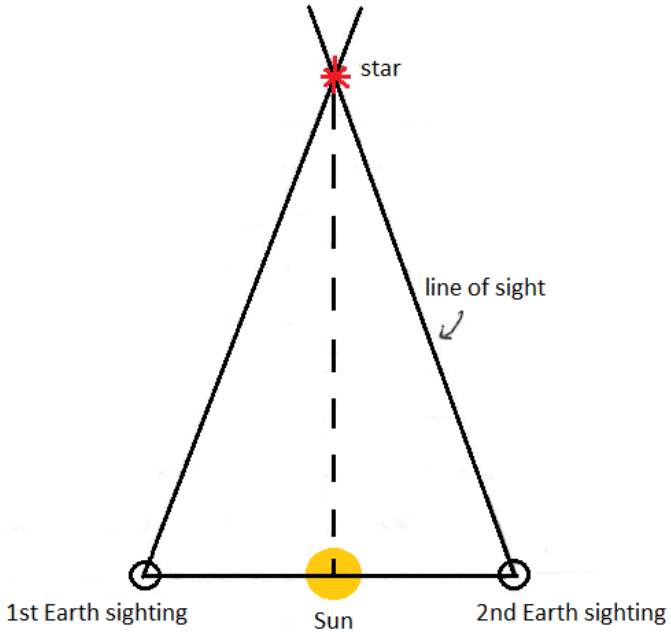
ASTROPHYSICS

2-1 Star magnitudes

1.



The line of sight to a nearby star changes as the Earth moves round in its orbit. It appears to change position against the fixed background of more distant stars as a result.

2. (a) The absolute magnitude of a star is defined as the star's apparent magnitude if it was at a distance of 10 parsecs from Earth.

(b) (i) angular shift = 0.45 arc seconds so $\theta = \frac{0.45}{2}$ arc seconds

$$d \text{ (in parsecs)} = \frac{1}{\theta \text{ (in arc seconds)}}$$

$$= \frac{2}{0.45}$$

= 4.444…. parsecs

= 4.4 pc to 2 sf

(ii) apparent magnitude, m = + 9.8

$$m - M = 5 \log \left(\frac{d}{10}\right)$$

$$+ 9.8 - M = 5 \log \left(\frac{4.4}{10}\right)$$

M = 9.8 - (-1.78) = + 11.582……. = + 11.6 to 3 sf

3. (a) (i) m = + 3.0, d = 100 pc

$$m - M = 5 \log \left(\frac{d}{10}\right)$$

$$M = m - 5 \log \left(\frac{d}{10}\right)$$

$$= + 3.0 - 5 \log \left(\frac{100}{10}\right)$$

$$= + 3.0 - 5.0$$

$$= - 2.0 \text{ to 2 sf}$$

(ii) m = - 1.4, d = 2.7 pc

$$m - M = 5 \log \left(\frac{d}{10}\right)$$

$$M = m - 5 \log \left(\frac{d}{10}\right)$$

$$= -1.4 - 5 \log \left(\frac{2.7}{10}\right)$$

$$= - 1.4 - (- 2.8)$$

$$= + 1.4 \text{ to 2 sf}$$

(b) M = + 3.5, d = 30 pc

$$M = m - 5 \log \left(\frac{d}{10}\right)$$

$$m = M + 5 \log \left(\frac{d}{10}\right)$$

$$= + 3.5 + 5 \log \left(\frac{30}{10}\right)$$

$$= + 3.5 + 2.4$$

$$= + 5.9 \text{ to 2 sf}$$

4. (a) m = - 26.8, d = $\frac{1}{206\ 000}$ pc (1 AU)

$$m - M = 5 \log \left(\frac{d}{10}\right)$$

$$M = m - 5 \log \left(\frac{d}{10}\right)$$

$$= - 26.8 - 5 \log \left(\frac{1}{206000 \times 10}\right)$$

$$= - 26.8 - (- 31.6)$$

$$= + 4.8 \text{ to 2 sf}$$

(b) M = + 4.8, d = 5.2 AU = $\frac{5.2}{206\,000}$ pc (2.52 x 10^{-5} pc)

M = m – 5 log $\left(\frac{d}{10}\right)$

m = M + 5 log $\left(\frac{d}{10}\right)$

= + 4.8 + 5 log $\left(\frac{30}{10}\right)$

= + 4.8 + (- 28.0)

= - 23.2 to 2 sf