

(2)

- (v) Prove that if A is Hermitian operator, then e^{iA} is unitary.
- (vi) What is the essential difference between a nuclear bomb and a nuclear reactor?
- (vii) A radio-isotope has a half life of 5 hours. Find its decay constant.
- (viii) For which value of scattering angle is the Compton shift equal to the Compton wavelength?
- (ix) What do you mean by tunneling through a barrier?
- (x) Show that $[\hat{x}, \hat{p}_x] = i\hbar$
2. Give the Bohr theory of hydrogen atom and derive expressions for the observed spectral series of Hydrogen. Draw the energy level diagram showing transitions for different spectral series. 5+5
3. Outline the experimental arrangement for observing the normal Zeeman effect. Derive an expression for Zeeman shift. 5+5

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(3)

4. (a) Show graphically the variation of the Binding Energy per nucleon with mass number. Discuss the significance of the curve. 5
- (b) Assuming that mass is uniformly distributed inside the nucleus and also assuming that it is spherical, derive a relation between the size of the nucleus and its mass number. 5
5. What is Compton effect? Derive an expression for Compton shift. Estimate the change in wavelength of the scattered radiation if the angle of scattering is 60° . 2+6+2
6. What are matter waves? Describe with necessary theory, the Davisson-Germer experiment for confirmation of matter waves. 3+7
7. Write down the Schrödinger equation for a particle in a box. Solve it to obtain the eigenfunction and show that the eigenvalues are discrete. 2+8
8. Establish the Schrödinger equation for a linear Harmonic oscillator. Find its eigenvalues and eigen functions. 2+8

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