Constants:

- Refractive index of air: $n_{\text{air}} = 1.0$
- Speed of light in air: $c = 2.9979 \cdot 10^8 \frac{\text{m}}{\text{s}}$
- Planck's constant: $h = 6.626 \cdot 10^{-34}\ \text{J} \cdot \text{s}$

1 Optical Lens (8 Points)

A biconcave lens is made of glass (refractive index $n_{\text{glass}} = 1.45$). The radius of curvature of the two surfaces are 30 cm and 25 cm, respectively. An object is located 80 cm to its left.

(a) Calculate the focal length of the lens. **(2 Points)**

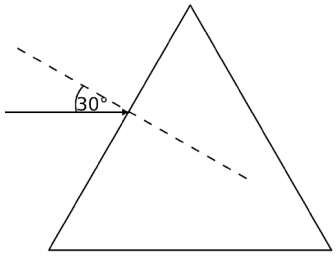
(b) Calculate the image width. **(2 Points)**

(c) Specify the magnification. **(2 Points)**

(d) Is the image real or virtual? Is it standing upright, or is it the other way around? **(2 Points)**

2 Prism (6 Points)

Ab beam of light is incident on an equilateral prism (see figure below) made of crown glass ($n = 1.51$). Calculate the first and second angles of refraction and draw schematically the ray path of the light. **(6 Points)**



Turn the page!

3 Photoelectric Effect (8 Points)

Monochromatic UV light with wavelength $\lambda = 300$ nm shines on a piece of metalic potassium. This emits electrons with a maximum kinetic energy of 2.03 eV.

(a) What is the energy of an incident photon? **(2 Points)**

(b) Calculate the work of detachment (= Work function) of potassium. **(2 Points)**

(c) Calculate the maximum kinetic energy of electrons when the incident light has a wavelength of 430 nm. **(2 Points)**

(d) In the photoelectric effect for potassium, what is the cutoff wavelength of the incident electromagnetic radiation? **(2 Points)**

4 Radioactive Decay (7 Points)

(a) Starting with 1 million polonium-210 nuclei (half-life 138 d), how many will decay in 24 hours? With what decay rate do the nuclei radiate? **(4 Points)**

(b) For the handling of radionuclides, protective regulations are only prescribed for activities above certain so-called exemption limits. For cobalt-60 (half-life 5.3 y), the exemption limit is $A_F = 50$ kBq. After how many half-lives has the activity of a Co-60 source of 185 kBq decayed to the level of the exemption limit? **(3 Points)**