

Name:

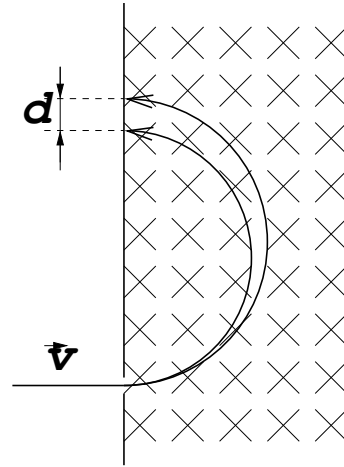
Group:

Number of points:

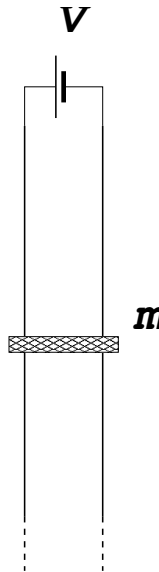
Problems

1. On the Figure a schematic picture of a mass spectrometer is shown. A mixture of the two isotopes of the carbon atoms enters the uniform magnetic field with velocity of v . The mass of the C^{13} isotope is $m_{13} = 13m_p$ and the mass of the C^{14} isotope is $m_{14} = 14m_p$ where $m_p = 1.6 \times 10^{-27}$ kg is the mass of a proton. The carbon atoms are singly ionized. It means that one electron is removed from the atoms and their charge is $Q = 1.6 \cdot 10^{-19}$ C. The velocity of the atoms is $v = 5 \times 10^6$ m/s and the magnetic field is $B = 1$ T.

- a) Give the distance d between the two isotopes when they collide into the detector! 7 points
- b) How much energy do they gain from the magnetic field? 3 points
- c) Give the magnitude of the force on the two isotopes! 5 points

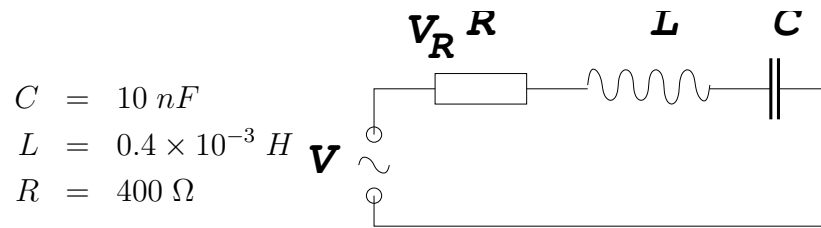


2. There is a long vertical rail on which a rod with mass of $m = 0.01$ kg can slide without any friction. The resistivity of the rod is $R = 0.1 \Omega$, and the distance of the rail is $d = 0.1$ m. The uniform magnetic field of $B = 0.1$ T is perpendicular to the plane of the rail.



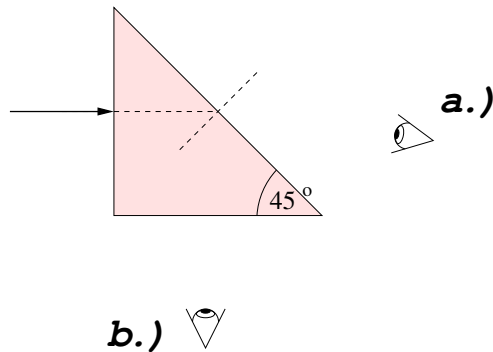
- a) How large voltage V must be applied in order to keep the rod at rest? 5 points
- b) How large will the maximum of the velocity of the rod be if only the half of that voltage is applied? 5 points
- c) How large is the current at maximum velocity? 5 points

3. A network of serially connected resistor, inductor and capacitor is shown by the figure. The amplitude of the voltage of the power supply is $V = 50 \text{ V}$ the voltage on the resistor is $V_R = 40 \text{ V}$.



- a) Give the impedance of the system! 5 points
- b) How much power is dissipated on the system? 5 points
- c) Find ω of the AC voltage! 5 points
4. There is a prism as it is given by the Figure. A purple ray which is a mixture of red and blue colour goes perpendicularly to the prism. The indices of refraction of the prism for the red and blue colours are $n_{red} = 1.38$ and $n_{blue} = 1.43$, respectively, and the index of refraction of the air is $n_{air} = 1$ for both colours.

- a) Which colour can be seen at side **a.)** and at side **b.)**? 7 points
- b) Under which angle can the different colours be seen? 8 points



0 – 20	1
21 – 30	2
31 – 40	3
41 – 50	4
51 – 60	5