RAVI TEST PAPERS & NOTES, WHATSAPP 8056206308

13. Nuclei previously asked

12th Standard

Physics

Multiple Choice Question 7 x 1 = 7

1) In the nuclear decay given below
$_ZX^A \longrightarrow_{Z+1} Y^A \longrightarrow_{Z-1} B*^{A-4} \longrightarrow_{Z-1} B^{A-4}$
The particles emitted in the sequence are :

(a) α, β, γ (b) β, α, γ (c) γ, β, α (d) β, γ, α

2) The activity of a radioactive sample is measured as N_0 counts per minute at t = 0 and N_0/e counts per minute at t = 5 minutes. The time (in minutes) at which the activity reduces to half its value is.

(a) $\log_e 2/5$ (b) $\frac{5}{\log_e 2}$ (c) $5\log_{10} 2$ (d) $5\log_e 2$

3) The radius (r_n) of n^{th} orbit in Bohr model of hydrogen atom varies with n as

(a) $r_n \propto n$ (b) $r_n \propto \frac{1}{n}$ (c) $r_n \propto n^2$ (d) $r_n \propto \frac{1}{n^2}$

4) The ratio of the nuclear densities of two nuclei having mass numbers 64 and 125 is

(a) $\frac{64}{125}$ (b) $\frac{4}{5}$ (c) $\frac{5}{4}$ (d) 1

5) The curve of binding energy per nucleon as a function of atomic mass number has a sharp peak for helium nucleus. This implies that helium nucleus is

(a) radioactive (b) unstable (c) easily fissionable (d) more stable nucleus than its neighbours

6) The formation of depletion region in a p-n junction diode is due to

(a) movement of dopant atoms (b) diffusion of the electrons and holes (c) drift of electrons only

(d) drift of holes only

7) Which of the following statements about nuclear forces is not true?

(a) The nuclear force between two nucleons falls rapidly to zero as their distance is more than a few femtometres.

(b) The nuclear force is much weaker than the Coulomb force.

(c) The force is attractive for distances larger than 0.8 fm and repulsive if they are separated by distances less than 0.8 fm

(d) The nuclear force between neutron-neutron,proton-neutron and proton-proton is approximately the same.

2 Marks 38 x 2 = 76

8) Why is nuclear density same for all nuclei?

9) State two characteristic properties of nuclear forces.

10) Two nuclei have mass numbers on the radio 1:8.What is the ratio of their nuclear radii?

11) The binding energies of deutron ($_1H^2$) and α- particle ($_2He^4$) are 1.25 and 7.2 MeV/nucleon respectively. Which nucleus is more stable?

12) Identify the nuclides X and Y in the nuclear reactions $_5\beta^{11} +_1 H^1 \rightarrow_4 Be^8 + X$;
$_6C^{14} \rightarrow Y +_{-1} e^0$.

13) The mean life of a radioactive sample is T_m. What is the time in which 50% of the sample would get decayed?

14) Out of alpha, beta and gamma radiations, which are affected by electric field and magnetic field?

15) A nucleus $_{92}U^{235}$ undergoes alpha decay and transforms into thorium. What is mass number and charge number of nucleus produced?

16) Name the process responsible for energy production in the sun.

17) What is the effect on neutron to proton ratio in a nucleus when (i) an electron, (ii) a positron is emitted?

18) If the nucleons bound in a nucleus are separated apart from each other, the sum of their masses is greater than the mass of the nucleus. Where does this mass difference come from? Explain briefly.

19) Show that the decay rate R of a sample of radionuclide is related to the number of radioactive nuclei N at the same instant by the expression $R = \lambda N$.

20) Write symbolically the nuclear β^+ decay process of ${}_6C^{11}$. Is the decayed product X an isotope or isobar of ${}_6C^{11}$? Given the mass values of $({}_6C^{11})$
11.011434 u and m(X) = 11.009305 u. Estimate the Q value in the process.

21) Draw a plot of potential energy between a pair of nucleons as a function of their separation. Mark the regions where potential energy is (i) positive and (ii) negative.

