Physics II

Optical Aberrations

Problem 1.- Chromatic aberration is due to dispersion of the indexes of diffraction in lenses for different wavelengths (colors). How can we avoid this problem?

a) Using parabolic lenses instead of spherical
b) Using mirrors instead of lenses
c) Coating the surface of the lens with anti-reflecting films
d) Using polarized light

Solution: It can be avoided using mirrors instead of lenses (**b**). Mirrors reflect all colors the same way, they do not disperse them.

Problem 2.-
a) How do you avoid chromatic aberration in a microscope?
b) How would you avoid spherical aberration in a telescope?

Solution:
a) You can avoid chromatic aberration in a microscope by using monochromatic light.
b) You can avoid spherical aberration in a telescope by using parabolic mirrors.

Problem 3.- What would you suggest to avoid chromatic aberration when designing a telescope.

Solution: You can avoid chromatic aberration using mirrors instead of lenses or by compensating with combinations of converging-diverging lenses. If the problem is in a microscope, you could use monochromatic light instead of white light.

Problem 4.- Explain a possible reason to use two lenses, one positive and one negative as the objective of a telescope instead of just one lens.

Solution: Using two lenses of different dispersion could minimize chromatic aberration of the combination. Using a yellow filter could help too, as it reduces blue and red light that would produce the largest dispersion.
Mirrors don't have chromatic aberration, so they are better for telescope optics in that respect.

Problem 5.- Explain a possible reason to use a sodium lamp in a microscope, instead of white light.

Solution: Sodium lamps are mostly monochromatic, which avoids chromatic aberration, giving sharper, more focused images.