



PHYSICS

BOOKS - OSWAAL PUBLICATION

PHYSICS (KANNADA ENGLISH)

NUCLEI

Topic 1 Very Short Answer Type Questions

1. How does nuclear radius of an atom depend on its mass number ?



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2. A radioactive element ${}_{92}\text{X}^{238}$ emits one α -particle and one β' particle in succession.

What is the mass number of new element formed?



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3. What is the SI unit of activity?



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4. What is mean life of a radioactive element?



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5. State the law of radiactive disintegration.



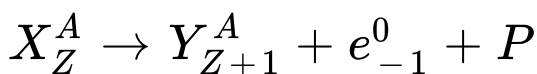
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6. Name the anti-particle of an electron.



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7. Identify the particle P in the following nuclear reaction.



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Topic 1 Short Answer Type Questions I

1. Two nuclei have mass numbers in the ratio 8 : 125. Calculate the ratio of their nuclear radii.



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2. Show that the density of nucleus over a wide range of nuclei is constant independent of mass number.



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3. Calculate the half-life period of a radioactive substance, if its activity drops to 16^{th} of its initial value in 30 years.



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Topic 1 Short Answer Type Questions Ii

1. Write the expression for the half life of a radioactive element.



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2. What are the characteristics of nuclear forces?



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3. A given number of atoms, N_0 of a radioactive element with a half life T is uniformly distributed in the blood stream of a

(i) Normal person A having total volume V of blood in the body.

(ii) Person B in need of blood transfusion having a volume V' of blood in the body.

The number of radioactive atoms per unit volume in the blood streams of the two persons after a time nT are found to be N_1 and N_2 .

Prove mathematically that the additional volume of blood that needs to be transfused in the body of person B equals $\left(\frac{N_2 - N_1}{N_2}\right)$

V.



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4. The half-life of ${}_{92}^{238}\text{U}$ undergoing α -decay is 4.5×10^9 years. What is the activity of 1g sample of ${}_{92}^{238}\text{U}$?



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5. State the law of radioactivity and hence,

show that $N = N_0 e^{-\lambda t}$.

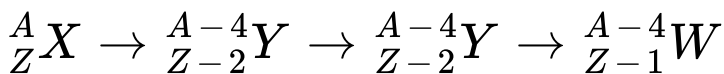


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6. (a) The number of nuclei of a given radioactive nucleus, at times $t = 0$ and $t = T$, are N_0 and (N_0/n) respectively. Obtain an expression for the half life ($T_{1/2}$) of this nucleus in terms of n and T .

(b) Identify the nature of the 'radioactive radiations', emitted in each step of the 'decay

chain' given below:



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7. State the law of radioactive decay.

Plot a graph showing the number (N) of undecayed nuclei as a function of time (t) for a given radioactive sample having half life $T_{1/2}$.

Depict in the plot, the number of undecayed nuclei at (i) $t = 3T_{1/2}$ and (ii) $t = 5T_{1/2}$.



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8. (a) Write symbolically the β -decay process of phosphorus.

(b) Derive an expression for the average life of a radionuclide. Give its relationship with the half-life.



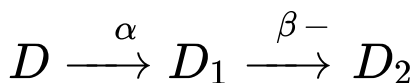
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9. (i) Define 'activity' of a radioactive material and write its S.I. unit.

(ii) Plot a graph showing variation of activity of

a given radioactive sample with time.

(iii) The sequence of stepwise decay of a radioactive nucleus is



If the atomic number and mass number of D_2 are 71 and 176 respectively, what are their corresponding values for D ?



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Topic 1 Long Answer Type Questions I

1. State the law of radioactivity and hence, show that $N = N_0 e^{-\lambda t}$.



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2. Write the expression for the half life of a radioactive element.



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3. (a) Define the terms (i) half-life ($T_{1/2}$) and (ii) average life (τ). Find out their relationships with the decay constant (λ).

(b) A radioactive nucleus has a decay constant, $\lambda = 0.3465 \text{ (day)}^{-1}$. How long would it take the nucleus to decay to 75% of its initial amount?



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Topic 1 Numerical Problems

1. Determine the mass of Na^{22} which has an activity of 5mCi. Half life of Na^{22} is 2.6 years. Avogadro number = 6.023×10^{23} atoms.



