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B.Sc. V. Semester Degree Examination, November/December 2016
PHYSICS
Paper – 5.1 : Atomic Molecular Physics & Special Theory of Relativity

Time : 3 Hours Max. Marks : 80

Instructions : *1) Section – I is **compulsory**.*
*2) Answer **any four** questions **each** from Section – **II** and from Section – **III**.*

SECTION – I

1. Answer **any twelve** of the following. **(12×1=12)**

A) Choose the correct answer :

i) Electronic charge is

a) –1.602 C b) +1.602 C c) –1.620 C d) +1.620 C

ii) What is the ratio of volume of atom and volume of nucleus ?

a) 10^9 b) 10^{12} c) 10^{15} d) 10^{18}

iii) The splitting of spectral lines under the influence of electric field is called

a) Stark effect b) Thomson effect
c) Zeeman effect d) Compton effect

iv) Choose the incorrect statement concerning the theory of relativity

a) there is variation of mass with velocity
b) velocity of light is independent of motion observer
c) it proves the existence of ether
d) time is relative

B) Fill in the blanks.

i) _____ oil is used in Millikan's Oil Drop method.

ii) _____ is the series of hydrogen atom which lies in the visible region.

iii) In normal Zeeman effect, when the spectral lines are viewed longitudinally, the number of lines observed are _____

iv) There are two exactly identical twin brothers. One of twins stays home while the other takes off on a long fast trip through space. On his return the traveler twin will be _____ than the twin who stayed at home.

P.T.O.

C) State **true** or **false** :

i) The value of sommerfeld fine structure constant 1/137.

ii) The concept of space quantization and electron spin was introduced by Uhlenbeck and Goudsmith.

iii) X-rays are neither deflected by electric field nor by magnetic field.

D) Answer the following in **one** or **two** sentences.

i) What is meant by electron spin ?

ii) Give the expression for Bohr magneton.

iii) What is Stark effect ?

iv) Define Minkowski space.

SECTION – II **(4×4=16)**

2. Define ionization potential, excitation potentials, ionization energy and excitation energy.

3. What is a characteristic X-ray spectrum ? Explain its origin.

4. What are different types of molecular spectra ? Define them.

5. State the Selection rules of rotational spectra. Show that in rotational spectra the energy levels are not equally spaced where as the frequencies are equally spaced.

6. Briefly explain electronic spectra of molecules.

7. What is Rayleigh scattering ? Explain with an illustration.

SECTION – III

8. a) Outline the principle of Dunningtton's method for the determination of specific charge of an electron. **9**

b) An oil drop of diameter 10^{-5} cm carrying two electronic charges remains suspended between two charged parallel plates 10 mm apart. If the density of oil is 1.8 g cm^{-3} calculate the potential difference between the two plates. **4**

9. a) State Bohr's postulates. Obtain an expression for the radius of the electron and the energy in the nth orbit. 9

b) Calculate the Rydberg constant for hydrogen atom if the energies of the 2nd and 3rd orbits are –3.4 eV and –1.51eV. 4

10. a) Describe with a diagram Stern and Gerlach experiment. Write the importance of the results of the experiment. 9

b) Calculate the wavelength of the first-member and the series limit of Lyman series of hydrogen spectrum. (Rydberg constant = 1.096×10^7 per meter). 4

11. a) What is Zeeman effect ? Give the quantum mechanical explanation for normal Zeeman effect. 9

b) Write a note on Duane-Hunt Limit. 4

12. a) How is Raman effect explained on the basis of quantum theory ? 9

b) A radiation of wavelength 546.1 nm excites a substance to emit a Raman line of wavelength 538.2 nm. Calculate the Raman frequency and the wavelength of the corresponding Stokes's line. 4

13. a) What is time dilation in special theory of relativity ? Deduced an expression for time dilation, in regard to the interval between two events measured from two different inertial frames. 9

b) How much electric energy could theoretically be obtained by annihilation of 1 gram of matter ? 4

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PHYSICS
Paper – 5.2 : Quantum Mechanics, Nuclear Physics and Energy Physics

