

Optics Exam

Name:
Number of points:

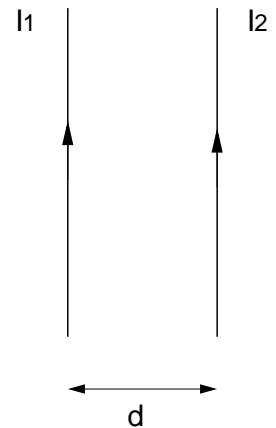
Group:
03.06.2013

Problems

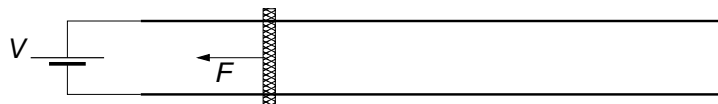
1. A particle with a mass of $m = 10^{-4}$ kg and with a charge of $Q = 10^{-4}$ C is moving in the presence of uniform magnetic and uniform electric field with constant velocity on a straight line. The components of the electric field and the velocity are $\vec{E} = (12 \text{ N/C}; 0; 0)$ and $\vec{v} = (0; 20 \text{ m/s}; 0)$.
 - a.) How large is the sum of the forces acting on the particle? 3 points
 - b.) Give the force vector due to the electric field! 3 points
 - c.) Give the Lorentz force and the magnetic field vector! 3 points
 - d.) Can the magnitude of the magnetic field be $B = 1 \text{ T}$? 3 points
 - e.) What kind of motion will the particle have if the electric field is switched off? Give the axis of the motion! 3 points
 - f.) Give the radius of that motion! 4 points

2. There is two long straight wires carrying a currents of $I_1 = 10 \text{ A}$ and $I_2 = 20 \text{ A}$, respectively. The distance between the wires is $d = 0.3 \text{ m}$.

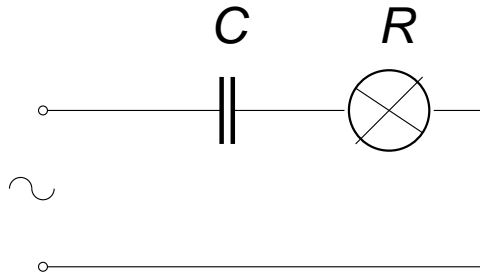
- a.) How large is the force on a 1 m segment of the wire carrying current of I_2 ? 6 points
- b.) Give the position of a third wire parallel to the others if the sum of the forces acting on it is zero! 7 points
- b.) How large is the current in the third wire if the magnetic field at the place of the 2nd wire is zero! 7 points



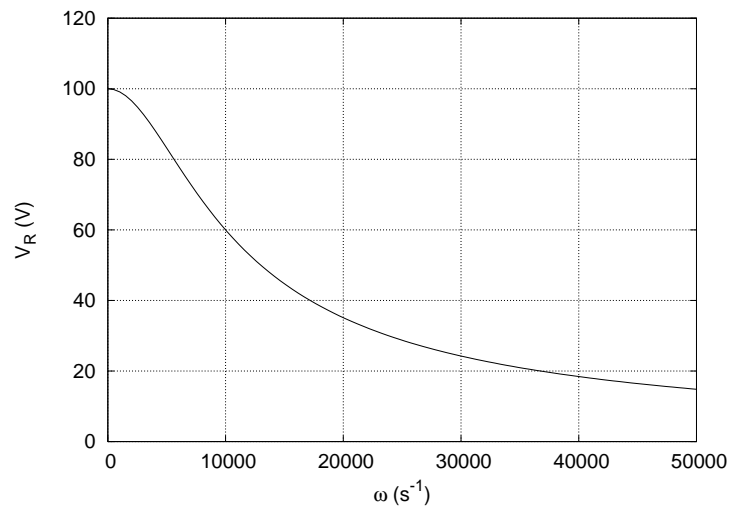
3. A small metal rod can slide without friction on a rail as it is shown in the figure. A force of $F = 1 \text{ N}$ must be exerted on the rod to keep it at rest if the voltage of the battery is $V = 10 \text{ V}$.
 - a.) Give the electric current through the rod! 8 points
 - b.) Give the maximum of the velocity of the rod after releasing it! 8 points
 - c.) How large is the current through the rod at that case! 4 points



4. In order to use a lamp in a 230 V power line which is originally designed for 110 V we apply serially a capacitor. The resistance of the lamp is $R = 1000\Omega$, how large must the capacitance of the capacitor be? 20 points



5. We have two electric components. One of them is a resistor with the resistance of $R = 300\Omega$. Unfortunately the description of the other component is disappeared. It can be a resistor, a capacitor or a coil. The two components are serially connected and the voltage can be measured on the resistor as a function of ω is shown in the Figure.



- a.) What is the second component? 6 points
 b.) Give the parameter of the second component! 7 points
 c.) How large is the amplitude of the power supply? 7 points