu C$ ) acquired by the sample in 200 min?

View Text Solution

**21.** For a substance, the average life for $\alpha$ -emission is 3240 years and for $\beta$ emission is 810 years. After how much time (in years) the one-fourth of the material remains by simultaneous emission? $(\ln 2 = 0.693)$ (Round of the answer to nearest integer.)

View Text Solution

**22.** A nucleus with mass number 220 , initially at rest, emits an $\alpha$ -particle. If the $Q$ value of reaction is $7.8MeV$ and subsequently after the emission of $\alpha$ -particle, a photon of energy $1.2MeV$ is also emitted, then the kinetic energy (in MeV ) of $\alpha$ -particle is.

View Text Solution

**23.** Consider the following 'fusion reaction: ${}_{1}^{2}H +$ underset(1)overset(2)H rarr ${}_{2}^{4}He$. If $20MeVofe \neq rgyisre \leq asedperfusionreaction$ and $masssof$ ${}_{1}^{2}H$ consumed per day is $0.1(\sim g)$, then what is the power of the reactor (in MW )? (Give answer in integer value)

View Text Solution

**24.** A radioactive sample $S_1$ having the activity $A_1$ has twice the number of nucleic as another sample $S_2$ of activity $A_2$. If $A_2 = 2A_1$, then the ratio of half-life of $S_1$ to the half-life of $S_2$ is

Watch Video Solution

**25.** Two radioactive elements R and S disintegrate as

$R \to P + \alpha, \lambda_R = 4.5 \times 10^{-3} \text{years}^{-1}$

$S \to Q + \beta l, \lambda_S = 3 \times 10^{-3} \text{years}^{-1}$

Starting with number of atoms of R and S in the ratio of 2:1 this ratio afte4r the lapse of three half lives of R will be

Watch Video Solution

**26.** The radioactive sources $A$ and $B$, initially containing the same number of radioactive atoms, have half lives of $2h$ and $4h$, respectively. At the end of $2h$, their rates of disintegration are in the ratio $\sqrt{\frac{p}{q}}$. Find $(p+q)$.

View Text Solution

**27.** A nucleus $X$, initially at rest, decays into a nucleus $Y$ with the emission of an $\alpha$ -particle'and energy $Q$ is released. If $m$ is mass of $\alpha$ -particle and $M$ that of rucleus $Y$, the energy of the emitted $\alpha$ -particle is given by $E_\alpha = \frac{QM}{M + xm}$. Find the value of $x$.

View Text Solution

**28.** The graph represents the decay of a newly prepared sample of radioactive nuclide $X$ to a stable nuclide $Y$. The half life of $X$ is $\tau$. The growth curve for $Y$ intersects the decay curve for $X$ after time $T$. What is the time $T$ in multiple of $\tau$ ?

'(## CEN_KSR_PHY_JEE_CO30_E01_028_Q01##)'

View Text Solution

**29.** The threshold energy (in $(MeV)$ ) for the following nuclear reaction to proceed is

$\overset{4}{\underset{2}{He}} + \text{underset(7)overset(14)N rarr } \overset{17}{\underset{8}{O}} + \text{underset(1)overset(1)H}$

$A \to mic, massof\text{underset(2)overset(4)He} = 4.00260 \text{ amu}$

$A \to micmassof\text{underset(7)overset(14)N=14.00307 amu}$

$A \to micmassof\text{underset(8)overset(17)Li} = 16.99913(a\mu)$

Atomic mass of $\overset{1}{\underset{1}{H}} = 1.00783(a\mu)$

View Text Solution

**30.** Half life of a radioactive substance is $2.34 \text{ min}$ . It is produced at'a constant rate of $10^8$ NUCLEI per second. How soon (in minute) after the beginning of production will its activity be equal to disintegration per second?

View Text Solution

**31.** A radioactive sample has a half life of $40s$. When its activity is measured $80s$ after the beginning, it is found to be $6.932 \times 10^{18}$ dps. During this time, total energy released is $6 \times 10^{8} J$. If the energy released per fission is $y \times 10^{-13}$ joule, then find $y$. $(\ln 2 = 0.6932)$

View Text Solution

**32.** A moving neutron collides with stationary H-atom in ground state. As a result it excites and then de-excites. The corresponding radiation fail on a surface having work function $\sigma$. The minimum value of required kinetic energy for neutron is $E_0$ and possible minimum value of de-Broglie wavelength of emitted photoelectrons is $\lambda_0$. If the neutron hits stationary $(He)^+$ ion instead of stationary $(H)$ atom, then the minimum

value of kinetic energy for neutron is $E_1$ and the value of energy. transferred from neutron to H-atom is $\frac{xE_0}{y}$. Find $(xy)$.

