problem 4.

A CCD detector will be used for photometry of a galaxy with average surface brightness in Johnson´s B band B = 21.8 mag/arcsec^2.

Knowing that:

- All observations were performed in dark sky (new moon), with a sky brightness B = 22.6 mag/arcsec^2.

- The CCD has a quantum efficiency of 87% at 4344 Å, 0.2 arcsec square pixels and it is read at a frequency that provides a RON of 5 e^- (RMS). Consider a linear response regime, negligible dark counts and no contribution from illumination and flatfield corrections to the error budget.

- The observations were performed at a 7.7m effective diameter telescope. The optical path has an overall efficiency of 70% at 4344 Å.

- A nearly constant airmass (X=1.2) can be assumed in addition to first order extinction with coefficient K_B = 0.21 mag for all exposures. Ignore the second order extinction coeffs.

- Consider that a constant sky brightness (in counts/pix/s) can be evaluated from the mode of many pixels values (over a large solid angle), yielding a well defined background value with negligible uncertainty when compared to the source photon noise.

- The standard Vega (B=0.0) flux outside the atmosphere (X=0.0) at 4344 Å is $f_\lambda = 6.32\times10^{-9}$ erg cm^{-2} s^{-1} Å^{-1} (Bessel 1998).

- The effective central wavelength of B band are: λ_{eff} = 4344 Å; $\Delta\lambda_{eff}$ = 98 Å.

- Four (4) 1200 s exposures where taken.

i. Calculate the final S/R per pixel in the surface brightness for the combined (co-added) set of exposures.

ii. Calculate the S/R per resolution element (FWHM) for an image quality of 1.0 arcsec (FWHM).

iii. Find the fractional contribution to the total variance (sigma^2) from

ii.1 sky background,
ii.2 readout noise and
ii.3 source photon counting.

Constants: h = 6.626×10^{-27} erg s ; c = 2.998×10^{10} cm s^{-1} .