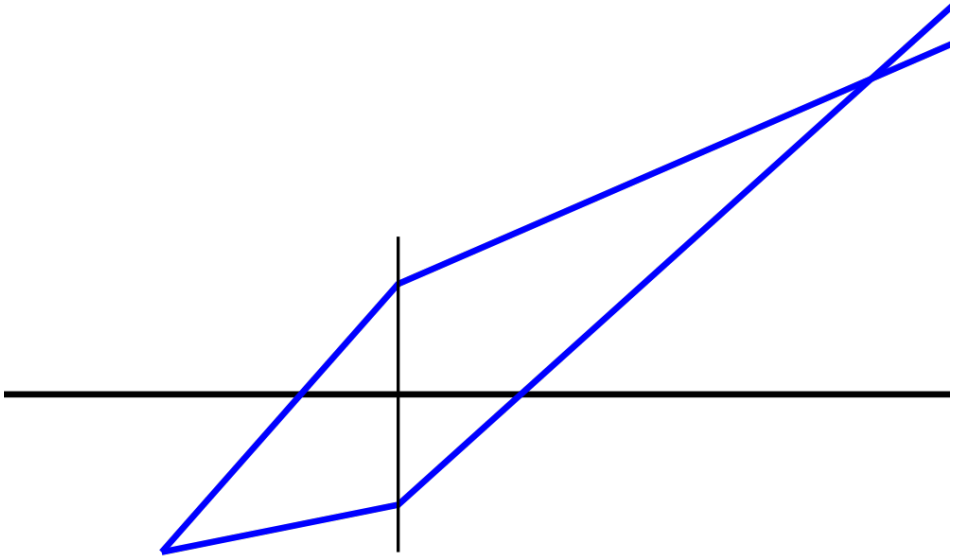
Problem 1. The figure below shows two light rays from a source. The rays are refracted by a lens.



a) Is this a positive or a negative lens? Explain. (1p)

Lösning:

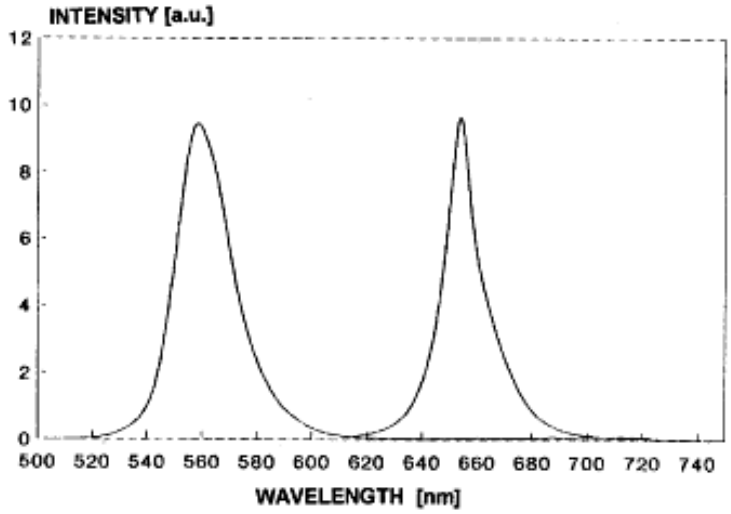
b) Determine by construction the focal points of this lens. Explain your lines. (2p)

Lösning:

c) There is a second way of determining the focal points by construction. Describe those lines. (1p)

Lösning:

Problem 2. The figure below shows the spectra of two light-emitting diodes.



a) What are their colours? What are their coherence lengths? (1p)

Lösning: .....

b) We want to modulate the intensity of the longer wavelength LED to transmit a signal through a 1 km optical fiber. The fiber's index of refraction is given as $n(\lambda) = A + B/\lambda^2$ with $A = 1.466$ and $B = 4.153 \cdot 10^{-15}$ m^2.

What is the phase velocity? (1p)

Lösning:

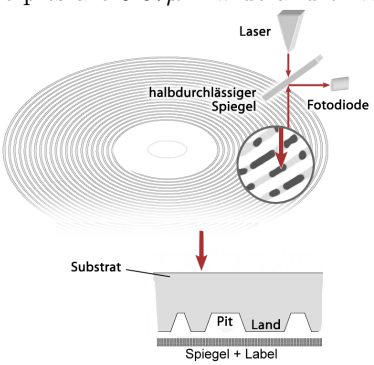
c) How large is the group velocity? (1p)

Lösning:

d) What is the highest modulation frequency that can be used? (1p)

Lösning:

Problem 3. The figure below illustrates the readout system of a Compact-Disc player (upside down and not to scale). The label 'halbdurchlässiger Spiegel' is German for semitransparent mirror. The laser has a wavelength of 780 nm. The laser optics has a numerical aperture of 0.45. The CD consists of a transparent polycarbonate substrate of 1.2 mm thickness; its index of refraction is 1.55. The information is encoded in a highly reflective metallized layer with shallow pits. The pits are 0.67μm wide and of varying length.



a) The diode detects less light when the laser spot is focused on a pit because of destructive interference when half the light is reflected from 'land' and half from 'pit'. How large should the height difference between pits and land be to achieve the largest difference in intensity on the diode? (1p)

Lösning: .....

b) Where does the energy of the incident laser beam go when it is focused on a pit? (1p)

Lösning:

c) The size of the focus is limited by diffraction. In order to minimize cross talk between neighbouring tracks, they should be separated by the first minimum of diffraction. What would be a suitable distance between tracks? (1p)

Lösning:

c) The focus is produced by a convergent beam coming from below, so that readout is insensitive to specks of dust on the surface. How large is the diameter of the laser beam at the lower surface? Make a clear sketch beside the figure above. (1p)

Lösning: .....

Växjö universitet

TENTAMEN

Institution: MSI, Fysik

Examinator: Pieter Kuiper

Datum: October 30, 2009

Tid:

Plats:

Kurskod: FY3083

Kurs/provmoment: Optics

Hjälpmedel: ruler, calculator, Hecht or any other books about optics, notes

Namn: .....

Adress: .....

.....

Personnummer: ☐☐☐☐☐☐-☐☐☐☐

Please write your solutions on this exam. Write your name on any additional pages.

This exam has 3 problems.

Lycka till!

	1	2	3	4	5	Summa	Betyg
Inlämnad							
Poäng							

Uppvisat legitimation: Ja ☐ Nej ☐

Uppvisat kårlegitimation: Ja ☐ Nej ☐

Tid för inlämning: .....

Tentavaktens signatur: .....