

Particles and radiation – AS Physics P1**1. No.01**

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1

 Identify the number of neutrons in a nucleus of polonium-210 ($^{210}_{84}\text{Po}$).Tick (✓) **one** box.**[1 mark]**

84

☐

126

☐

210

☐

294

☐

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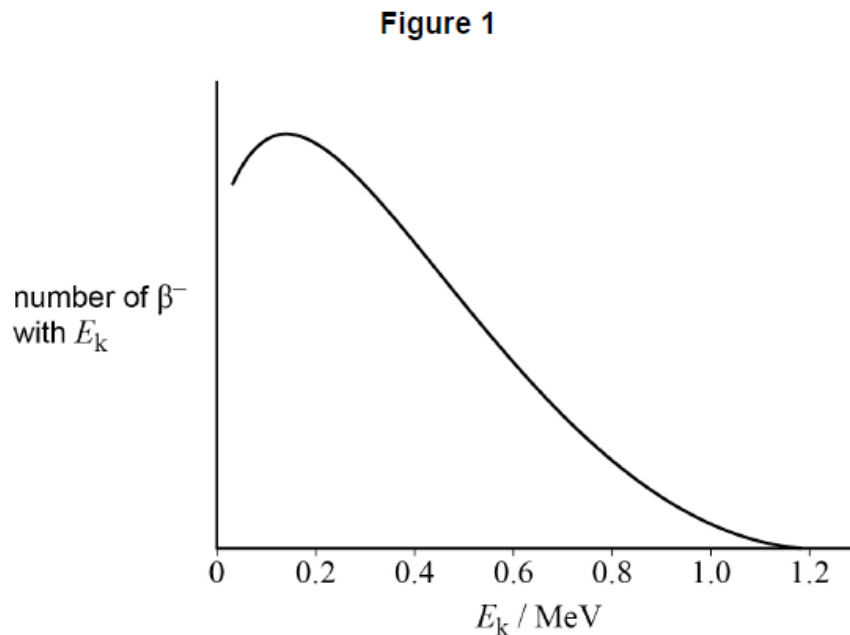
2

 A polonium-210 nucleus is formed when a stationary nucleus of bismuth-210 decays. A beta-minus (β^-) particle is emitted in this decay.Outline, with reference to β^- decay, why bismuth-210 and polonium-210 have different proton numbers.**[2 marks]**

The kinetic energies of β^- particles emitted from a sample of bismuth-210 are analysed. These β^- particles have a range of kinetic energies.

The total energy released when each nucleus of bismuth-210 decays to a nucleus of polonium-210 is 1.2 MeV.

Figure 1 shows the variation with E_k of the number of β^- particles that have the kinetic energy E_k .



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Explain how the data in **Figure 1** support the hypothesis that a third particle is produced during β^- decay.

[2 marks]

0 1 . 4 This third particle is an electron antineutrino.

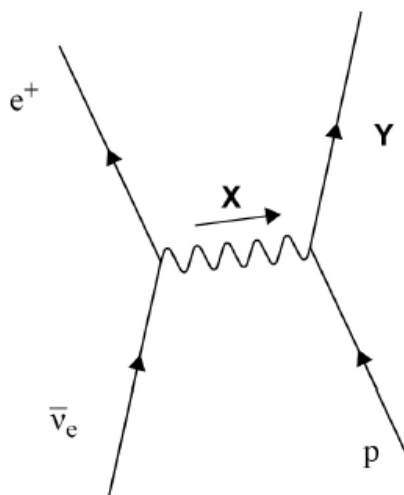
Explain why an electron antineutrino, rather than an electron neutrino, is produced during β^- decay.

[2 marks]

0 1 . 5 A large tank of water is used as part of an electron antineutrino detector. An electron antineutrino $\bar{\nu}_e$ enters the tank and interacts with a proton (p).

Figure 2 represents this interaction.

Figure 2



Identify X and Y.

[2 marks]

X = _____

Y = _____

0 1 . 6

The positron produced in the interaction in **Figure 2** slows down and collides with a lepton in a molecule of water.

Describe the process that occurs when the positron collides with this lepton.
In your answer you should identify the lepton in the molecule of water.

[3 marks]

0 1 . 7

The range of the electromagnetic interaction is infinite.

Table 1 gives the range of the strong nuclear interaction and the range of the weak nuclear interaction.

Table 1

Interaction	Range / m
strong nuclear	10^{-15}
weak nuclear	10^{-18}

Deduce whether the positron or the electron antineutrino is likely to travel the shorter distance in the tank of water before interacting.

[3 marks]
