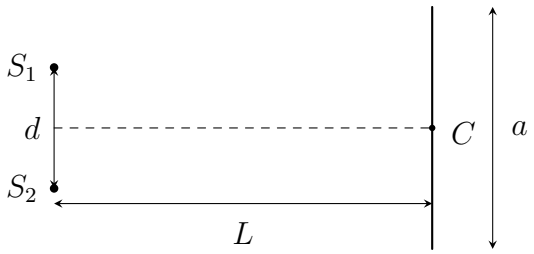
1st Exam – Physics at FRI
21st January 2026, 13:00 – 14:30

1. Nina synchronized two lasers (labeled S_1 and S_2 in the sketch), both with a wavelength of $\lambda = 632\,\text{nm}$, which she treats as two coherent point light sources (i.e. they emmit waves in-phase). She then places them $d = 3\,\text{mm}$ apart and observes their interference pattern on a $a = 10\,\text{cm}$ wide screen that is $L = 3\,\text{cm}$ away. Note that the center point of the screen lies on the symmetrical line between the two sources.

   a) Write down the condition for constructive interference.

   b) At what angle does she observe the first maximum on the screen? How far from the center of the screen is this maximum?

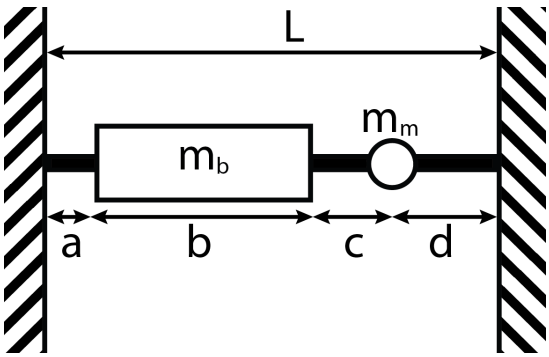
   c) How many maxima can she observe on the screen?



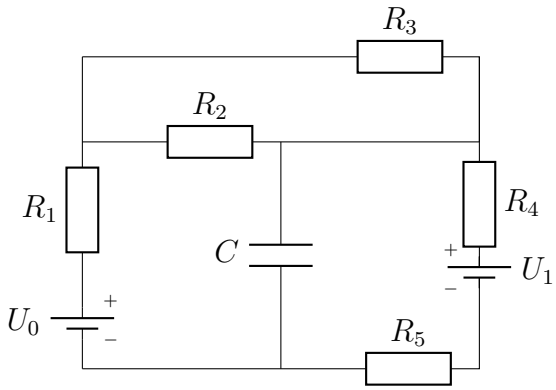
2. In a closet, we have a rod ($m_\text{p} = 0.8\,\text{kg}$, $L = 1.3\,\text{m}$) that is attached at both ends (see sketch). We hang a towel on the rod, which we treat as rod with mass $m_\text{b} = 600\,\text{g}$ and length $b = 0.6\,\text{m}$, and a shirt, which we treat as a point mass $m_\text{m} = 150\,\text{g}$. All distances ($a = 0.1\,\text{m}$, $c = 0.2\,\text{m}$, $d = 0.4\,\text{m}$) are marked on the sketch.

   a) What is the force needed to support the left end of the rod, and what is the force needed to support the right end?

   b) The support at the right end of the rod breaks. The rod falls in a way that it rotates around the left attachment point. What is the angular acceleration at the moment when the support breaks?



3. From resistors ($R_1 = 1\,\Omega$, R_2, $R_3 = 3\,\Omega$, $R_4 = 4\,\Omega$, $R_5 = 5\,\Omega$), a capacitor ($C = 3\,\mathrm{pF}$) and two batteries ($U_0 = 12\,\mathrm{V}$, $U_1 = 6\,\mathrm{V}$), we assemble a circuit as shown in the figure. Assume that the capacitor is already fully charged.

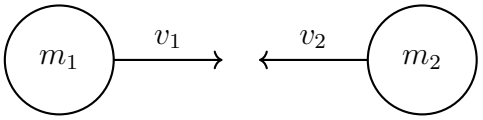


a) Calculate the resistance R_2 so that a current of $I = 0.5\,\mathrm{A}$ flows through resistor R_1 after a long time.

b) How much power is dissipated on resistor R_2 after a long time?

c) How much charge is stored on the capacitor after a long time?

4. From the left, a ball with mass $m_1 = 3\,\mathrm{kg}$ and velocity $v_1 = 7\,\mathrm{m/s}$ flies in and collides with a ball of mass $m_2 = 5\,\mathrm{kg}$, which is moving in the opposite direction with velocity $v_2 = 2\,\mathrm{m/s}$. During the collision, 30 % of the initial energy of the balls is lost. What are the velocities of the balls after the collision (magnitude and direction)?



5. Calculate the resistance of a $L = 4\,\mathrm{cm}$ long section of germanium wire in the shape of a truncated cone with radii of its bases $a = 17\,\mathrm{mm}$ and $b = 6\,\mathrm{mm}$ (see the sketch below)! Specific resistivity of germanium is $\zeta = 0.46\,\Omega\,\mathrm{m}$.