Data Analysis Problems - II

1. What is the best way to combine 3 successive data frames taken with the same exposure time but under the following conditions:-

   - perfect transparency and "dark" sky
   - high level cirrus $\Rightarrow$ transparency down by factor of 2
   - same as preceding but moon has risen $\Rightarrow$ sky $2\times$ brighter

   assume that the frames remained coaligned, had the same seeing and that the noise in each pixel is Poisson. Consider two cases:- faint images where sky noise dominates, bright images where sky noise is negligible. What is the improvement compared to straight coaddition ?

2. What is the improvement in peak signal:to:noise obtained by using:- a matched detection filter; a circular "top-hat" filter; compared to no filter; for Gaussian images with FWHM = 2, 4 and 6 pixels respectively – as usual assume faint images where sky noise dominates ?

3. There are two wavelength-calibrated stellar spectra available as either ascii or 1D FITS files on http://www.ast.cam.ac.uk/lect.html . Cross-correlate them to find their relative radial velocity (in km/s) using either a package (eg. IRAF, IDL .....) or a standalone program. [Hardcopy of the various stages with a brief description of what you have done would be more pursuasive than just the answer.]