Total Page → 5 PHE-05SE1, Nuclear and Particle Physics

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2020

Time : 3 hours UDHB (I)
Full marks : 70 05E 1

Group A
(compulsory)

1. Answer the following multiple choice question $2 \times 10 = 20$

(i) The mean momentum of a nucleon in a nucleus with mass number A varies as
(a) A (b) $A^{-1/3}$ (c) A^2 (d) $A^{1/3}$

Ans → (b) $A^{-1/3}$

(ii) If the nuclear radius of ^{27}Al is 3.6 fm, then the approximate nuclear radius of ^{64}Cu in fermi is
(a) 4.8 (b) 3.6 (c) 1.2 (d) 2.4

Ans (a) 4.8

(iii) According to semi empirical mass formula. what is the approximate average binding energy per nucleon (B/A) ?
(a) 16 MeV (b) 8 MeV (c) 4 MeV (d) 2 MeV

Ans → (b) 8 MeV

(iv) According to shell model of nucleus which is incorrect.
(a) magic number exist
(b) Nucleons interact with their nearest neighbour only.

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(c) Nucleons in a nucleus interact with a general force field

(d) None of these

Ans → (b) Nucleons interact with their nearest neighbours only

(v) The nuclear reaction

$4_1H^1 \longrightarrow 2He^4 + 2_{-1}e^0 + 26$ Mev represents

(a) fusion (b) fission (c) β decay (d) γ decay

Ans (a) fusion

(vi) Typical energies released in nuclear fission and a nuclear fusion reaction are

(a) 50 Mev and 1000 Mev
(b) 300 Mev and 1000 Mev
(c) 1000 Mev and 50 Mev
(d) 200 Mev and 10 Mev

Ans → (d) 200 Mev and 10 Mev

(vii) The strangeness quantum number is conserved in

(a) strong, weak and electromagnetic interaction
(b) weak and electromagnetic interaction
(c) strong and weak interaction
(d) strong and electromagnetic interaction

Ans → strong and electromagnetic interaction

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(viii) The Beta decay of neutron is explictly given by
(a) $n \rightarrow p + e$ (b) $n \rightarrow p + e + \nu_e$
(c) $n \rightarrow p + e + \bar{\nu}_e$ (d) $n \rightarrow p + e + \gamma$

Ans (c) $n \rightarrow p + e + \bar{\nu}_e$

(ix) which of the following is not a type of Radiation detector.
(a) Geiger - Muller counter
(b) Proportional counter
(c) Semiconductor detector
(d) Flame emission detector

Ans (d) Flame emission detector

(x) The spin and parity of ${}_4Be^9$ nucleus as Predicted by shell model are
(a) $\frac{3}{2}$ and odd (b) $\frac{1}{2}$ and odd (c) $\frac{3}{2}$ and even
(d) $\frac{1}{2}$ and even

Ans → (a) $\frac{3}{2}$ and odd

Group B

Write any four short answer type question $5 \times 4 = 20$

2. What are the constituents of nucleus ? write their ~~intrinsic~~ intrinsic properties.

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3. write down the basic assumption of liquid drop model.

4. Discuss Geiger Nuttall law

5. write the conservations laws of nuclear reaction

6. what is pair production? Give eg

7. Give the symbol, mass, charge, spin and anti particle for pions

8. Estimate the pulse height and current in Ionisation chamber

9. what are cerenkov radiation

Group C

Answer any two from the following questions $15 \times 2 = 30$

10. Derive semi empirical mass formula and write the significance of various terms

11. what is compton effect? Derive an expression for compton shift. what is compton wavelength

12. Discuss in detail the construction and working of a GM counter. What is dead and recovery time?

13. Describe briefly the following intrinsic quantum numbers in connection with elementary particles:

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(i) charge quantum number (ii) lepton number
(iii) multiplet number (iv) Baryon number
(v) ISO spin quantum number.
Explain with appropriate examples.