Stars and Galaxies

Coursework Sheet 1 – Feedback

1.

$4\,^1\mathrm{H} \rightarrow {}^4\mathrm{He}$

so $\Delta m = 4.1.0078 - 4.0026$ (1 mark)

$= 4.0312 - 4.0026 = 0.0286$ amu (1 mark)

and $\frac{\Delta m}{m} = \frac{0.0286}{4.0312} = 0.0071 = 0.71\%$ (1 mark)

2.

$L = 4\pi R^2 \sigma T_{eff}^4$

$T_{eff} = \left(\frac{L}{4\pi R^2 \sigma} \right)^{\frac{1}{4}}$ (1 mark)

$= \left(\frac{4.10^{26}}{4\pi (7.10^8)^2 5.7.10^{-8}} \right)^{\frac{1}{4}}$

$= 5\,800$ K (1 mark)

3.

Use Wien's Displacement Law

$\lambda_{max} = \frac{3.10^{-3}}{T}$ (1 mark)

$= \frac{3.10^{-3}}{3500}$

$= 8.6.10^{-7}$ m $= 860$ nm (1 mark)

i.e. in the near infrared part of the spectrum.

4.

Flux is related to the luminosity by

$f = \frac{L}{4\pi d^2}$ (1 mark)

The luminosity of the Sun is $4\text{x}10^{26}$ W and the Earth - Sun distance is 1 AU $= 1.5\text{x}10^{11}$ m. So

$f = \frac{4\text{x}10^{26}}{4\pi \left(1.5\text{x}10^{11}\right)^2}$

$= 1400$ Wm^{-2} (1 mark)

Since Alpha Centauri is solar - like let us assume it has the same luminosity as the Sun.

Also $1\,\text{pc} = 3.1\text{x}10^{16}$ m. So

$$f = \frac{4\text{x}10^{26}}{4\pi\left(1.3\text{x}3.1\text{x}10^{16}\right)^2}$$

$= 2.0x10^{-8}$ Wm^{-2} (1 mark)

Could alternatively use the inverse square law and say that

$$\frac{f_{\alpha Cen}}{f_{Sun}} = \left(\frac{d_{Sun}}{d_{\alpha Cen}}\right)^2 = \left(\frac{1.5\text{x}10^{11}}{1.3\text{x}3.1\text{x}10^{16}}\right)^2 = 1.4\times10^{-11}$$

$f_{\alpha Cen} = 1.4\times10^{-11} f_{Sun} = 2.0x10^{-8}$ Wm^{-2}