PART IV

Question 7

[Book 3 subsections are given.]

(a) A standard candle is an object of known luminosity embedded in the object whose distance you want to know. To obtain the distance d you measure the flux density F received on Earth from the standard candle, and use its known luminosity L in the equation

$$d = (L/(4\pi F))^{1/2}$$

[2.3.1]

[For full marks the equation needs to be quoted – it's given in the list at the beginning of the paper. Full marks would be awarded for any algebraic variation of this equation, including the use of V band quantities. Note that the glossary definition of a standard candle is included: it was not asked for in the question, but forms a natural part of the answer, so marks would be awarded.]

(b) (i) Type Ia supernovae reach roughly the same peak luminosity. The light curve and spectrum of a supernova are obtained by observation, to see whether it is a Type Ia. The form of the light curve, and the absence of hydrogen lines in its spectrum, reveal a supernova to be Type I – Type Ia is a sub-class. If it is Type Ia, then we can estimate its peak luminosity fairly accurately. The flux density at the peak of the light curve is then measured. The distance d is then obtained from the above equation. [2.3.3]

(ii) The luminosity of a Cepheid varies periodically, with a period that is correlated with its peak (or average) luminosity in a known manner – the period-luminosity relation. The Cepheid is identified through the form and period of its light curve. From its light curve its period is obtained. Its peak (or average) flux density is also measured. The period-luminosity relation is then used to obtain its peak (or average) luminosity. The distance d is then obtained from the above equation. [2.3.3]

Question 8

[Book 3 (sub)sections are given.]

(a) A Seyfert galaxy and a starburst galaxy both have spiral form.

A Seyfert has a bright point source at the centre of the galaxy – a starburst does not. The point source exhibits

- variable emission
- strong, broad emission lines
- excess emission at X-ray, UV and IR wavelengths.

A starburst galaxy has a spatially extended source that has

- narrow emission lines
- strong emission in the far IR, but not at X-ray and UV wavelengths.

[Though the glossary is useful here, you are asked to outline the similarities and differences, rather than separately state the main features of each type of galaxy. However, information *appropriately* drawn from the glossary carries marks.]

(ii) The Seyfert galaxy is believed to contain an AGN because the source of its activity is point-like and near its centre. By contrast, the peculiarities of a starburst galaxy originate from an extended region, and seem to be due to a burst of star formation.

[3.3.1–3.3.3]