InkPhysics

QUESTION WORKBOOK

Collisions of electrons with atoms

Quantum phenomena · Year 12

AQA 3.2.2.2 · CIE 22.4 · OCR A 5.5.2

10 questions · 30 marks

NAVY SCREEN EDITION

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SECTION A · Warm-up

A1 Distinguish between excitation and ionisation of an atom by a colliding electron. [2]

A2 Convert 3.4 eV to joules ($e = 1.60 \times 10^{-19}$ C). [2]

A3 Convert 8.0×10^{-19} J to electronvolts. [2]

SECTION B · Standard

B1 Define the electronvolt, and convert 12.1 eV into joules. [3]

B2 An electron is accelerated from rest through a potential difference of 5.0 V. Calculate its kinetic energy in joules and its final speed ($m_e = 9.11 \times 10^{-31}$ kg). [3]

B3 An atom has a first excitation energy of 4.9 eV. An electron with a kinetic energy of 6.0 eV collides with it and excites it. State whether excitation is possible and calculate the kinetic energy the electron has left afterwards, in joules. [4]

B4 A hydrogen atom has an ionisation energy of 13.6 eV. Calculate the minimum speed an electron must have to ionise it ($m_e = 9.11 \times 10^{-31}$ kg). [3]

SECTION C · Stretch

C1 Explain how excitation and ionisation lead to the emission of light in a fluorescent tube. [4]

C2 An atom has excitation energies of 4.9 eV and 6.7 eV. It is struck by an electron accelerated through 12 V. State which excitations are possible, and calculate the wavelength of the photon emitted when the atom de-excites from the 4.9 eV level ($h = 6.63 \times 10^{-34}$ J s, $c = 3.0 \times 10^{8}$ m s^{-1}). [4]

C3 Explain why an electron with less than an atom's first excitation energy passes through the gas without transferring energy to the atoms. [3]