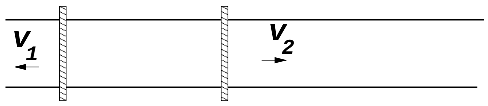
Optics Exam

Name: Group:
Number of points:

Problems

1. There are two metal rod can slide on a rail in the presence of uniform magnetic field perpendicular to the plane of the paper. A force of $F_1 = 10\,N$ has to be exerted on the first rod in order to move it with a constant velocity of $v_1 = 10\,m/s$. How much force must be exerted on the other rod in order to move it with a constant velocity of $v_2 = 20\,m/s$? Find the currents through the rods if their resistance is $R = 0.1\,\Omega$ and the magnetic field is $B = 1\,T$! 20 points

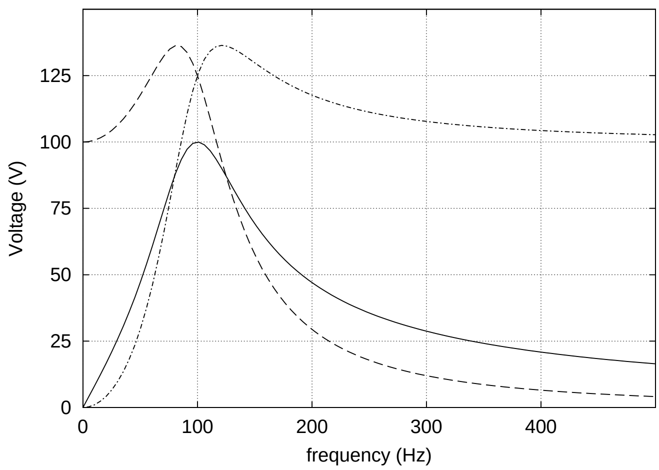


2. A charged particle is moving in the presence of uniform magnetic field of $B = (0, 0, 1\,T)$. Its initial velocity vector is $v = (10\,m/s, 0, 0)$.

   a.) How large will the speed of the particle be in $t = 10\,s$? 10 points

   b.) The mass of the particle is $m = 10^{-4}\,kg$ and its charge is $Q = 10^{-4}\,C$. How large is the radius of the motion? 10 points

3. In the figure the amplitudes of the voltage on the resistor V_R, on the capacitor V_C and on the coil V_L are shown as a function of the frequency for a serially connected RLC system.



   a.) Identify the curves belonging to V_R, V_C and V_L ! 4 points

   b.) How large is the resonance frequency? 4 points

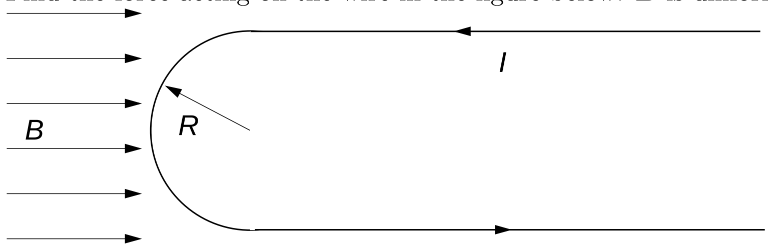
   c.) Give the amplitude of the voltage of the power supply! 4 points

   d.) At the resonance frequency the inductive reactance of the coil is $L\omega = 250\,\Omega$. How large is the resistance of the resistor? 4 points

   e.) How much power is dissipated on the system? 4 points

4. A lamp is designed for $V_1 = 110\,V$ power line. Using this voltage its power is $P_1 = 110\,W$. We would like to use it in the case of $V_2 = 230\,V$ power line. Give the capacitance of the capacitor which should connect serially to the lamp if the frequency of the power line is $f = 50\,Hz$! 20 points

5. Find the force acting on the wire in the figure below! **B** is uniform! 20 points



$I = 10\,A, \quad R = 0.1\,m, \quad B = 0.5\,T$