Time: 3 Hours

Max. Marks: 80

Instructions : *1) Section – **I** is **compulsory**.*
*2) Answer **any four** questions **each** from Section – **II** and from Section – **III**.*

SECTION – I

1. Answer **any twelve** of the following : **(12×1=12)**

A) Choose the correct answer :

i) Thomson experiment verifies

a) particle nature of the wave b) wave nature of the particle

c) uncertainty principle d) none of these

ii) Wavelength of the wave associated with matter

a) $\lambda = \frac{h}{2mev}$ b) $\lambda = \frac{h}{\sqrt{2mev}}$

c) $\lambda = \sqrt{\frac{h}{2mev}}$ d) $\lambda = \frac{\sqrt{h}}{2mev}$

iii) The size of atomic nucleus is

a) 10^{-10} m b) 10^{-12} m

c) 10^{-14} m d) 10^{-15} m

iv) Photons obey

a) Classical statistics b) Bose-Einstein statistics

c) Fermi-Dirac statistic d) None of them

B) Fill in the blanks :

i) Nuclear density is independent of _____

ii) The S.I. unit of radioactivity is _____

iii) Coolant used in nuclear reactor is _____

iv) One dimensional potential well possess _____ energy values.

P.T.O.

C) State **true** or **false** :

i) Scintillation counter is used to accelerate the particles.

ii) Nuclear forces are attractive forces.

iii) de Broglie wave show diffraction.

D) Answer the following in **one** or **two** sentences :

i) What is zero point energy ?

ii) State Geiger Nuttall law.

iii) Define Avalanche in G. M. Counter.

iv) What is plasma state ?

SECTION – II **(4×4=16)**

2. Describe Thomson experiment to demonstrate that electrons behaves as waves.

3. Obtain Schrodinger time independent wave equation.

4. State radioactive decay law. Derive an expression $N = N_0 e^{-\lambda t}$.

5. Describe how range of α particles is determined by Bragg and Kleeman experiment ?

6. Write a note on C-N cycle of thermonuclear reaction.

7. Write a note on biomass energy.

SECTION – III

8. a) Explain the failure of classical mechanics and origin of quantum mechanics. **6**

b) Give the physical significance of wave function. **3**

c) Calculate the energy of neutron in eV if de Broglie wavelength is 1Å, $m = 1.674 \times 10^{-27}$kg, $h = 6.625 \times 10^{-34}$Js. **4**

9. a) Show that one dimensional potential well possesses discrete set of energy values and also find the complete solution of wave function. **9**

b) State Heisenberg's uncertainty principle. Illustrate with gamma ray microscope experiment. **4**

10. a) Explain the following properties of nucleus :
    1) Mass
    2) Charge
    3) Size
    4) Magnetic moment and
    5) Binding energy. **9**

    b) Calculate binding energy per nucleon of alpha particle.

    Given : mass of proton = 1.00728 a.m.u., mass of neutron = 1.00867 a.m.u., mass of alpha particle = 4.0026 a.m.u. **4**

11. a) Give the theory of successive radioactive disintegration of radioactive substance and derive the condition for secular and transient equilibrium. **9**

    b) Find the time during which the activity of a sample Actinium reduces to 80% of its original value. Assume the half life of Actinium is 1.4×10^{10} years. **4**

12. a) Describe theory, construction and working of betatron. **9**

    b) Calculate energy of deuteron emerging from cyclotron having dees of radius 50 cm and magnetic field 1.5 Wb m^{-2}. Given : $q = 1.6 \times 10^{-19}$ C, mass = 3.35×10^{-27} kg. **4**

13. a) What are controlled and uncontrolled chain reactions ? Give an example each. **5**

    b) Distinguish between renewable and non-renewable energy resources. **4**

    c) Find Q value of the following reaction :

    $${}_{6}C^{12} + {}_{6}C^{12} \rightarrow {}_{10}Ne^{20} + {}_{2}He^{4} + Q$$

    Given : ${}_{6}C^{12} = 12.0000$ a.m.u., ${}_{10}Ne^{20} = 19.992439$ a.m.u., ${}_{2}He^{4} = 4.002603$ a.m.u. **4**
