Diploma in Astronomy—First Term 2005-6

DP11 Foundations of Astronomy: Problem Paper 3.

22nd November 2005

Solutions should be returned by Tuesday 6 December. After that date they can be accepted, but once model solutions are posted, they cannot receive credit for marks (but can count towards completion of the course). The weighting for each question is given in ().

1) A starburst galaxy that I am studying has an Hα emission line (i.e. a hydrogen transition from the n=3 to n=2 state) observed at a wavelength of 670 nm. How fast is this galaxy moving relative to us? Note: the rest wavelength (λ_0) of Hα is 656.3 nm (use the Doppler shift equation on page 113). What would the wavelength of a Hβ line be in this galaxy (λ_0=486 nm)? Is this galaxy moving toward or away from us? (7 marks)

2) If the galaxy in problem 1 is 50 Mpc away from us, what would its parallax be? What diameter telescope would be needed to resolve this parallax angle if we observed in the optical (e.g. 500 nm)? (6 marks)

3) If a star has a luminosity 100,000 times that of the sun and a surface temperature of 50,000 degrees (K), what is the radius of this star (in solar units). When this star evolves off the main sequence into the super-giant phase, its temperature will drop to 4,000 degrees (K). Assuming that the luminosity stays the same, what will its new radius be? (7 marks)