

- 9 (a) Define mass defect.

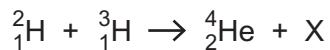
.....  
.....  
..... [2]

- (b) Table 9.1 shows the mass defects of three nuclei.

**Table 9.1**

nucleus	mass defect/u
$^2_1\text{H}$	0.002388
$^3_1\text{H}$	0.009105
$^4_2\text{He}$	0.030377

The nuclear fusion process in a particular star is described by



where X is a particle that has no mass defect.

- (i) State the name of particle X.

..... [1]

- (ii) Show that the energy released when one nucleus of  $^4_2\text{He}$  is formed in this fusion reaction is  $2.8 \times 10^{-12}\text{ J}$ .

[3]

- (c) The star in (b) has a radius of  $2.3 \times 10^9$  m and a luminosity of  $1.4 \times 10^{28}$  W.  
All the energy released from the formation of  $^4_2\text{He}$  is radiated away from the star.  
All the energy that is radiated from the star has been released in the formation of  $^4_2\text{He}$ .

Determine:

- (i) the mass of  $^4_2\text{He}$  produced per unit time by the fusion process

$$\text{mass per unit time} = \dots \text{ kg s}^{-1} \quad [3]$$

- (ii) the surface temperature of the star.

$$\text{temperature} = \dots \text{ K} \quad [2]$$