6 (a) Define binding energy. [1]

(b) A minimum energy *Q* is required to remove a neutron from a helium-4 nuclide to form a helium-3 nuclide. The following data is given:

Binding energy per nucleon of helium-4 nuclide = 6.8465 MeV
Binding energy per nucleon of helium-3 nuclide = 2.2666 MeV
Mass of neutron = 1.0097 u
1u = 931.494 MeV

(i) Write the nuclear equation for this reaction. [1]

(ii) Calculate *Q*. [3]

(iii) Hence, calculate the difference in mass between the helium-3 and helium-4 nuclides. [3]

(iv) With reference to the above process, explain why the mass difference is less than the mass of a neutron. [1]