PHYSICS

BOOKS - JEEVITH PUBLICATIONS PHYSICS (KANNADA ENGLISH)

NUCLEI

One Mark Questions With Answers

1. Mention Einstein's mass energy realation.

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2. Give the relation between amu and meV,

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3. What is the relation between the radius of a nucleus and mass number of the corresponding element ?

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4. What is meant by specific binding energy ?

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5. What is a nuclear reactor ?

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6. What is the meant by mass number ?

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7. Do nuclear forces obey the inverse square law ?

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8. What is mass defect ?

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9. On what factors does the stability of a nucleaus depend ?

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10. What is binding energy ?

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11. Why are nuclear forces called exchange forces?

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12. What is the nature of nuclears force?

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13. What are Nuclear forces ?

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14. What is the range of nuclear forces ?

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15. Mention the order of nuclear density.

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16. What is meant by nuclear fission ?

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17. What is the function of moderator in a nuclear reactor ?

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18. What is nuclear fusion ?

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19. Define critical size.

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20. What is the charge on neutrons?

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21. How many kg of mass of a substance make 1 amu?

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22. What is the function of a breeder reactor ?

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23. What is the function of cadmium rods in a nuclear reactor ?

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24. What are the two types of reactors ?

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25. What is radioactivity ?

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26. Who discovered radioactivity ?

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27. What is an α particle?

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28. What are β particles ?

Watch Video Solution

29. What are γ radiations

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30. A radioactive sample is placed in boiling water. Will its activity increase ?

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31. Can a powerful magnetic or electric field deflect γrays ?

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32. What is the velocity of γ radiations?

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33. Can a radioactive sample emit all types of radiations at the same time ?

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34. What is the charge of an α particle?

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35. Name radioactive radiations which undergo scattering .

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36. State the law of radiactive disintegration.

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37. Define 'half life' , 'decay constant and 'mean life'of a radioactive element and write the relation connecting them.

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38. What is a positron ?

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39. What is mean life of a radioactive element?

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40. Define curie.

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41. What is artificial radioactivity ?

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42. What are radioisotopes ?

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43. Mention the isotope used for dting ancient samples.

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44. Name any one isotope used in the field of medicine.

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

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46. What is the SI unit of activity?

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47. What is the relation between curie and becquerel ?

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48. Define half life of a radiactive element.

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49. Write the relative between mean life and decay constant.

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50. What is meant by activity of a sample?

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Two Marks Questions With Answers

1. What are atomic number and mass numbers ?

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2. What is nuclear mass ? How is it calculated ?

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3. Calculate the energy equivalent of 1kg of mass .

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4. Explain nuclear chain reaction.

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5. Explain nuclear binding energy.

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6. Give an example for exothermic and endothermic processes.

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7. Outline the method of converting non-fissible Uranium -238 into fissible Plutonium-239.

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8. Why do nuclear fusion reactions take place at a very high temperature?.

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9. What is an isotope? Give an axample ?

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10. What is an isobar ? Give an example.

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11. What is an isotone? Give an example .

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12. Draw the block diagram of a nuclear reactor .

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13. Mention any two methods of disposal of nuclear waste.

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14. Draw a neat labelled specific binding energy curve.

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Three Marks Questions With Answers

1. Show that 1 amu = $932 MeV$.

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2. Define amu and eV. Mention the relation between them.

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3. Name the different types of nuclear reactors.

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4. Explain the nuclear fusion reaction with an example.

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5. Distinguish between a controlled and an uncontrolled chain reaction.

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6. What is radioactivity ?

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7. Give any three properties of α -rays.

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8. Give any three properties of β- rays.

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9. Give any three properties of γ- radiations.

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10. Mention any three applications of radio isotopes.

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11. Give an example for β decay followed by γ-decay (gamma decay).

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12. Name the particle discovered in the process of β^+ and β^- decay with an example.

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13. What will be the position of the daughter nucleus in the periodic table, when β^+ and β^- decays take place? Give an example under each.

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14. Define and explain K-factor (multiplication factor) with respect to a nuclear fission chain reaction.

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15. Write the nuclear reaction equations for

(i) αdecay of $._{88}^{226}$ Ra (ii) β^{-} decay of $._{83}^{210}$ Bi

(iii) Electron capture of $._{54}^{120}$ Xe

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16. Define the average time period of a radio active element.

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17. Outline any three main features of specific binding energy curve.

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18. Outline any three main features of specific binding energy curve.

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Five Marks Questions With Answers

1. What are the characteristics of nuclear forces?

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2. Write a note nuclear fission chain reaction.

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3. Explain the nuclear fusion reaction with an example.

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4. Write a note on nuclear binding energy.

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5. Distinguish between nuclear fission and nuclear fusion.

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

A.

B.

C.

D.

Answer:

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7. Define 'half life' , 'decay constant and 'mean life'of a radioactive element and write the relation connecting them.

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8. Define half life of a radioactive element and deduce the expression for the same .

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9. Give a brief account on the application of radio isotopes.

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10. Explain the parts of a nuclear power reactor.

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Numericals With Solutions

1. 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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2. A radioactive sample has ,a half life of 10 days. What is its disintegration constant? What is its mean life?

