

- 9 (a) State what is meant by the mass defect of a nucleus.

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

- (b) The nuclear fusion reaction for the formation of helium-4 from deuterium is represented by

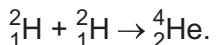


Table 9.1 shows the masses of the nuclides involved in this reaction.

Table 9.1

nuclide	nuclide mass/u
${}_1^2\text{H}$	2.013553
${}_2^4\text{He}$	4.001505

Calculate the energy released in the formation of 1.00 mol of helium-4.

energy = J [4]

- (c) The star Sirius has a radius of 1.19×10^9 m and loses mass due to nuclear fusion at a rate of 1.09×10^{11} kg s $^{-1}$. Assume that the power of the radiation emitted by the star is equal to the power released by this process.
- (i) Determine a value for the luminosity of Sirius. Give a unit with your answer.

luminosity = unit [2]

- (ii) Use your answer in (c)(i) to determine the surface temperature of Sirius.

surface temperature = K [2]

- (d) Explain how cosmologists use standard candles to estimate the distance of a galaxy from the Earth.

.....
.....
.....
.....

[3]

[Total: 13]