

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-even 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) ${}_{5}^{10}\text{B} + {}_{2}^{4}\text{He} \rightarrow {}_{6}^{13}\text{C} + {}_{1}^{1}\text{H}$
- (ii) ${}_{4}^{9}\text{Be} + {}_{1}^{1}\text{H} \rightarrow {}_{3}^{6}\text{Li} + {}_{2}^{4}\text{He}$
- (iii) ${}_{3}^{7}\text{Li} + {}_{2}^{4}\text{He} \rightarrow {}_{5}^{10}\text{B} + {}_{0}^{1}n$
- (iv) ${}_{5}^{11}\text{B} + {}_{1}^{1}\text{H} \rightarrow {}_{6}^{11}\text{C} + {}_{0}^{1}n$

(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

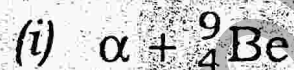
(a) Why do neutrons exceed protons in heavy nuclei?

(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 :



(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-Weizäcker 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. $2+5=7$
