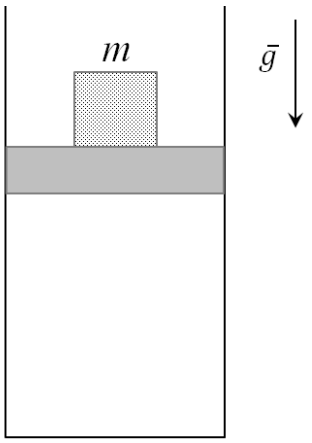
INTERNATIONAL OLYMPIADS OF KFU
profile «Physics»
final stage
2025-2026 academic year
Grades 10-11

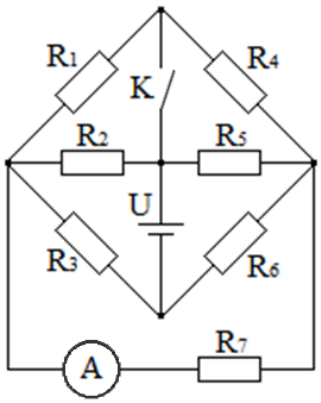
Problem 1. (25 points)

An ideal gas is under a sealed massive piston, which can move without friction in a cylindrical vessel. The height of the gas column under the piston is 30 cm. When a weight of mass m is placed on the piston, it descends by 4 cm. By how many centimeters will the piston descend if a second weight of mass m is added on top of it? The gas temperature is kept constant.



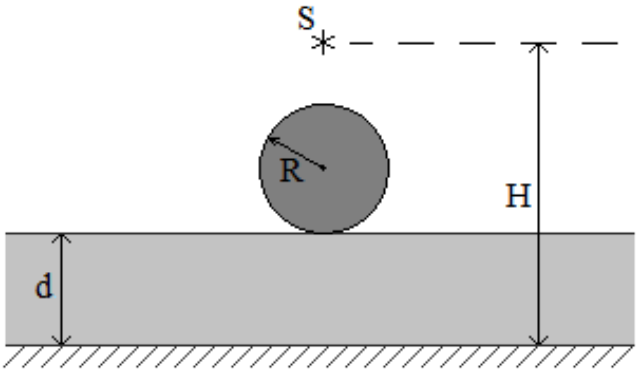
Problem 2. (25 points)

In the circuit shown in the figure, with the switch open (switch off), the ammeter reads zero current. It is known that $R_6/R_3 = 2$. Find R_4/R_1 if, when the switch is closed (switch on), the ammeter reading does not change. Neglect the resistance of connecting wires.



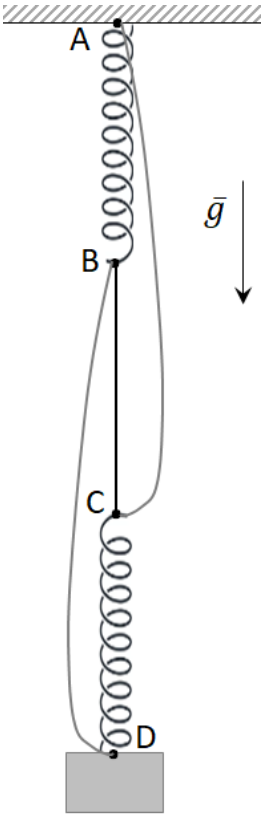
Problem 3. (25 points)

On a flat surface that does not transmit or reflect light lies a glass sheet of thickness $d = 5$ cm. On the sheet lies a ball of radius $R = 2\sqrt{2}$ cm that does not transmit or reflect light. Above the center of the ball at a height $H = 8 + 2\sqrt{2}$ cm above the surface, a point light source S is located. Find the area of the shadow cast by the ball on the surface. The refractive index of the glass is $n = 1.5$.



Problem 4. (25 points)

The system consists of two identical ideal springs with stiffness k, an inextensible thread of length 5 cm, and two inextensible threads of length 11 cm. A weight of 100 N is suspended from the system as shown in the figure. Points A, B, C, D denote connection points. In the initial state $AB = CD = BC = 5$ cm. Neglect the mass of all threads and springs. After cutting thread BC, the system comes to a new equilibrium after a long time.



1. Find the distance between points A and D in the new equilibrium. What values can k take?

2. Determine the stiffness k for which the weight remains at the same height after cutting the thread and establishing equilibrium.