practice problem:

a) pixel size $p = L\tan\alpha$, $p = 5\mu m$, $L = 24mm$, $\arctan(P/L) = \alpha \therefore \alpha = 0.75''$

b) $\theta = 1.22\,\lambda/D$, $D = 8mm$, $\lambda = 550\,nm \therefore \theta_{optical} \geq 1.22\,\frac{550nm}{8mm} = 17.3''$. The resolution of the eye is diffraction limitted.

c) $R_\odot = 7\cdot10^{10}cm \longrightarrow d_\odot = 1.4\cdot10^{11}cm$, we know parsec $\equiv$ AU/arcsec and $1.4\cdot10^{11}cm = 9.3\cdot10^{-3}AU$

$9.3\cdot10^{-3}/17.3'' = 5.4\cdot10^{-4}\,pc$
there are no stars (other than the sun) which are this close to Earth

d) The diffraction limit of the eye means the image of the disk of the star is spread over multiple rod cells.*

*of course, atmospheric blurring also contributes to this effect of spreading light over multiple cells, but I believe (I hope) that this effect is less significant than the diffraction limit

e) 17.3'' is the diffraction limitted resolution, 0.75'' is angular resolution of rod cell.
$17.3''/0.75''$ = diffraction-limitted circle is 23 rods across $\therefore$ has an area equal to $\sim$415 rod cells.
min 6 γ/s per rod cell $\longrightarrow$ 2490 γ/s must enter the eye for a star to be visible
apperature of eye is 8mm diamater $\longrightarrow$ area of "light-bucket" is $0.5\,cm^2$
$\frac{2490}{0.5} = 4980\ \gamma/s/cm^2$ is the minimum photon flux incident upon the eye

$4980\ \gamma/s/cm^2 \xrightarrow{\text{multiply by } cm^2\ (*)} 4980\ \gamma/s = L_2$

$\frac{L_1}{L_2} = 10^{0.4(m_2-m_1)}$

$10^6\ \gamma/s/cm^2 \longrightarrow 10^6\ \gamma/s = L_1 \longrightarrow m_1 = 0$

$\frac{L_1}{L_2} = 10^{0.4(m_2-m_1)} \longrightarrow \frac{10^6}{4980} = 10^{0.4m_2} \longrightarrow \log_{10}\left(\frac{10^6}{4980}\right)\left(\frac{1}{0.4}\right) = m_2 =$ largest apparent magnitude a preceptible star can have $= 5.75$

*this is a sneaky trick that works because we only care about the ratio of luminosities, not the true values. $L = F\cdot\text{area} \longrightarrow L \propto F \longrightarrow \frac{L_1}{L_2} = \frac{F_1}{F_2}$