6 The energy spectrum of the beta particles emitted from an initially stationary parent nuclei is shown in Fig. 6.1.

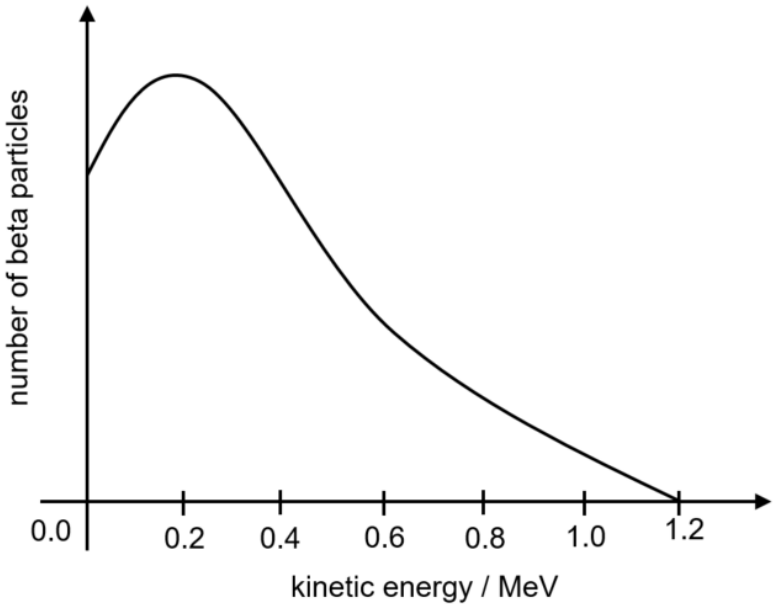

Fig. 6.1

(a) Explain why a continuous spectrum of kinetic energy for the beta particles is obtained.

.....

.....

.....

.....

.....

..... [3]

(b) The radioisotope Bismuth $^{210}_{83}$Bi undergoes beta decay into a stable isotope of Polonium (Po).

(i) Write down a nuclear equation that describes the above nuclear reaction.

[1]

(ii) Using data from Fig. 6.1 and Fig. 6.2, determine the mass of the Polonium nucleus in terms of *u*.

particle	mass / *u*
$^{210}_{83}$Bi nucleus	209.939
proton	1.00729
neutron	1.00867
electron	0.000548795
neutrino	negligible

Fig. 6.2

mass of polonium nucleus = ... *u* [4]

(iii) Research has shown that stable isotopes of heavy elements have an optimal neutron-to-proton ratio and lies on a "belt of stability". Unstable isotopes will undergo transmutation through radioactive decay such that the resulting nucleus achieves this optimal ratio.

Using your answer in **(b)(i)** or otherwise, suggest if Bismuth-210 has an excess of neutrons or protons, as compared to the optimal ratio.

.....

.....

.....

..... [2]

(c) A Geiger-Muller tube used in an experiment is positioned at a fixed distance from a radioactive sample to measure the variation of count rate with time, as shown in Fig. 6.3.

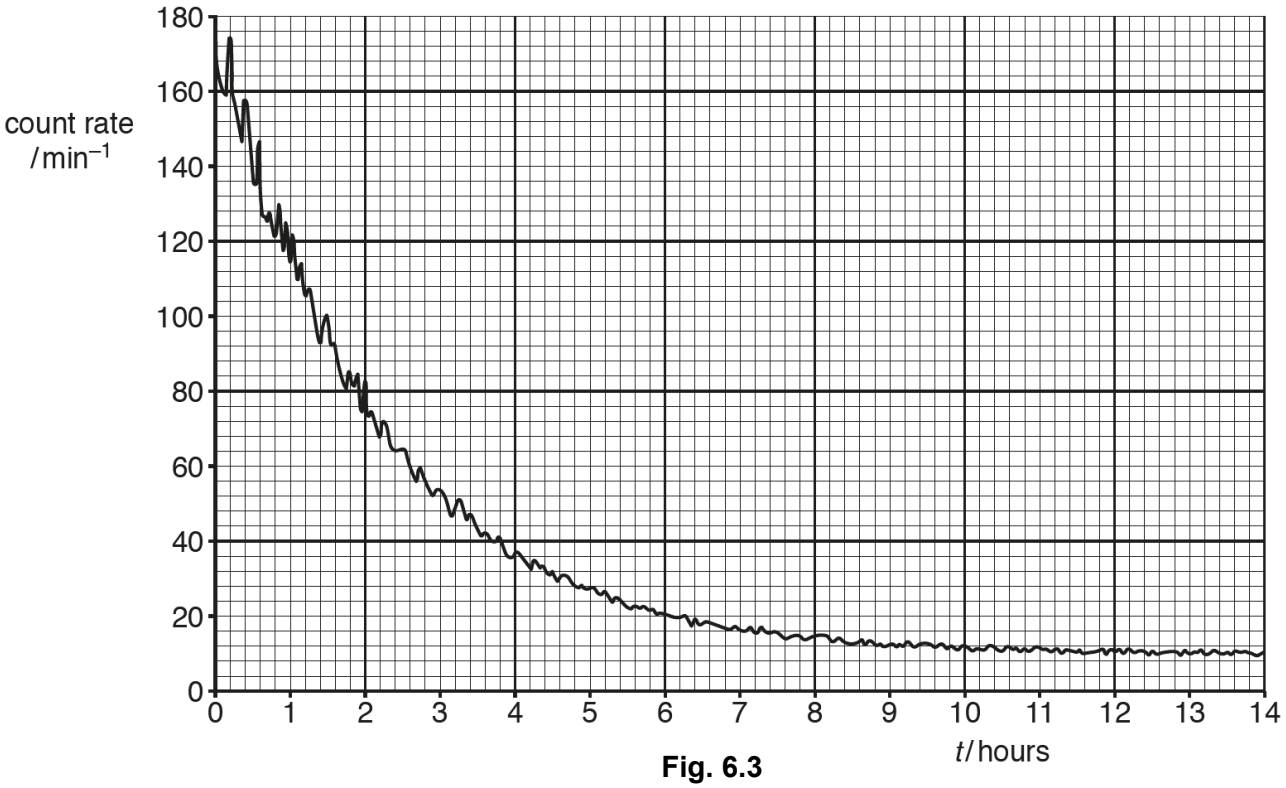

Fig. 6.3

(i) Explain why the data points on the graph do not lie on a smooth curve.

.....

..... [1]

(ii) Suggest a reason why the count rate recorded is not equal to the activity of the radioactive sample.

.....

..... [1]

[Total: 12]

Section B

Answer any **one** question in this Section in the spaces provided.