2020

PHYSICS (Honours)

Paper Code : IX

[Old Syllabus]

Full Marks : 90   Time : Four Hours

The figures in the margin indicate full marks.

Answer question no. 1 and any *five* from the rest, taking at least *one*
from each group but not more than *two* from any group.

1. (a) In the decay process of muon $\mu^- \rightarrow e^- + v_\mu + \hat{v}_e$. Two neutrinos are emitted explain why?   3

    (b) Three fermions each of mass m(identical particles), are confined in a one dimensional potential box $V(x) = 0, 0 < x < l$ (l = width of the box). Calculate the energy of the system at ground state.   3

    (c) Illustrate the origin of the fine structure in α-decay.   3

    (d) The operator $\left(\dfrac{d}{dx} + x\right)$ has an eigen value 'α' with respect to an eigen function ψ. Find ψ, given $\psi = \psi_0$ at $x = 0$.   3

    (e) Find the values of L, S, J and multiplicity of the atomic term $^3P_2$.   3

Group - A

(Atomic Physics)

2. State and explain Moseley's law for X-rays. State and prove Ehrenfest's theorem.
                                                                                        6+9

3. (a) Describe Millikan's oil drop method of measuring the electronic charge. What correction did Millikan apply to Stoke's formula?   7+3

    (b) Sketch the schematic energy level diagram to show the allowed transitions from the state $^2P_{\frac{3}{2}}$ to $^2s_{\frac{1}{2}}$ state of Sodium atom under anomalous Zeeman effect.   5

4. Describe Thomson's method for the determination of $\frac{e}{m}$ of an electron. What are the drawbacks of the method? 10+5

Group - B

(Quantum Mechanics)

5. Write down the time-dependent Schrödinger wave equation for a particle. Hence obtain steady-state Schr.dinger wave equation, mentioning the necessary condition. 4+11

6. A particle is confined in a one dimensional box with infinitely hard walls. Find the energy eigenvalues and normalized wave functions. 9+6

7. Define photoelectric effect. Mention the characteristic features of photo electric effect.Write down Einstein's photoelectric equation and explain the above-mentioned characteristic features. 3+(6+6)

Group - C

(Nuclear and Elementary Particle Physics)

8. Explain nuclear fission on the basis of the liquid drop model. A nucleus with A = 235 splits into two fragments with mass numbers in the ratio 3 : 2. Taking r_0 = 1.4F, what is the separation between the fragments at the moment of splitting? 8+7

9. Discuss the theory of successive disintegration of radioactive substance. What are leptons and hadrons? Give the quark structure of a neutron. 9+(4+2)

10. Discuss the construction, working and theory of Betatron. 15

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