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GS-299

VI Semester B.Sc. Examination, May/June 2019

PHYSICS-VII
ATOMIC, MOLECULAR AND NUCLEAR PHYSICS

(CBCS) (FRESH) (2018-19 & Onwards)

Time : 3 Hours Max. Marks : 70

Instructions : *Answer **any five** questions from all the parts.*

PART - A

Answer **any five** of the following questions. Each question carries **eight** marks. **5x8=40**

1. (a) State and explain Pauli's exclusion principle. **4+4**

(b) Obtain an expression for the maximum number of electrons in a shell.

2. (a) What is Zeeman effect ? **1+2+5**

(b) Distinguish between normal and anamalous Zeeman effect.

(c) Give the Quantum theory of Normal Zeeman effect.

3. (a) What is Raman effect ? Give the Quantum mechanical explanation of Raman effect. **2+4+2**

(b) Distinguish between Stoke's and Antistoke's lines.

4. (a) State the assumptions of Rutherford's theory of α-ray scattering. **2+6**

(b) Obtain an expression for Rutherford's scattering formula.

5. (a) What is α-decay ? **2+4+2**

(b) Outline Gamow's theory of α-decay.

(c) What are the factor's on which the range of α-particle depends ?

P.T.O.

6. (a) What is β-decay ?

(b) Mention the types of β-decay.

(c) Give the important features of β-ray spectrum. 1+2+5

7. (a) Explain endoergic and exoergic types of reactions.

(b) What is threshold energy ? Derive an expression for the same. 4+4

8. (a) What are elementary particles ?

(b) What are the broad categories into which the elementary particles are classified ? 2+6

PART - B

Answer **any five** of the following questions. Each question carries **four** marks. **5x4=20**

9. Find the wavelength of light emitted when the hydrogen atom undergoes transition from the 5^{th} orbit to the 2^{nd} orbit. Assume ionization potential for hydrogen atom to be 13.6 eV.

10. In a normal Zeeman effect, the sodium 422.6 nm line splits into three components separated by 0.025 nm in a magnetic field of 3T. Calculate the specific charge of the electron.

11. The force constant of CO bond is 187 Nm^{-1}. Find the frequency of vibration of CO molecule given mass of $C^{12} = 1.99 \times 10^{-26}$ kg, and $O^{16} = 2.66 \times 10^{-26}$ kg. Also find the spacing between vibrational levels.

12. 1 g of a radioactive substance takes 50 s to lose one centigram. Find its half life period.

13. Calculate the α-particle potential barrier in case of $_{86}Rn^{222}$.

14. C^{14} undergoes β-decay transition to N^{14}. If the end point energy of the transition is 0.156 MeV and the mass of the initial atom is 14.00768 amu, find the mass of the final atom.

15. Calculate the Q value of the reaction ${}_1H^2(d, n){}_2He^3$. Given ${}_1H^2 = 2.0141$ amu, ${}_2He^3 = 3.0160$ amu, ${}_0n^1 = 1.00866$ amu. Is it exoergic or endoergic ?

16. When target Lithium (${}_3Li^7$) of thickness 0.025 mm is bombarded with a beam of intensity 10^{15} protons per second, 10^9 neutrons are produced. Calculate the cross-section of the reaction.

Given density of Lithium = 500 kg/m^3.

PART - C

Answer **any five** of the following questions. Each question carries **two** marks. **5x2=10**

17. (a) The Alkali metals have hydrogen - like spectra. Explain.

(b) Why is normal Zeeman effect observed in a strong magnetic field ?

(c) Why is red light used in danger signals ?

(d) Electrons of target atoms are not effective in scattering alpha particles. Explain.

(e) Electrons do not exist in the nucleus. How is it emitted during β-decay ?

(f) Alpha ray spectrum is characteristic of the nucleus while β-ray spectrum is not. Explain.

(g) What is the significance of positive and negative sign of Q values in nuclear reaction ?

(h) Is kinetic energy conserved in inelastic scattering. Explain.

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