



# **A Level Physics A**

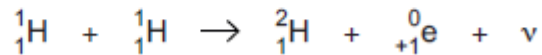
H556/02 Exploring physics

## **Question Set 11**

1

Stars produce energy by nuclear fusion.

One particular fusion reaction between two protons ( ${}^1_1\text{H}$ ) is shown below.



In this reaction 2.2 MeV of energy is released.

- (a) Only one of the particles shown in the reaction has binding energy.  
Determine the binding energy per nucleon of this particle. Explain your answer.

${}^2_1\text{H}$  has 2 nucleons. So binding energy per nucleon = 1.1 MeV. [2]

- (b) Explain why high temperatures are necessary for fusion reactions to occur in stars. [2]

— Protons in nuclei repel each other, but high temps give high KE so nuclei can get close enough to fuse. [2]

- (c) A gamma photon in a star can spontaneously create an electron-positron pair.  
Calculate the **maximum** wavelength of a gamma photon for this creation event.

maximum wavelength = .....  $1.2 \times 10^{-12}$  ..... m [3]

Max  $\lambda$  is min E, where all E transferred to mass and none left over for KE

$$\frac{hc}{\lambda} = 2 \times mc^2 \quad \Rightarrow \quad \lambda = \frac{h}{2mc} = \frac{6.63 \times 10^{-34}}{2 \times 4.11 \times 10^{-31} \times 3 \times 10^8} = 1.2 \times 10^{-12} \text{ m}$$

**Total Marks for Question Set 11: 7**

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