Stars and Galaxies

Coursework Sheet 2 – Feedback

1.

$$\frac{f_1}{f_2} = 10^{0.4(m_2 - m_1)} \qquad (1\,\text{mark})$$

$$= 10^{0.4(11.0-0.0)} = 10^{4.4} = 2.5 \times 10^4 \qquad (1\,\text{mark})$$

i.e. Proxima Centauri is 25 thousand times fainter than Alpha Centauri. (1 mark)

2. The definition of absolute magnitude is

$$m_V - M_V = 5\log d - 5$$

Remember the distance must be in parsecs in this formula. Distance to the Sun in parsecs $=1.5.10^{11}/3.1.10^{16}=4.8.10^{-6}$ pc. (1 mark)

$$m_V - M_V = 5\log 4.8.10^{-6} - 5 = -26.6 - 5 = -31.6$$

$$m_V = -31.6 + 4.8$$

$$= -26.8$$

(1 mark)

3.

$$m_V - M_V = 5\log d - 5$$

$$M_V = m_V - 5\log d + 5$$

Alpha Cen :

$$M_V = 0.0 - 5\log 1.3 + 5$$

$$= 4.4$$

i.e. very similar to the Sun. (1 mark)

Proxima Cen :

$$M_V = 11.0 - 5\log 1.3 + 5$$

$$= 15.4$$

i.e. much fainter than the Sun. This is a very faint red dwarf star. (1 mark)

4. The important point here is that you can only add fluxes together not magnitudes since the latter are logarithmic. There are several ways to do this – here is one.

Flux ratio

$$\frac{f_2}{f_1} = 10^{0.4(m_1 - m_2)} = 10^{0.4(7.9-8.6)} = 0.52 \qquad (1\,\text{mark})$$

Now total flux

$f = f_1 + f_2$

so

$$f = f_1(1 + \frac{f_2}{f_1}) = f_1(1 + 0.52) = 1.52 f_1 \qquad (1\,\text{mark})$$

so magnitude m is given by

$$m - m_1 = 2.5 \log \frac{f_1}{f} = 2.5 \log \frac{f_1}{1.52 f_1} = -0.45$$

$$m = m_1 - 0.45 = 7.9 - 0.45 = 7.4 \qquad (1\,\text{mark})$$