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6 SEM TDC PHY M 3

2019

(May)

PHYSICS

(Major)

Course : 603

(Nuclear Physics)

Full Marks : 60

Pass Marks : 24/18

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer from the following (any *five*) : 1×5=5

(a) Packing fraction

(i) is always positive

(ii) is always negative

(iii) is zero

(iv) may be zero or positive or negative

(b) In the process of fission, the binding energy per nucleon

(i) increases

(ii) decreases

(iii) remains constant

(iv) increases for mass number $A < 56$ but decreases for $A > 56$ nuclei

(c) The mass defect in the nucleus of helium is 0·03030 a.m.u. What is the binding energy per nucleon for helium in MeV?

(i) 28

(ii) 7

(iii) 4

(iv) 1

(Continued

(d) Consider the decay, $\mu^- \rightarrow e^- + \bar{\nu}$. This decay is forbidden because of law of conservation of

(i) energy and momentum

(ii) baryon number

(iii) angular momentum

(iv) lepton number

(e) In the nuclear reaction given by

$$_2He^4 + _7N^{14} \rightarrow X + _1H^1$$

the nucleus X is

(i) $_8N^{16}$

(ii) $_8N^{17}$

(iii) $_8O^{16}$

(iv) $_8O^{17}$

(Turn Over)

(f) The quark composition of proton particle is

(i) uud

(ii) ddu

(iii) $u\bar{d}$

(iv) udd

2. Answer any *five* of the following : $2\times5=10$

(a) The binding energy per nucleon for C^{12} is 7·68 MeV and that of C^{13} is 7·47 MeV. Calculate the energy required to remove a neutron from C^{13}.

(b) Explain the concept of parity of nuclear physics.

(c) How will you explain the stability of nucleus on the basis of different forces associated to it?

(d) Write two characteristic features of nuclear force which distinguish it from Coulomb force.

(Continued)

(e) Discuss the limitations of a cyclotron.

(f) Distinguish between primary and secondary cosmic rays.

3. (a) Which is the correct composition of nucleus from electron-proton and neutron-proton? Justify your answer. 1+4=5

(b) What is meant by nuclear magnetic moment? Derive an expression for it. 1+3=4

Or

Calculate the binding energy and packing fraction for helium. The atomic masses of proton, neutron and helium are 1·00814 u, 1·00898 u, 4·00387 u and 1u = 931 MeV. 4

4. Explain the various terms in the semiempirical mass formula. 4

5. (a) State the principle of linear accelerator. Describe its construction and working. 1+5=6

(Turn Over)

Or

Deuterons in a cyclotron describe a circle of radius 0·32 m just before emerging from the dees. The a.c. voltage applied to the dees is 2×10^4 volt at 10 MHz. Find—

(i) the velocity of deuterons;

(ii) the magnetic field;

(iii) the energy of deuterons in MeV. 2+2+2=6

(b) Define the threshold energy of a nuclear reaction. Derive an expression for the Q-value for a reaction. 2+3=5

Or

Discuss the important cycles for production of energy in stars. 5

(c) Calculate the binding energy per nucleon of $_{28}Ni^{64} = 63 \cdot 9280$ amu.

Mass of hydrogen atom

$(M_H) = 1 \cdot 007825$ amu

(Continued)

Mas of neutron

$(M_n) = 1 \cdot 008665$ amu

Mass of electron

$(M_e) = 0 \cdot 00055$ amu 5

6. What are elementary particles? How are the elementary particles classified on the basis of their spin and interaction? 2+5=7

7. Write short notes on any *three* of the following : 3×3=9

(a) Nuclear disintegration energy

(b) Induced radioactivity

(c) Shell model of nucleus

(d) Bosons

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