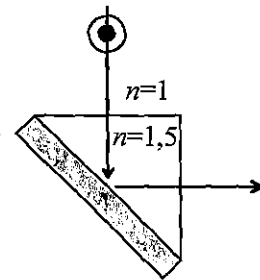


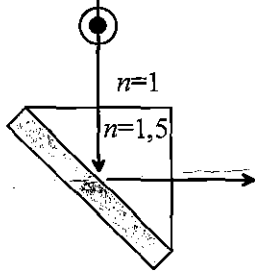
**Sallitut apuvälineet:** Konseptiarkin kokoinen (A3 tai 2 x A4), käsin kirjoitettu muistilappu (palautetaan vastausten yhteydessä), laskin (voi olla myös graafinen), matemaattinen kaavakokoelma (esim. MAOL).

- Määrittele seuraavien termien tarkoitus mahdollisimman lyhyesti: a) Poikittainen aalto, b) Säteilypaine, c) Paraksiaalinen optiikka, d) Aukkorajoitin, e) Kuidun moodidispersio, f) Diffraktorajoitettu optinen instrumentti.
- Vastaa seuraaviin kysymyksiin lyhyesti, mutta täsmällisesti:
  - Miksi läpinäkyvien aineiden taitekerroin kasvaa, kun aallonpituus lyhenee?
  - Miten valon vaihenopeus ja ryhmänopeus vaikuttavat valopulssien etenemiseen?
  - Aaltolevyjen toimintaperiaate?
- Oheisen prisman yksi kulma on suora ja muut kulmat  $45^\circ$ . Prisman taitekerroin on 1,5 ja ympäröivän aineen 1. Valo on polarisoitunut kohtisuorassa paperin tason suhteen. Valo tulee prisman toiselle lyhyelle sivulle kohtisuorassa. Mikä osuus alkuperäisestä valoenergiasta saadaan ulos toiselta lyhyeltä sivulta, kun prisman hypotenuusa on peitetty aineella, jonka taitekerroin on a) 1 tai b) 1,3.



Over for problems in English

**Allowed in the examination:** A3-size (or 2 x A4) hand-written notes (to be returned with the exam), calculator (can be also programmable), mathematical tables.

- Define the meaning of the following concepts as briefly as possible: a) Transverse wave, b) Radiation pressure, c) Paraxial optics, d) Aperture stop, e) Modal dispersion of a fiber, f) Diffraction-limited optical instrument.
- Explain briefly but accurately:
  - Why does the index of refraction of transparent materials increase for decreasing wavelength?
  - How do the phase and group velocity of light influence propagation of optical pulses?
  - Operation principle of wave plates?
- One angle of a prism is  $90^\circ$  and the other two  $45^\circ$ . The refractive index of the prism is 1,5 and that of the surrounding material 1. Light is polarized perpendicular to the plane of the paper and arrives to one of the short faces of the prism at normal incidence. Which fraction of the incident light energy exits through the other short face when the hypotenuse is coated with a material whose refractive index is a) 1 or b) 1,3?
 
- By coincidence, students A and B have bought new eye glasses with identical frames. The power of A's glasses is -1.0 diopters and that of B's -1.5 diopters. After certain colorful events, A and B have ended up with each other's glasses. How far do A and B see sharply with each other's glasses?
- The reflectivities of the mirrors of a Fabry-Perot interferometer are 98%. The space between the mirrors is filled with air and the nominal distance between the mirrors can be chosen freely. Light arrives to the interferometer approximately at normal incidence with respect to the mirrors surfaces. The interferometer is used to measure a spectrum that is known to include frequencies in a 10-GHz broad band near the wavelength of 589 nm. What should be the nominal distance between the mirrors that the whole spectrum can be measured at the highest possible resolution? What is then the frequency resolution of the interferometer?

**Suomenkieliset tehtävät kääntöpuolella**