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| *Sl. No. Of Ques. Paper* | : | **8422C** |
| *Unique Paper Code* | : | **222503** |
| *Name of the Paper* | : | **PHHT- 517 : Atomic & Molecular Physics** |
| *Name of the Course* | : | **B.Sc. (Hons) Physics Part III** |
| *Semester* | : | **V** |
| *Duration* | : | **3 hours** |
| *Maximum Marks* | : | **75** |

*Attempt five questions including Question No. 1 which is compulsory.*

1. Answer any *five* of the following questions briefly:-      (3x5)

    a. Compute the orbital magnetic moment of the electron,

    b. The smallest angle of Bragg scattering in potassium chloride (KCl) is $28.4^0$ for 0.30 nm X-ray. Find the distance between atomic planes in KCl.

    c. Differentiate between absorption and emission spectrum.

    d. What voltage must be applied to an X-ray tube for it to emit X-rays with a minimum wavelength of $30 \times 10^{-12}$ m?

    e. The $J=0 \to J=1$ rotational absorption line occurs at $1.153 \times 10^{11}$ Hz in $^{12}C^{16}O$ and at $1.102 \times 10^{11}$ Hz in $^?C^{16}O$. Find the mass number in the unknown carbon isotope.

    f. Compare the Bohr radius of the hydrogen atom with the de Broglie wavelength of an electron moving with a speed of $10^7$ ms$^{-1}$.

    g. What is the physical significance of orbital magnetic quantum number $m_l$ ?

2.      a. Differentiate continuous and characteristic X-rays.      (3+3)

    b State Moseley's law and discuss its importance.      (2+2)

    c State and derive Bohr's correspondence principle.      (2+3)

3.      a. Describe Stern-Gerlach experiment and discuss its importance in understanding vector atom model.      (4+4)

    b Calculate the shortest wavelength present in the Lyman Series of spectral lines.      (4)

    c State and explain Larmor's Theorem .      (1+2)

4.      a. What are the features of normal and anomalous Zeeman effect?      (5+5)

    b. What is Stark effect?      (3)

    c. What are possible values of 'l' for j=5/2 ?      (2)

5.      a. The carbon mono-oxide (CO) molecule has a bond length R of 0.113 nm and the masses of the $^{12}C$ and $^{16}O$ atoms are respectively $1.99 \times 10^{-26}$ Kg and $2.66 \times 10^{-26}$ Kg. Find (i) the energy, (ii) the angular velocity of CO molecule when it is in its lowest rotational state.      (6)

    b. In which region of energy do the molecular rotational spectra and molecular vibrational spectra lie? Discuss the rotational and vibrational modes of molecules and state their selection rules.      (1+4+4)

6. a. Explain Raman effect. State the selection rules for Raman scattering. (9)

   b. Differentiate between resonant elastic scattering and non-resonant in-elastic scattering. (3)

   c. What is the importance of charge to the mass ratio for any charged particle? (3)

7. a. Distinguish between spontaneous and stimulated emission of radiation. Derive Einstein coefficients. (3+3+4)

   b What is an advantage of four level laser over three level laser? Give one example for each case. (3+1+1)