

6 SEM TDC PHY M 3

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(May)

PHYSICS

(Major)

Course : 603

(**Nuclear Physics**)

Full Marks : 60

Pass Marks : 24

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct answer from the following : 1×5=5

(a) Isobar of nucleus ${}^A_Z X_N$ is a nucleus with

- (i) same Z but different N
- (ii) same N but different Z
- (iii) same A but different Z
- (iv) same A but different N

(b) The pairing term in semiempirical mass formula is

- (i) zero for odd-odd nuclei
- (ii) positive for odd-even nuclei
- (iii) negative for odd-odd nuclei
- (iv) zero for even-odd nuclei

(c) Nuclear force is not

- (i) charge symmetric and charge independent
- (ii) long range
- (iii) attractive
- (iv) saturative

(d) Which of the following is (α, n) reaction?

- (i) ${}^{10}_5\text{B} + {}^4_2\text{He} \rightarrow {}^{13}_6\text{C} + {}^1_1\text{H}$
- (ii) ${}^9_4\text{Be} + {}^1_1\text{H} \rightarrow {}^6_3\text{Li} + {}^4_2\text{He}$
- (iii) ${}^7_3\text{Li} + {}^4_2\text{He} \rightarrow {}^{10}_5\text{B} + {}^1_0n$
- (iv) ${}^{11}_5\text{B} + {}^1_1\text{H} \rightarrow {}^{11}_6\text{C} + {}^1_0n$

(e) Which of the following is not an elementary particle?

- (i) Electron
- (ii) Proton
- (iii) Quark
- (iv) Neutrino

2. Answer any *five* of the following questions :

2×5=10

- (a) Why do neutrons exceed protons in heavy nuclei?
- (b) What is isospin? How is it different from spin?
- (c) Write and sketch the form of potential used in nuclear shell model.
- (d) Define nuclear reaction cross section. What is its unit?
- (e) Write down the possible nuclear reactions for the following :
 - (i) $\alpha + {}^9_4\text{Be}$
 - (ii) $\gamma + {}^2_1\text{H}$
- (f) What are quarks? Write their different types.

3. What is nuclear magnetic moment? What is its unit? How is it different from atomic magnetic moment?

2+1+2=5

4. Define nuclear binding energy. How does it depend on mass number of a nucleus? Find the energy release, if two ${}^2\text{H}$ nuclei fuse together to form ${}^4\text{He}$ nucleus.
[Hint : The binding energy per nucleon of ${}^2\text{H}$ and ${}^4\text{He}$ are 1.1 MeV and 7.0 MeV, respectively.] 1+1+3=5

5. Discuss the properties of nuclear force. 5

Or

Deduce the various terms in Bethe-Weizsäcker semiempirical nuclear mass formula. 5

6. Define nuclear fission. Calculate the amount of energy released in burning 1 kg of ${}_{92}^{238}\text{U}$.
[Hint : Consider fission energy per ${}_{92}^{238}\text{U}$ to be 200 MeV.] 2+3=5

7. Classify the elementary particles on the basis of their spins. 5

8. What is Q value of a nuclear reaction? Obtain a general expression for it. 2+4=6

9. What are cosmic rays? Who discovered it? Write the compositions of primary and secondary cosmic rays. $2+1+4=7$
10. What are nuclear accelerators? Explain briefly the principle, construction and working of any one of the nuclear reactors. $2+5=7$