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2. A given coin has a mass of 3.0g . Calculate the nuclear energy that would be required to separate all the neutrons and protons from each other . For simplicity, assume that the coin is entirely made of ${}_{29}^{63}Cu$ atoms (of mass 62.92960 u)



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Topic 2 Very Short Answer Type Questions

1. What is meant by specific binding energy ?



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2. Write the relation for binding energy (BE)

(in MeV) of a nucleus of mass $\frac{A}{Z}M$, atomic

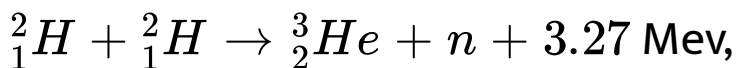
number (Z) and mass number (A) in terms of

the masses of its constituents - neutrons and protons.



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3. In a typical nuclear reaction, e.g.



although number of nucleons is conserved, yet energy is released. How ? Explain.



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4. What characteristic property of nuclear force explains the constancy of binding energy per nucleon (BE/A) in the range of mass number 'A' lying $30 < A < 170$?



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5. State any three features of nuclear force



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1. Draw a plot of BE/A versus mass number A for $2 \leq A \leq 170$. Use this graph to explain the release of energy in the process of nuclear fusion of two light nuclei.

OR

Using the curve for the binding energy per nucleon as a function of mass number A , state clearly how the release in energy in the processes of nuclear fission and nuclear fusion can be explained.

OR

Draw a plot of the binding energy per nucleon as a function of mass number for a large number of nuclei, $2 < A < 240$. How do you explain the constancy of binding energy per nucleon in the range $30 < A < 170$ using the property that nuclear force is short-ranged ?



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2. A heavy nucleus X of mass number 240 and binding energy per nucleon 7.6 MeV is split into two fragments Y and Z of mass numbers

110 and 130. The binding energy of nucleons in Y and Z is 8.5 Me V per nucleon. Calculate the energy Q released per fission in Me V.



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Topic 2 Short Answer Type Questions I

1. Define the terms (i) mass defect, (ii) binding energy for a nucleus and state the relation between the two.

For a given nuclear reaction, the B.E./nucleon

of the product nucleus/nuclei is more than that for the original nucleus/nuclei. Is this nuclear reaction exothermic or endothermic in nature? Justify your choice.



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2. Draw a plot of potential energy of a pair of nucleons as a function of their separations. Mark the regions where the nuclear force is (i) attractive and (ii) repulsive. Write any two characteristic features of nuclear forces.

OR

Draw a plot of potential energy of a pair of nucleons as a function of their separation.

Write two important conclusions which you can draw regarding the nature of nuclear forces.



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Topic 2 Long Answer Type Questions

1. Distinguish between nuclear fission and nuclear fusion.



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2. Show that $1 \text{ amu} = 932 \text{ MeV}$.



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Topic 2 Numerical Problems

1. The half life of ${}_{38}\text{Sr}^{90}$ isotope is 28 years.

What is the rate of disintegration of 15 mg of

this isotope? (Given Avogadro No

$$= 6.023 \times 10^{23})$$

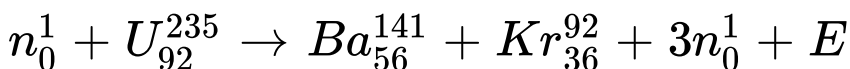


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2. A thermal neutron strikes U_{92}^{235} nucleus to

produce fission. The nuclear reaction is as

given below :



Calculate the energy released in MeV. Hence calculate the total energy released in the fission of 1 Kg of U_{92}^{235} .

Given mass of $U_{92}^{235} = 235.043933$ amu

Mass of neutron $n_0^1 = 1.008665$ amu

Mass of $Ba_{56}^{141} = 140.917700$ amu

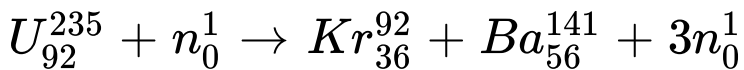
Mass of $Kr_{36}^{92} = 91.895400$ amu



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3. Calculate the energy released in the following nuclear reaction and hence calculate

the energy released when 235 gram of uranium-235 undergoes fission.



Rest masses of U^{235} , Ba^{141} , Kr^{92} and neutron are 235.04390 amu, 140.91390 amu, 91.89730 amu and 1.00867 amu respectively.

Avogadro number = 6.023×10^{23} .



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