Optics

1. At the interface between two media the angle of incidence is 15°, the index of refraction of the medium on the incidence side is 1.9. What is the index of refraction of the other medium, if the angle of refraction is 23.16°? (1.25)
2. After passing from one medium into another, the angle of refraction of a light ray is 4.425^{o}. What is the angle of incidence, if the light travels from a medium with an index of refraction of 1.07 into a medium with an index of refraction of 1.69? (7°)
3. What is the critical angle for a light ray reaching an interface with index of refraction of 1.31 on the incidence side and 1.16 on the refraction side? (62.31°)
4. If $n_1 = 1.97$ and $n_2 = 1.91$, what is the critical angle for light incident from side 1? (75.82°)
5. An object is placed 12 cm away from a convex lens. The image is located 36 cm behind the lens. Find the focal length of the lens, its power in diopters and the magnification. (9 cm, 11.1 D, $M = 3$)
6. Distilled water (index of refraction: 1.333) is dropped between the prisms (index of refraction: 1.739) of the Abbe refractometer.
   a) Calculate the critical angle. (50º)
   b) How does the critical angle (and the position of the shadowline) change if we drop blood serum of a healthy person (of 70 g/l protein concentration) between the prisms? The index of refraction of blood serum is 1.349. (50.85º)
   c) By what percentage is the speed of light decreased in the prism compared to distilled water? Calculate the decrease for the air versus prism case, too. Assume that the index of refraction of air is 1. (23.4 %, 42.5 %)
7. We make a plan-convex lens from glass with a refractive index of 1.52. The power of the lens is 2 dpt. How large should be the radius of curvature of the lens? (26 cm)
8. What is the velocity of light in water, if the refractive index of water relative to air is 1.333? (225 000 km/s)
9. What is the speed of light with a frequency of $5.19 \cdot 10^{14}$ Hz in glass if its wavelength in that medium is 310 nm? (160 890 km/s)
10. The diffraction pattern of an optical grating is produced on a screen at 2 m distance from the grating. The distance of bright areas on the screen is 12 cm. Calculate the grating constant, if the wavelength of the laser light used for illumination is 632 nm. (10.5 μm)