



RR-0841

Third Year B. Sc. Examination

March / April – 2010

Physics : Paper - VIII

(New Course)

Time : 3 Hours]

[Total Marks : 70

**Instructions :**

(1)

નીચે દર્શાવેલ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<input type="text" value="T. Y. B. Sc."/>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="text" value="Physics - 8 (New)"/>	<input type="text"/>
Subject Code No. : <input type="text" value="0"/> <input type="text" value="8"/> <input type="text" value="4"/> <input type="text" value="1"/>	<input type="text"/>
Section No. (1, 2,.....) : <input type="text" value="Nil"/>	<input type="text"/>
	Student's Signature

- (2) Draw neat diagrams wherever necessary.
- (3) Symbols used in the paper have their usual meaning.
- (4) Figures to the right indicate full marks of the question.
- (5) Scientific calculator may be used.

1 Answer the following questions in brief :

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- (i) What is Schrodinger's equation? Write Schrodinger's equation in spherical polar coordinates. What is the advantage of writing this equation in spherical polar coordinates?
- (ii) Why could Bohr not allow the quantum number  $n$  to take the value  $n = 0$  ?
- (iii) What is the origin of molecular spectra? What factors affect the intensity of molecular spectra?
- (iv) Define range of  $\alpha$  particle. On what factors does it depend ?
- (v) State Geiger - Nuttal law. What are its implications?
- (vi) State the limitations of a cyclotron.
- (vii) What are strange particles?

- 2 (a) Explain the details the orbital quantum number ( $l$ ). 7  
Also discuss the designation of electron angular momentum states.

- (b) Verify that the average value of  $\frac{1}{r}$  for a 1s electron 4

in the hydrogen atom is  $\frac{1}{a_0}$ . The wave function of

1s electron is  $\Psi = \frac{e^{-r/a_0}}{\sqrt{\pi a_0^3}}$ , where  $a_0$  is Bohr radius.

**OR**

- 2 (a) Discuss the factors that lead to the introduction of vector atom model. Also explain the concept of spatial quantization and spinning electron. 7

- (b) Calculate the wavelength separation of the fine structure resulting from the spin orbit interaction within the hydrogen atom. 4

- 3 (a) Discuss the quantum mechanical explanation of the normal Zeeman effect. 7

- (b) The red line of cadmium splits into three components 4 separated by 120 MHz when the source is placed in a magnetic field of flux density 8.6 mT, the light being examined in a direction perpendicular to the magnetic field. Calculate the ratio of charge to mass of the electron.

**OR**

- 3 (a) Discuss the theory of Raman effect and describe an experimental arrangement for studying it. 7

- (b) HCl molecule has a rotational constant B value of 1059.3  $\text{m}^{-1}$  and a centrifugal distortion constant D of  $5.3 \times 10^{-2} \text{m}^{-1}$ . Estimate the vibrational frequency and force constant of the molecule. Reduced mass for HCl molecule is  $1.627 \times 10^{-27} \text{kg}$ . 4

- 4 (a) Explain in details, the Gamow's theory of alfa decay. 7  
 (b) Calculate the velocity and the mass of a  $\beta$  particle 4  
 with a kinetic energy of 0.5 MeV. Rest mass of  $\beta$   
 particle is  $9.11 \times 10^{-31}$  kg.

**OR**

- 4 (a) What are the constructional features of the bubble 7  
 chamber ? How does the instrument work ?  
 Enumerate its advantages over the cloud chamber.  
 (b) Explain Mossbauer effect briefly. 4
- 5 (a) What is the difference between a cyclotron and a 7  
 synchrocyclotron? Explain the theory and principle  
 of working of a synchrocyclotron.  
 (b) A betatron has the following parameters : Magnetic 4  
 current supply frequency = 50 Hz. Peak magnetic  
 flux density at the orbit = 0.4 T. Electron orbit  
 radius = 0.75 m. Calculate the final energy of the  
 electrons and energy gained per revolution.

**OR**

- 5 (a) What are cosmic ray showers? Explain the cascade 7  
 theory for cosmic ray showers.  
 (b) Find the maximum kinetic energy of the electron 4  
 emitted in the beta decay of the free neutron.  
 The neutron-proton mass differences is 1.30 MeV.
- 6 Explain any **two** of the following in detail : 12  
 (a) Pauli's exclusion principle  
 (b) Different modes of molecular excitation and factors  
 affecting line width of molecular spectra.  
 (c) Cerenkov counter.  
 (d) The mesons.