A $R = 20$ star observed with LRIS (the Keck imaging spectrograph) produces 1890 detected photo-electrons per second. The R-band sky brightness at Mauna Kea is listed at the CFHT WWW site as 20.9 mag/arcsec^2. The LRIS pixel scale is 0.22 arcseconds/pixel, the readout noise is 8e- and the inverse gain of the system is 2.0 e-/DN.

(a) What is the rate of detected e-/pixel from the sky in the R band?

(b) What is the rate of detected e- from a $R = 26$ magnitude star observed at an airmass of 1.2 assuming the extinction coefficient in R is 0.1 mag/(unit airmass)?

(c) Assume that you are measuring all of the light for the $R = 26$ magnitude star in an aperture with a radius of 7 pixels. At what exposure time does the measurement become sky dominated?

(d) For the sky-dominated case, how does the S/N scale with exposure time?

(e) How does the S/N scale with seeing (assume you scale the measuring radius linearly with FWHM of points sources).

(f) Make a table of the source noise, sky noise, readnoise and S/N for exposure times of 1, 60, 600, and 3600 seconds.

(g) What is the exposure time required to make an observation of this star with a S/N of 20?

(f) What is the exposure time required to make an observation of this star with S/N=20 with WFPC2 in the filter that is the closest match to "R"?

R_*	count rate from star	e-/second
R_{sky}	count rate from background	e-/second/pixel
t	exposure time	seconds
r	radius of aperture	pixels
G	inverse-gain	e-/DN
D	dark current	e-/pixel/sec
RN	Readout noise	e-pixel