

Stars and Galaxies
Observational Techniques Workshop 1

- 1) What is the sidereal day? Why is one sidereal day not equal to 24 hours?
- 2) Astronomers often use a rule of thumb that a change in brightness of 1% corresponds to a change of 0.01 magnitudes. Justify this.
- 3) The most distant galaxy that has ever been detected is approximately 30th magnitude. How much fainter (in linear scale) is this than you can see with the naked eye (assume you are on a dark site and your eyes are well adapted to the dark).
- 4) The V -band magnitude of two stars are both observed to be 7.5, but their blue magnitudes are $B_1 = 7.2$ and $B_2 = 8.7$.
 - (i) What is the colour index, $(B - V)$, of each star?
 - (iii) If these two stars are in a binary system at a distance of 100 pc, what are their absolute magnitudes?
- 5) A certain globular cluster is comprised of 10^4 stars. When observed at very high resolution, it is found that 100 of the stars have apparent magnitude, $m_v = +1.0$. The rest have $m_v = +6.0$. However, when observed from Durham, due to bad seeing, this star cluster appears unresolved. What will the total apparent magnitude of the cluster be when observed from Durham?
- 6) List the four main atmospheric factors that dominate the choice of a telescope site.
- 7) A telescope with a 0.5 m primary mirror has a focal length of 15 meters and a CCD camera which is 3 cm across and comprises 1000×1000 pixels.
 - (a) Calculate the plate scale in arcseconds / pixel and the field of view of the instrument.
 - (b) If this telescope is observing at a wavelength of 600 nm, calculate approximately how many pixels will the image of the star cover if:
 - (i) if the telescope is placed in space (i.e. observing at the diffraction limit)
 - (ii) if the telescope is observing from the ground, where atmospheric turbulence results in seeing of 1"
- 8) What size will the Moon appear, in mm, on a detector placed in the focal plane of a telescope with an aperture of 1.2 m and a focal ratio of $f/2.5$? Assume that the Moon has an angular diameter of 0.5 degrees.
- 9) (a) State three advantages of modern CCD detector technology over photographic films.
 - (b) A 4 m telescope has been equipped with a CCD camera which is read out using a 16-bit controller with a gain of 1 and a bias of 200 ADU. The CCD is used to perform a set of observations designed to link the positions of bright ($V = 8-10$) stars to those of much fainter stars ($V > 15$). To achieve this the CCD must detect the faintest stars without saturating the brightest stars.
 - (i) What is the maximum number of photo-electrons that can be registered before the CCD is saturated?
 - (ii) If the zero point of the system is 16.5 magnitudes, what is the longest exposure that can be made where a $V = 8$ magnitude star will be unsaturated? You may assume that all the counts fall on one pixel.