Sr. No. 322405

May 2023

B.Sc. (H) Chemistry Semester-IV

Nuclear and Particle Physics (OPHY-401)

Time: 3 Hours **Max. Marks:75**

Instructions:

1. *It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.*
2. *Answer any four questions from Part -B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*
4. *Use of non-programmable simple calculator is allowed.*

		PART -A	
Q1	(a)	Find the mass number of the nucleus if its radius is 3.6 fm. (Given r_o = 1.2 fm).	(1.5)
	(b)	Explain the main features of neutron number versus the mass number (N/A) curve.	(1.5)
	(c)	Why magic numbered nuclei are more stable than their neighboring nuclides.	(1.5)
	(d)	What is energy equivalent of 1 amu?	(1.5)
	(e)	By what process is $^{15}_{8}O$ likely to decay? Write the reaction.	(1.5)
	(f)	What is 'Q' value of a reaction? What do positive and negative Q values indicate?	(1.5)
	(g)	Explain how energy of a heavy charged particle dissipates while traversing through matter.	(1.5)
	(h)	Describe the function of moderator and control rods in a nuclear reactor giving examples of each.	(1.5)
	(i)	Describe the basic principle of gas filled detectors.	(1.5)
	(j)	In what respect is an antiparticle similar to and dissimilar from a particle?	(1.5)
		PART -B	
Q2	(a)	How can 'nuclear fission' and 'nuclear fusion' be accounted for by the 'Binding Energy per nucleon' versus 'Atomic mass number' graph. What is the difference between 'spontaneous fission' and 'induced fission'? Why is it difficult to make nuclear fusion occur in the laboratory while it occurs so easily in stars?	(10)
	(b)	The mass of Deutron ($^1H_2$) nucleus is 2.014103 amu. If the masses of proton and neutron are 1.007825 and 1.008665 amu respectively. Calculate the binding energy.	(5)
Q3	(a)	Illustrate the similarities between a nucleus and liquid drop. Derive Weizsacker semiempirical mass formula.	(10)
	(b)	What are the evidences of shell structure of a nucleus? What are the assumptions of the shell model of a nucleus?	(5)

Q4	(a)	Distinguish between compound nuclear reaction and direct reaction with examples. What is meant by a (d, p) reaction? Is it likely to occur by direct reaction or compound nuclear reaction?	(7)
	(b)	State the law of radioactive decay. If 99% of a radioactive element disintegrates in 48 hours. What is the half -life of this isotope?	(5)
	(c)	Why are only Alpha- particles emitted by radioactive nuclei, while proton and neutron are not? Explain.	(3)
Q5	(a)	What is the Compton effect? Show that the change in wavelength in Compton scattering is independent of the incident wavelength.	(10)
	(b)	Light of wavelength 3000 Å falls on a metal surface having a work function of 2.3 eV. Calculate the maximum velocity of the ejected photoelectron.	(5)
Q6	(a)	Describe in detail the basic principle, construction and working of a GM counter.	(10)
	(b)	Differentiate between Wilson's cloud chamber and bubble chamber.	(5)
Q7	(a)	Distinguish between different fundamental interaction on the basis of their strength, range and reaction rate. Name the exchange particle involved in each case.	(10)
	(b)	Illustrate in detail the quark model for mesons and baryons.	(5)

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