InkPhysics

QUESTION WORKBOOK

Energy levels and photon emission

Quantum phenomena · Year 12

AQA 3.2.2.3 · CIE 22.4 · OCR A 5.5.2

10 questions · 30 marks

NAVY SCREEN EDITION

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SECTION A · Warm-up

A1 Explain what the sharp lines of an emission line spectrum tell us about the energy of electrons in an atom. [2]

A2 An electron transition releases 3.0 eV of energy. Calculate this in joules ($e = 1.60 \times 10^{-19}$ C). [2]

A3 State the equation relating the frequency of an emitted photon to the energy levels involved. [2]

SECTION B · Standard

B1 An electron falls from a level at -1.5 eV to a level at -3.4 eV. Taking $h = 6.63 \times 10^{-34}$ J s, $c = 3.0 \times 10^{8}$ m s^{-1} and $e = 1.60 \times 10^{-19}$ C, calculate (a) the photon frequency and (b) its wavelength. [4]

B2 A transition releases a photon of energy 2.55 eV. Calculate its wavelength. [3]

B3 An electron drops from a level at -0.54 eV to a level at -3.40 eV. Calculate the wavelength of the emitted photon. [3]

B4 A photon of wavelength 486 nm is emitted from an atom. Calculate the energy of the transition, in electronvolts. [3]

SECTION C · Stretch

C1 An atom has levels at 0 eV (ionised), -1.5 eV and -13.6 eV. An electron falls from the -1.5 eV level to the -13.6 eV level. Calculate the wavelength of the photon emitted and state which part of the spectrum it lies in. [4]

C2 An atom has three energy levels: -1.5 eV, -3.4 eV and -13.6 eV. State how many different spectral lines can be produced by transitions between them, and calculate the wavelength of the line with the longest wavelength. [4]

C3 Explain why the line spectrum of each element is unique. [3]