

Tutorial for PHYS210 Lectures 6 and 7. Monochromatic lens aberrations

- 1) Light enters from air to glass ($n=1.6$) under an angle of 40° with the normal. What is the refraction angle according to Snell's law? By how many degrees is the light bent at the surface? Calculate these two numbers also for the paraxial approximation. Make a sketch indicating both the true refraction and the paraxial approximation. Is the true bending of light stronger or weaker than the paraxial approximation?
- 2) Someone tries to focus parallel light into a point. She has two plano-convex lenses with the same focal distance, one made of glass with refractive index 1.45 and one with refractive index 1.65. Which of the following configurations will give the least spherical aberrations?
 - A. The $n=1.65$ lens with the flat side towards the parallel beam of light
 - B. The $n=1.65$ lens with the curved side towards the parallel beam of light
 - C. The $n=1.45$ lens with the flat side towards the parallel beam of light
 - D. The $n=1.45$ lens with the curved side towards the parallel beam of light
- 3) Someone tries to make a beam of parallel light from a point source. He has two plano-convex lenses with the same focal distance, one made of glass with refractive index 1.45 and one with refractive index 1.65. Which of the following configurations will give the least spherical aberrations?
 - A. The $n=1.65$ lens with the flat side towards the point source
 - B. The $n=1.65$ lens with the curved side towards the point source
 - C. The $n=1.45$ lens with the flat side towards the point source
 - D. The $n=1.45$ lens with the curved side towards the point source
- 4) Spherical aberrations
 - A. Are a consequence of dispersion
 - B. Can be reduced by using an aspheric lens
 - C. Cause the image of a line to be a curve
 - D. Are worsened when an aperture stop is introduced
- 5) Which of the following statements is true?
 - A. The inner part of the ocular lens has a lower refractive index than the outer part
 - B. The graded index of the ocular lens acts as an aperture stop
 - C. The graded index of the ocular lens helps to reduce spherical aberrations in the eye
 - D. The graded index of the ocular lens worsens spherical aberrations in the eye
- 6) Coma
 - A. Arises only for objects on the principal axis
 - B. Is worse for red light than for blue light
 - C. Comes from unequal magnification of light going through different zones of the lens
 - D. Is worse for a lens of high refractive index

- 7) Which of the following statements is true?
- A. The focal distance in the tangential plane is smaller than in the sagittal plane
 - B. The tangential plane is parallel to the sagittal plane
 - C. The sagittal plane contains the principal axis
 - D. Oblique astigmatism is only relevant for toric lenses
- 8) Which of the following statements is true?
- A. The circle of least confusion coincides with the lens
 - B. The circle of least confusion is behind the interval of Sturm
 - C. The circle of least confusion is inside the interval of Sturm
 - D. The circle of least confusion is in front of the interval of Sturm
- 9) Distortion
- A. Blurs the image
 - B. Arises because the magnification varies across the image
 - C. Cannot be reduced using doublets
 - D. Does not apply to off-axis objects