7 **(a)** The radioactive isotope of Bismuth $^{210}_{83}\text{Bi}$ decays into Polonium (chemical symbol: Po) with the emission of a beta particle.

(i) State the origin of the beta particle.

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.....[1]

(ii) Write down the equation representing the beta decay of $^{210}_{83}\text{Bi}$.

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.....[1]

(iii) State two quantities that are conserved in any radioactive decay process.

1. .....

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2. .....

[2]

(iv) The mass of a $^{210}_{83}\text{Bi}$ nucleus is 209.939 *u*. Show that its mass defect is 1.767 *u*. (mass of proton, m_p = 1.00729 *u*; mass of neutron, m_n = 1.00867 *u*)

[2]

(v) Calculate the binding energy per nucleon, in MeV, of $^{210}_{83}\text{Bi}$.

binding energy per nucleon = ... MeV [2]

(b) Fig. 7.1 shows the energy spectrum for beta particles emitted during the decay of $^{210}_{83}Bi$.
The intensity indicates the number of beta particles emitted with each particular kinetic energy.

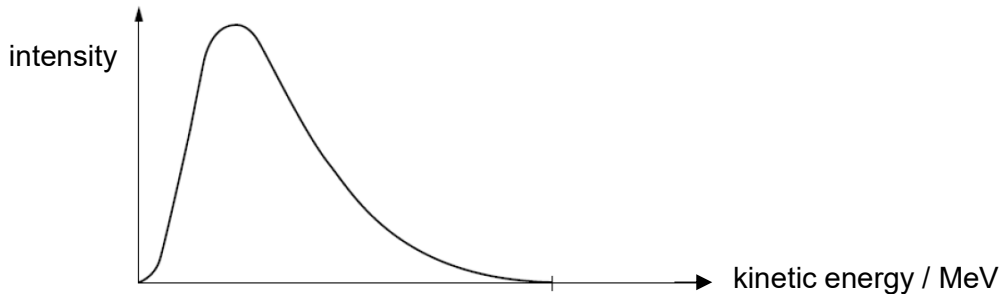

Fig. 7.1

Explain how a consideration of this kinetic energy spectrum provide evidence for the prediction of the existence of the antineutrino.

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