

University of Calgary
Winter semester 2007

PHYS 471: Optics

Midterm examination

March 2, 2007

Closed books. Attempt all questions. Partial credit will be given. Calculators permitted but cannot be used to store equations.

Problem 1.

- (15 pts) On this examination sheet, construct the image produced by the lens. Using the ruler, measure the object distance s , image distance s' , focal length f and magnification M .
- (5 pts) Characterize the image.
- (5 pts) Based on the parameters measured, verify the thin lens equation and the expression for the magnification by a thin lens.

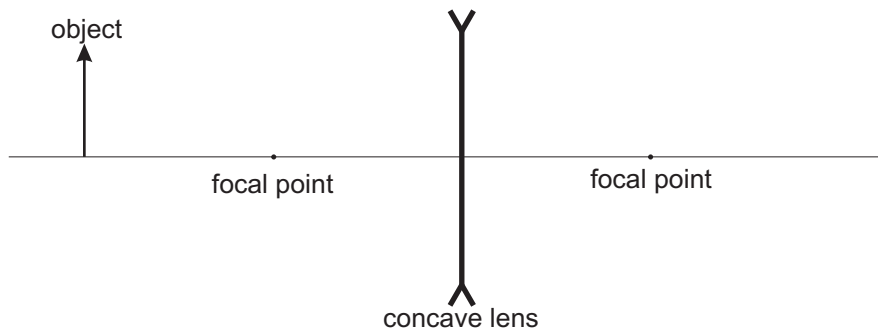


Figure 1:

Problem 2. Consider the Doppler-broadened spectral lines of atomic vapors of sodium (atomic mass 23, wavelength 590 nm) and rubidium (atomic mass 87, wavelength 795 nm).

- (15 pts) What is the ratio of the linewidths?
- (10 pts) By which factor will the linewidths change if the absolute temperature is increased by a factor of 2?

EXAM CONTINUES ON THE OTHER SIDE

Problem 3. A birefringence-based polarizer is shown in Fig. 2.

- a) (5 pts) What is the name of this optical instrument?
- b) (10 pts) Show a possible orientation of the optical axes in both prisms.
- c) (5 pts) With this orientation, is this a positive or negative crystal? Why?

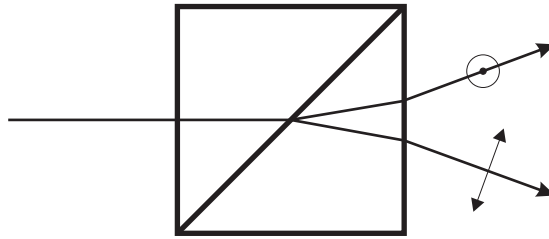


Figure 2:

Problem 4. The index of refraction n of a certain material is a known function $n(\omega)$ of the optical frequency ω .

- a) (5 pts) Find the wavevector k as a function of ω .
- b) (15 pts) Find the group velocity in terms of $n(\omega)$.