

Problem 1. Solargraphy is a method of recording the ecliptic (the path of the Sun over the sky) using a pinhole camera. The Sun's apparent diameter is about $\frac{1}{2}^\circ$. In the method of the Finnish artist Tarja Trygg, the camera is a standard black-plastic film canister (diameter is 30 mm), with ordinary photographic paper as the sensor.

a) Estimate from geometrical optics the size of the largest pinhole that can resolve objects of the size of the Sun. (1p)

Lösning:



b) You decide to use a small pinhole to try to make sharper images and you choose 0.01 mm. Using all optics taught in this course, what is the size of the image of the Sun on the photographic paper? Does this resolve the Sun? (1p)

Lösning:



Problem 2. Consider a multi-mode stepped-index optical fiber with an attenuation of 0.3 dB/km. The refractive index of the core is 1.500, the cladding has an index of 1.485.

a) What is the critical angle inside the fiber? (1p)

Lösning:

b) How large is the numerical aperture of this fiber? (1p)

Lösning:

c) How large is the mode dispersion (in ns/km) of this fiber? (1p)

Lösning:

c) After what length of this fiber has the intensity dropped to 1%? (1p)

Lösning:

Problem 3. Turpentine has a refractive index of 1.472 and a rotatory power of $-0.37^\circ\text{mm}^{-1}$ (at 10°C , $\lambda = 589.3\text{ nm}$).

a) A 10 mm wide cuvette with turpentine is placed between crossed polarizers. Disregarding reflection and absorption, how much light is transmitted through the setup? (1p)

Lösning:



b) How large is the absolute value of the difference between the refractive indices for left-handed and right-handed circularly polarized light in turpentine? (1p)

Lösning:



Problem 4. *a)* Large magnifying glasses for reading have much smaller magnifications than jewellers' loupes. Explain why. (1p)

Lösning:

b) What use is such a large magnifying glass for an elderly Sherlock Holmes when its nominal magnification is less than 2? (1p)

Lösning:

TENTAMEN

Institution: DFM, Fysik

Examinator: Pieter Kuiper

Datum: November 5, 2010

Tid:

Plats:

Kurskod: 2FY811

Kurs/provmoment: Optics

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

Namn:
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Skriv helst lösningarna på tentan. Skriv ditt namn på eventuella tillägsblad.

Den här tentan har 4 problem.

Lycka till!

	1	2	3	4	5	Summa	Betyg
Inlämnad							
Poäng							

Uppvisat legitimation:	Ja	<input type="checkbox"/>	Nej	<input type="checkbox"/>
Uppvisat kårlegitimation:	Ja	<input type="checkbox"/>	Nej	<input type="checkbox"/>
Tid för inlämning:	Tentavaktens signatur:			