22) In accordance with the Bohr's model, find the quantum number that characterises in the earth's revolution around the sun in an orbit of radius 1.5×10^{11}m with orbital speed 3×10^{4}m/s. (Mass of the earth = 6×10^{24} Kg)

23) Calculate the half-life period of a radioactive substances,if its activity drops to $\frac{1}{16}$ th of its initial value in 30 years

24) What characteristic property of nuclear force explain the constancy of binding energy per nucleon (BE/A) in the range of mass number 'A' lying 30

25) Draw a plot of BE/A versus mass number A for Use this graph to explain the release of enegry in the process of nuclear fusion of two light nuclei.

26) Two nuclei have mass numbers in the ratio 8: 125. What is the ratio of their nuclear radii?

27) Complete the following nuclear reactions.
$^{10}_{5}B + ^{1}_{0}n \rightarrow ^{4}_{2}He + ...$
$^{94}_{42}Mo + ^{2}_{1}H \rightarrow ^{95}_{43}Te + ...$

28) How the size of a nucleus is experimentally determined? Write the relation between the radius and mass number of the nucleus. Show that the density of nucleus is independent of its mass number.

29) Calculate the energy in fusion reaction
$^{2}_{1}H + ^{2}_{1}H \longrightarrow ^{3}_{2}He + n$, where BE of $^{2}_{1}H = 2.23$ MeV and of $^{3}_{2}He$ = 7.73 MeV.

30) The mass of a nucleus in its ground state is always less than the total mass of its constituents neutrons and protons. Explain.
Plot a graph showing the variation of potential energy of a pair of nucleons as a function of their separation.

31) Draw a graph showing the variation of potential energy of a pair of nucleons as a function of their separation. Indicate the region in which the nuclear force is (i) attractive and (ii) repulsive.

32) (i) Write three characteristic properties of nuclear force.
(ii) Draw a plot of potential energy of a pair of nucleons as a function of their separation. Write two important conclusions that can be drawn from the graph.

33) The following table shows some measurements of the decay rate of a radio nuclei sample. Find the disintegration constant.

TIME(MIN)	**INR (BQ)**
36	5.08
100	3.29
164	1.52
218	1.00

34) The activity R of an unknow nuclide is measured at hourly intervals. The results found are tabulated as follows:

T(H)	0	1	2	3	4
R(MBQ)	100	35.36	12.51	1.56	1.56

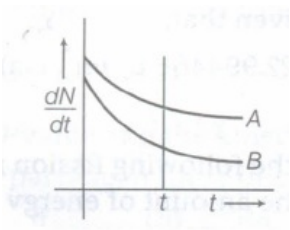
35) Explain the processes of nuclear fission and nuclear fusion by using the plot of binding energy per nucleon (BE/ A) versus the mass number A.

36) A heavy nucleus X of mass number 240 and binding energy per nucleon 7.6MeV is splitted, into two fragments Y and Z of mass numbers 110 and 130 .The binding energy of nucleons in Y and Z is 8.5MeV per nucleon. Calculate the energy released per fission in MeV.

37) Anuclide 1is said to be the mirror isobar of nuclide 2, if $Z_1 = N_2$ and $Z_2 = N_1$
(i) What nuclide is a mirror isobar of $^{23}_{11}\mathrm{Na}$?
(ii) Which nuclide out of the two mirror isobars have greater binding energy and why?

38) Why a-particles have high ionising power?

39) Which sample A or B shown in the figure, has shorter mean-life?



40) Aradioactive isotope has a half-life of 10 yr. How long will it take for the activity to reduce to 3.125%?

41) Define the term "activity" of a radio nuclide. Write its SI unit.

42) How is the mean life of a radioactive sample related to its half-life?

43) (a) Write the β-decay of tritium in symbolic form.
(b) Why is it experimentally found difficult to detect neutrinos in this process?

44) A nucleus $^{238}_{92}\mathrm{U}$ undergoes alpha-decay and transforms to thorium. What is
(i) the mass number, and
(ii) atomic number of the nucleus produced?

45) What is the nuclear radius of $^{125}\mathrm{Fe}$, if that of $^{27}\mathrm{Al}$ is 3.6 fm ?

3 Marks 25 x 3 = 75

46) From the relation $R = R_0A^{1/3}$, where R_0 is a constant and A is the mass number of a nucleus, show that the nuclear matter density is nearly constant (i.e. independent of A).

47) An isotope of $_{92}U^{238}$decays successively to form $_{90}Th^{234}$,$_{91}Pa^{234}$,$_{92}U^{234}$,$_{90}Th^{230}$ and $_{88}Ra^{226}$What are the radiations emitted in these five steps?

