

Answer TWO questions

The numbers at the right hand margin indicate the provisional allocation of the maximum number of marks per sub-section of a question

1. Discuss carefully the differences in the basic interactions of electrons and positrons with atomic and molecular targets. **4 marks**

Sketch qualitatively the behaviour of the total cross section for

(i) electron scattering

(ii) positron scattering

from helium and xenon at low energies (less than 10eV).

4 marks

Briefly explain the nature of the Ramsauer-Townsend minimum in electron-atom scattering. How can such a phenomena be explained using quantum mechanical scattering theory. **8 marks**

Compare and contrast such phenomena with those observed in low energy positron scattering. **4 marks**

2. *Briefly* describe the nature of resonant states in electron-atom scattering. Discuss one example of an atomic collision resonance **4 marks**

Describe, in some detail, an experimental apparatus to study resonance phenomena in electron-atom/molecule scattering. **6 marks**

Explain, in some detail, the mechanism by which atoms may be trapped in an optical trap. **6 marks**

How might such a device be used to measure electron or positron scattering from atomic targets? **4 marks**

3. Discuss what is meant by *ortho- and para- positronium*. What are the dominant decay modes? Explain the selection rules governing these decay modes. **6 marks**

Briefly describe an experiment to detect the formation of positronium in the first excited state. Compare the excited states of positronium with those of atomic hydrogen. **8 marks**

Describe how either an electron or a positron may be used to generate synchrotron radiation. **6 marks**

END OF PAPER