View Text Solution

**33.** One possible method for revealing the presence of concealed nuclear weapons is to detect the neutrons emitted in the spontaneous fission of $^{240}Pu$ in the warhead. In an actual trial, a neutron detector of radius $1.0m$ carried on a helicopter measured a neutrón flux of $50s^{-1}$ at a distance of $100m$ from a missile warhead. Estimate the mass of $^{240}Pu$ (in kg ) in the warhead. The mean life for spontaneous fission in $^{240}Pu$ is $6 \times 10^{18}s$, and $2.5$ neutrons on the average are emitted in each fission. (Avogadro's number $= 6 \times 10^{23}$ )

View Text Solution

**34.** For a substance, the average life for $\alpha$ -emission is 1620 years and for $\beta$ emission is 405 years. If after $(k \times 0.693)$ years, the one-fourth of the material remains by simultaneous emission, then find $k$

View Text Solution

**35.** A radioactive sample decays by ' $\beta$ -emission. In first 2 seconds, $n\beta$ -particles are emitted and in next 2 seconds, $0.25n\beta$ -particles are emitted. The half life of radioactive NUCLEI (in second) is

View Text Solution

**36.** The graph in the figure shows how the count-rate $A$ of adioactive source as measured by a Geiger counter varies with time $t$. The relationship between $A$ and $t$ is $A = ke^{-0.1t}$. Find $k$. (Assume ln12=2.6)`

'(## CEN_KSR_PHY_JEE_CO30_E01_036_Q02##)'

View Text Solution

**37.** Consider a nuclear fusion reaction $A + B \to C$. Nucleus $A$ is moving with kinetic energy $= 5MeV$ and collides with mucleus $B$ moving with kinetic energy $= 3MeV$ and $f$ or $ms'\nu c \leq us$C $\in excitedstate. F \in dthek \in etice \neq rgy(\in MeV)ofnúc \leq us$ C$justafteritsf$ or $mationgiventîtsexcitatione \neq rgyis$10.3 MeV. $TakemassesofNUCLEIof$A, B and C$as$25.0 amu, 10.0 amu, 34.99 amu`, respectively. (1 amu=930 MeV )

View Text Solution

**38.** The positions of ${}_{1}^{2}D$, ${}_{2}^{4}He$ and ${}_{3}^{7}Li$ are shown on the binding energy curve as shown in the figure. Find the energy released (in multiple of $2(MeV)$ ) in the fusion reaction, ${}_{1}^{2}D +$ underset(3)overset(7)Li rarr $2{}_{2}^{4}He + {}_{o}^{1}n$

'(## CEN_KSR_PHY_JEE_CO30_E01_038_Q03##)'

View Text Solution

**39.** A radioactive sample contains two radionuclids $A$ and $B$ having décay constant $\lambda h^{-1}$ and $2\lambda h^{-1}$. Initially, $25\,\%$ of total decay comes from $A$. How long (in h ) will it take before $75\,\%$ of total decay comes from $A$. (Take $\lambda = \ln 3$)

View Text Solution

**40.** Consider the following process of decays

$_{92}^{234}U \rightarrow {}_{90}^{230}Th + {}_{2}^{4}He, T_{\frac{1}{2}} = 250000 years$

$_{90}^{230}Th \rightarrow {}_{88}^{226}Ra + {}_{2}^{4}He, T_{\frac{1}{2}} = 80000 years$

$_{226}^{88}Ra \rightarrow {}_{222}^{86}Rn + {}_{2}^{4}He, T_{\frac{1}{2}} = 1600 years$ After above process has occurred for a long time, a state is reached where every two thorium atoms formed from $_{92}^{234}U$, one decomposes to form $_{88}^{226}Rn$ and for every two $_{88}^{226}Ra$ formed, one decomposes to form underset(222)overset(86)Rn

. $Calcatetheratioofvmberof NUCLEIof$

underset(90)overset(230)Th $\rightarrow {}_{88}^{226}Ra$ at this state.

View Text Solution

**41.** The friction of a radioactive sample which remains active aftertime $t$ is $\frac{9}{16}$. What friction remains active after $\frac{t}{2}$ time?

Watch Video Solution

**42.** The power obtained in a reactor using $U^{235}$ disintergration is $1000kW$. The mass decay of $U^{235}$ per hour is (in $\mu g$ )

Watch Video Solution

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

Watch Video Solution

**44.** Obtain the amount of $()_{27}^{60}(Co)$ (in $\mu(g)$ ) necessary to provide a radioactive source of $8.0(\sim m)(Ci)$ strength. The half life of $()_{27}^{60}(Co)$ is $5.3$ years. (Give answer in integer value)

Watch Video Solution

**45.** The binding energy per nucleon of $._3^7 Li$ and $._2^4 He$ nuclei are $5.60$ MeV and $7.06$ MeV, respectively. In the nuclear reaction $._3^7 Li + ._1^1 H \rightarrow ._2^4 He + ._2^4 He + Q$, the value of energy $Q$ released is

Watch Video Solution

**46.** In the process of nuclear fission of $1g$ of uranium, the mass lost is $0.90mg$. The efficiency of fission reactor of power house is $20\,\%$. To obtain $400MW$ power from the power house, how much uranium (in gram) is required per hour?