48) find the quantum number n corresponding to the excited state of He^+ ion, if on transition to the ground state that ion emits two photons in succession with wavelength 1026.7 $\mathring{A}$ and 304$\mathring{A}$ (Take, R = 1.097 $\times$ 10^7per m)

49) Write symbolically the process expressing the β^+ decay of $^{22}_{11}Na$. Also write the basic nuclear process underlying this decay.

50) Identify the nature of the 'radioactive radiations', emitted in each step
of the 'decay chain' given below:
$^{A}_{Z}X \rightarrow^{A-4}_{Z-2} Y \rightarrow^{A-4}_{Z-2} Y \rightarrow^{A-4}_{Z-1} W$

51) (a) Write symbolically the β^- decay process of phosphorus.
(b) Derive an expression for the average life of a radio-nuclide. Give its relationship with the half life.

52) In a Geiger-Marsden experiment, calculate the distance of the closest approach to the nucleus of Z = 80, when an α-particle of 8 MeV energy impinges on it comes momentarily to rest and reverses its direction.
How will the distance of the closest approach be affected when the kinetic energy of the α- particle is doubled?

53) (i) Write the basic nuclear process involved in the emission of β^+ in a symbolic form by a radioactive nucleus.
(ii) In the reactions given below:
(a) $^{11}_{6}C \rightarrow^{z}_{y} B + x + v$
(b) $^{12}_{6}C \rightarrow^{12}_{6} C +^{20}_{6} Ne +^{c}_{b} He$
Find the values of x,y and z and a,b and c.

54) Complete the following nuclear reactions:

(a) $^{208}_{84}Po \rightarrow ^{204}_{82}Pb + \ldots\ldots$

(b) $^{32}_{15}P ^{32}_{16}S + \ldots\ldots\ldots$

(ii) Write the basic process involved in nuclei responsible for (a) ß$^-$ and (b) ß$^+$ - decay.

(iii) Why is it found experimentally difficult to detect neutrinos?

55) An observer in a laboratory starts with N_0 nuclei of a radioactive sample and keep on observing the number (N) of left over nuclei at regular intervals of 10 min each. She prepares the following table on the basis of her observation.

Time t (in min)	$log_e\left(\frac{N_0}{N}\right)$
0	0
10	3.465
20	6.930
30	10.395
40	13.860

Use this data to plot a graph. of $\log_e(N_0/N)$ versus time (t) and calculate the decay constant and half-life of the given sample.

56) Explain giving necessary reactions, how energy is released during

(i) fission

(ii) fusion

57) Obtain the relation $N = N_0e^{-\lambda t}$ for a sample of radioactive material having decay constant λ, where N is the number of nuclei present at instant t. Hence obtain the relation between decay constant λ and half life $T_{1/2}$ of the sample.

58) 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.

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

60) Answer the following.

(i) Why is the binding energy per nucleon found to be constant for nuclei in the range of mass number (A) lying between 30 and 170?

(ii) When a heavy nucleus with mass number A = 240 breaks into two nuclei, A = 120, energy is released in the process.

61) In the study of Geiger-Marsdon experiment on scattering of α-particles by a thin foil of gold, draw the trajectory of α-particles in the Coulomb field of target nucleus. Explain briefly how one gets the information on the size of the nucleus from this study. From the relation $R = R_0 A^{1/3}$ where Ro is constant and A is the mass number of the nucleus, show that nuclear matter density is independent of A.

62) (ii) (a) Write symbolically the process expressing the β- decay of $^{22}_{11}\mathrm{Na}$. Also, write the basic nuclear process underlying this decay.

(b) Is the nucleus formed in the decay of the nucleus $^{22}_{11}\mathrm{Na}$,an isotope or isobar?

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

(ii) Write the basic nuclear process underlying β$^-$ - decay of a given radioactive nucleus

64) (i) Write the basic nuclear process involved in the emission of β$^+$ in a symbolic form by a radioactive nucleus.

(ii) In the reactions given below:

(a) $^{11}_{6}\mathrm{C} \rightarrow ^{z}_{y}\mathrm{B} + x + \mathrm{v}$

(b) $^{12}_{6}\mathrm{C} \rightarrow ^{12}_{6}\mathrm{C} + ^{20}_{a}\mathrm{Ne} + ^{c}_{b}\mathrm{He}$

Find the values of x, y and z and a, band c

65) (a) State the law of radioactive decay. Write the SI unit of 'activity'.

