CHAPTER 23

Astronomy: finding the distance to stars

Answers to revision questions

1. The change in the position of a star in the sky relative to distant background objects is measured as the Earth revolves around the Sun. Half the maximum angle of change is called the parallax angle, measured in arcsecs (seconds of a degree of arc), p''. The distance to the star is calculated using $d = \frac{1}{p''}$, where d is the distance in parsecs.
2. The doubling of Earth's orbital radius would result in the doubling of all parallax measurements made. It would also allow for doubling of the distances measured to objects that are possible using trigonometric parallax before errors make the technique of no use.
3. The Hipparcos Observatory, in orbit around the Earth, is not affected by the 'seeing' and refraction caused by the atmosphere. With better resolution and no refraction, very precise measurements of the parallax angles of thousands of stars has been possible. (The orbital radius of the observatory has no bearing on its benefits.)
4. On a scale diagram, if 1 a.u. is represented by a length of 1 mm, then one light-year would be 63.1 m long, and a parsec would be 205.0 m long. It is thus the exercise of attempting to represent these lengths on the one scale that shows their relative sizes.
5. The source of error in making parallax measurements is primarily in the resolution of the observing device, as refraction errors can be compensated. Space-based observations that avoid 'seeing' from the atmosphere can have far better resolution than ground-based observations, and hence less error in the parallax measurements. With less error in each measurement, smaller parallax angles can be measured to find the distances to objects which are further away.
6. A light-year uses the period of revolution of the Earth around the Sun. A light-year is the distance light travels in a vacuum in one Earth year. It would be most unlikely for another planet to have exactly the same period of revolution around its star, and therefore the same length of its 'year' as the Earth.

   A parsec is a distance derived from measurements dependent on the radius of the Earth's orbit around the Sun. Again, it would be unlikely for another planet to have the same orbital radius as the Earth.
7. Using $d = \frac{1}{p''}$:

   (a) 20 pc

   (b) 4.35 pc

   (c) 125 +/– 42 pc