Watch Video Solution

**47.** $200(MeV)$ of energy can be obtained per fission. In a reactor generating $1000kW$, the number of NUCLEI under going the fission per second is $3.125 \times 10^n$. Find $n$.

Watch Video Solution

**48.** A nucleus of mass number 220 , initially at rest, emits an $\alpha$ - particle. If the $Q$ value of the reaction is $5.5MeV$, the energy

(in MeV) of the emitted $\alpha$ -particle will be

Watch Video Solution

**49.** A radioactive material decays by simultaneous emission of two particles of half lives 1620 and 810 years. The time (in years) after which one-fourth of the material remains, is

Watch Video Solution

**50.** In an $\alpha$ -decay, the kinetic energy of $\alpha$ particle is $48(MeV)$ and $Q$ value of the reaction is $50MeV$. The mass number of the mother nucleus is (Assume that daughter nucleus is in ground state).

Watch Video Solution

**51.** The nuclear radius of a certain nucleus is $7.2fm$ and it has charge of $1.28 \times 10^{-17}(C)$. Find the number of neutrons inside the nucleus.

Watch Video Solution

**52.** For a substance, the average life for $\alpha$ -emission is 3240 years and for $\beta$ emission is 810 years. After how much time (in years) the one-fourth of the material remains by simultaneous emission? $(\ln 2 = 0.693)$ (Round of the answer to nearest integer.)

Watch Video Solution

**53.** A nucleus with mass number 220 , initially at rest, emits an $\alpha$ -particle. If the $Q$ value of reaction is $7.8MeV$ and subsequently after the emission of $\alpha$ -particle, a photon of energy $1.2MeV$ is also emitted, then the kinetic energy (in MeV ) of $\alpha$ -particle is.

Watch Video Solution

**54.** A radioactive sample $S_1$ having the activity $A_1$ has twice the number of NUCLEI as another sample $S_2$ of activity $A_2$ : If $A_2 = 2A_1$, then the ratio of half life of $S_1$ to the half life of $S_2$ is

Watch Video Solution

**55.** Two radioactive elements $R$ and $S$ disintegrate as

$R \to P + \alpha, \lambda_R = 4.5 \times 10^{-3}$ years $\hat{}\ (-1)$

$S \to P + \beta, \lambda_s = 3 \times 10^{-3}$ years $\hat{}\ (-1)$

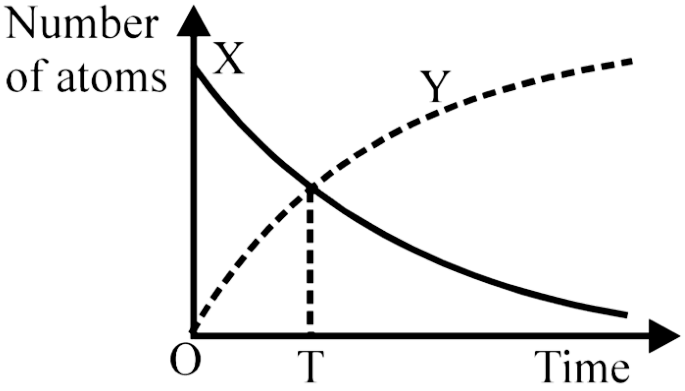
Starting with number of atoms of $R$ and $S$ in the ratio of $2:1$, this ratio after the lapse of three half lives of $R$ will be

Watch Video Solution

**56.** The radioactive sources $A$ and $B$, initially containing the same number of radioactive atoms, have half lives of $2h$ and $4h$, respectively. At the end of $2h$, their rates of disintegration are in the ratio $\sqrt{\frac{p}{q}}$. Find $(p+q)$.

Watch Video Solution

**57.** The graph represents the decay of a newly-prepared sample of radioactive nuclide X to a stable nuclide Y. The half-life of X is t. The growth curve for Y intersects the decay curve for X after time T. What is the time T ?




Watch Video Solution

**58.** For a substance, the average life for $\alpha$ -emission is 1620 years and for $\beta$ emission is 405 years. If after $(k \times 0.693)$ years, the one-fourth of the material remains by simultaneous emission, then find $k$

Watch Video Solution

**59.** A radioactive sample decays by ' $\beta$ -emission. In first 2 seconds, $n\beta$ -particles are emitted and in next 2 seconds, $0.25n\beta$ -particles are emitted. The half life of radioactive NUCLEI (in second) is

Watch Video Solution