22. (a) Explain briefly doublet separation in alkali spectra.

Or

(b) Give an account of the coupling schemes.

23. (a) What is meant by spin–orbit interaction? Calculate $H_{s.o.}$ – spin orbit interaction as a correction to the Hamiltonian.

Or

(b) Write a note on hybridisation.

24. (a) Explain the terms emission and absorption rates.

Or

(b) Discuss briefly the interaction of the radiation field with atoms.

25. (a) Explain creation, annihilation and number operators.

Or

(b) Describe briefly the quantisation of wave fields.

SECTION C — (5 × 8 = 40 marks)

26. (a) Discuss fully Born's approximation and its validity.

Or

(b) Outline the principle of partial wave analysis and calculate the scattering cross–section.

27. (a) What is meant by central field approximation? Explain Hartree's self consistent field model.

Or

(b) Discuss in detail Thomas–Fermi statistical model.

28. (a) Discuss the problem of the hydrogen molecule ion and obtain its energy values.

Or

(b) Using Heitler London method, solve the problem of the hydrogen molecule.

29. (a) Deduce Einstein's coefficients from semi–classical theory.

Or

(b) What are the properties and applications of the density matrix?