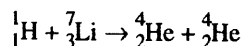


Question 32 — From Quanta to Quarks (25 marks)

- (a) Explain how Neils Bohr was able to adapt the concept of the quantization of energy to improve upon the Rutherford model of the atom. 2

- (b) Consider the following nuclear reaction.



The masses are as follows:

$${}^1_1\text{H} = 1.0078 \mu$$

$${}^7_3\text{Li} = 7.0160 \mu$$

$${}^4_2\text{He} = 4.0026 \mu$$

- (i) State whether energy is absorbed or released during this reaction. 1
- (ii) Determine the mass defect and the energy in joules associated with this reaction. 3
- (c) (i) Explain how Neils Bohr's postulates were utilised to explain the line emission spectra of hydrogen. 2
- (ii) Calculate the wavelength of the photon of light released when an electron falls from the $n = 3$ level to the $n = 2$ level. 2
- (d) Name and describe how a particular isotope is used in agriculture. 3
- (e) Assess the significance of the Manhattan Project to society. 4
- (f) Discuss Pauli's suggestion of the existence of neutrino and relate it to the need to account for the energy distribution of electrons emitted in β - decay. 4
- (g) Evaluate the relative contributions of electrostatic and gravitational forces between nucleons. 4