(b) There are $4\sqrt{2} \times 10^6$ radioactive nuclei in a given radioactive sample. If the half life of the sample is 20 s, how many nuclei will decay in 10 s?

66) (a) Write the process of β-decay. How can radioactive nuclei emit β-particles even though they do not contain them? Why do all electrons emitted during β-decay not have the same energy?
(b) A heavy nucleus splits into two lighter nuclei. Which one of the two - parent nucleus or the daughter nuclei has more binding energy per nucleon?

67) (a) What is meant by half-life of a radioactive element?
(b) The half-life of a radioactive substance is 30 s.
Calculate
(i) the decay constant, and
(ii) time taken for the sample to decay by 3/4th of the initial value.

68) A radioactive sample can decay by two different processes. The half-life for the first process is T_1 and that for the second process is T_2. Show that the effective half-life T of the nucleus is given by
$\frac{1}{T} = \frac{1}{T_1} + \frac{1}{T_2}$

69) In a given sample, two radioisotopes, A and B, are initially present in the ratio 1 : 4. The half-lives of A and B are respectively 100 years and 50 years. Find the time after which the amounts of A and B become equal.

70) (i) Differentiate between nuclear fission and nuclear fusion.
(ii) Deuterium undergoes fusion as per the reaction
$_1^2\mathrm{H} + {}_1^2\mathrm{H} \longrightarrow {}_2^3\mathrm{He} + {}_0^1n + 3.27\mathrm{MeV}$
Find the duration for which an electric bulb of 500 W can be kept glowing by the fusion of 100 g of deuterium.

5 Marks 9 x 5 = 45

71) Calculate the B.E/nucleon of $_{17}Cl^{35}$ the nucleus. Given that mass of proton = 1.007825 u, mass of neutron = 1.008665 u, mass of $_{17}Cl^{35}$ = 34.980000 u; 1 u = 931 MeV.

72) Calculate the binding energy per nucleon of $_{20}Ca^{40}$ the nucleus. Given $m(_{20}Ca^{40}) = 39.962589\ u; m_n = 1.008665u;$
$m_p = 1.007825\ u$
$Take\ 1a.m.u. = 931\ MeV$

73) Calculate binding energy per nucleon of $_{83}Bi^{209}$ Given that
$m_p = 1.00727\ amu,\ m_n = 1.00866\ amu,$
$m(_{83}Bi^{209}) = 208.980388\ amu$
$m(neutron) = 1.008665\ amu$
$m(proton) = 1.007825\ amu$

74) A radioactive material is reduced to $\frac{1}{16}$ of its original amount in 4days. How much material should one begin with so that $4 \times 10^{-3}\,kg$ of the material is left over after 6 days?

75) For the past some time.Arti has been observing some erratic body movement, unsteadiness and lack of aoordination in the activities of hersister Radha, who also used to complain of serve headache occasionally.Aarti suggested to her parents to get a medical check-up of Radha. The doctor throughly examined Radha and diagnosed that she has a brain tumour
(a) What,according to you,are the value displayed by Arti?
(b) How can radioisotopes help a doctor to diagnose brain tumour?

76) Define the Q-value of a nuclear process. When can a nuclear process not proceed spontaneously? If both the number of protons and the number of neutrons are conserved in a nuclear reaction in what way is mass converted into energy (or vice-versa) in the nuclear reaction?

77) Asha's mother read an article in the newspaper about a disaster that took place at Chernobyl. She could not understand much from the article and asked a few questions from Asha regarding the article.
Asha tried to answer her mother's questions based on what she learnt in Class XII Physics?

78) A heavy nucleus P of mass number 240 and binding energy 7.6 MeV per nucleon splits in to two nuclei Q and R of mass numbers 110, 130 and binding energy per nucleon 8.5 MeV and 8.4 MeV, respectively. Calculate the energy released in the fission.

79) Calculate for how many years will the fusion of 2.0 kg deuterium keep 800 W electric lamp glowing. Take the fusion reaction as $_1^2\mathrm{H} + {}_1^2\mathrm{H} \longrightarrow {}_2^3\mathrm{He} + {}_0^1n + 3.27\mathrm{MeV}$

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