5 Two deuterium ($^2_1$H) nuclei are travelling directly towards one another. When their separation is large compared with their diameters, they each have speed v as illustrated in Fig. 5.1.

$\xrightarrow{\quad v \quad}$ $\xleftarrow{\quad v \quad}$

deuterium $\bigcirc$ $\bigcirc$ deuterium
nucleus   nucleus

Fig. 5.1

The diameter of a deuterium nucleus is 1.1×10^{-14} m.

(a) Use energy considerations to show that the initial speed v of the deuterium nuclei must be approximately 2.5×10^6 m s^{-1} in order that they may come into contact.
Explain your working.

[3]

(b) For a fusion reaction to occur, the deuterium nuclei must come into contact.
Assuming that deuterium behaves as an ideal gas, deduce a value for the temperature of the deuterium such that the nuclei have an r.m.s. speed equal to the speed calculated in **(a)**.

temperature = ... K [4]

(c) Comment on your answer to **(b)**.

....

....[1]