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3. The decay contsnt of a radioactive substance is at the rate of 0.05 per hour. Calculate its half life and mean life .

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4. A radioactive sample of half life $T_{\frac{1}{2}}$ contains 1000 nuclei. How many members will be left after a time $t = (T/8)$?

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5. A radioactive element has a half life of 20 days . What amount would be left after 80 days , if the original amount was 8 g?

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6. Radioactive element has a half life of 25 minutes. Calculate the fraction of element that has decayed in 60 minutes.

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7. Find the activity of 1 gm of radium $\left({}_{88}Ra^{226}\right)$ Whose half life is 1620 years.

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8. A radioactive sample has a half life of 30 minute. How long will it take for $\frac{5}{6}th$ of the sample to disintegrate?

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9. Calculate the time reuired for $40\,\%$ of a radioactive sample to disintegrate. Half life of the sample is 1.6×10^{10} years.

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10. A certain radioactive sample decays for a time period equal to its mean life . Find (i) the fraction of the sample that disintegrates and (ii) the fraction of the sample that remains intact.

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11. Calculate the specific binding energy of the nucleus of $._{7}^{14}N$. Given the rest mass of nucleus of $._{7}^{14}N = 14.00307$u, the rest mass of proton =1.00783 u and the rest mass of neutron=1.00867 u.

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12. Determine the mass of 10 k Ci sample of $._{11}Na^{24}$ Whose half life is 20 hours.

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

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14. A radio active isotope has a half - life of 'T' years. How long will it take the activity to

reduce to (a) $3.125\,\%$ (b) $1\,\%$ of the original value.

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15. The radio nuclide $.^{11}C$ decays according to $._{6}^{11}C \rightarrow {}_{5}^{11}B + e^{+} + v$. The maximum energy of the emitted positron is 0.960 MeV. Given, the rest mass of $c - 11 = 11.011434$ u and rest mass of $B - 11 = 11.009304$ u, calculate 'Q' and compare it with the maximum energy of the positron emitted.

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16. How long can an electric lamp of 100W be kept glowing by fusion of 2.0 kg of deuterium? Take the fusion reaction as

$${}_1^2H + {}_1^2H \rightarrow {}_2^3He + n + 3.27MeV.$$

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17. Estimate the order of nuclear density.

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18. A souree contains two phosphorus radio nuclides $._{15}^{33}P\left(T_{1/2}=14.3d\right)$ and $._{15}^{32}P\left(T_{1/2}=25.3d\right)$. Initially, $10\,\%$ of the decays come from $._{15}^{33}P$. How long must one wait unit $90\,\%$ do so ?

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19. Obtain the maximum kinetic energy of β-particle and the radiation frequencies corresponding to $\gamma-$ decays in the figure

given below. (rest mass of au -198.968233 u and r.m. of Hg=198=197.966760 u)

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20. Activity of a certain radioactive sample is 25 μCi at the end of 20 days and 6.25 μCi at the end of 40 days. What will be its activity at the end of 30 days?

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21. Suppose India has a target of producing by 2020AD, 200 GW of electric power, ten precent of which is to be obtained from nuclear power plants. Suppose the efficiency remained at $25\,\%$, what amount of fuel may be required per year by 2020? Take the heat energy per fission of $.^{235}U$ to be about 200 MeV.

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22. Consider the D–T reaction (deuterium–tritium fusion)

$${}_1^2H + {}_1^3H \rightarrow {}_2^4He + n$$

(a) Calculate the energy released in MeV in this reaction from the data:

$$m\left({}_1^2H\right) = 2.014102u$$

$$m\left({}_1^3H\right) = 3.016049u$$

(b) Consider the radius of both deuterium and tritium to be pproximately 2.0 fm. What is the kinetic energy needed to overcome the coulomb repulsion between the two nuclei? To what temperature must the gas be heated to

initiate the reaction? (Hint: Kinetic energy required for one fusion event =average thermal kinetic energy available with the interacting particles = 2(3kT/2), k = Boltzman's constant, T = absolute temperature.)

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23. Consider the D-T reaction (fusion of deuterium - tritium) ${}_1^2H + {}_1^3H \rightarrow {}_2^4He + n$

(a) Calculate the energy released in MeV in this reaction from the data:

$m\left(._1^2 H\right) = 2.014102u, m\left(._2^4 He\right) = 4.002604u$

$m\left(._1^3 H\right) = 3.0016040u, m(n) = 1.00867u$

(b) Consider the radius of both deuterium and tritiumto be approximately 2.0fm. What is the kinetic energy needed to overcome the coulomb repulsion between that two nuclie? To what temperature must the gas be heated to initate the reaction ?

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24. Calculate the energy required to separate a neutron (neutron separation energy) from the nucleus $._{20}^{41}Ca.$ Given r.m. of $._{20}^{41}Ca = 40.962278U,$ r.m of $._{20}^{40}Ca = 39.962591U,$ r.m. of $.^{1}n = 1.00867U.$

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25. Show that $N = \frac{N_0}{2^n}$ where n = number of half lives n=t/T

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26. From the relation $R = R_0 A^{1/3}$, where $'R_0'$ is a constant and 'A' is the mass number of a nucleus, show that the nuclear matter density is nearly constant.

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