

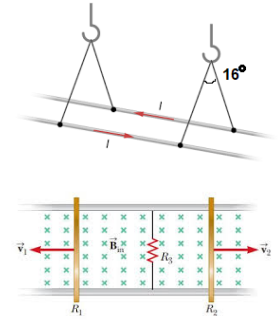
General Physics II Honors (PHYS 102H)

Problem set # 7 (due April 4)

All problems are mandatory, unless marked otherwise. Each problem is 10 points.

Q1 Early version of a telegraph included two long suspended wires that were repelled from each other when the current was flowing through them. For a particular configuration, the wire mass per unit length is 40 g/m, and they are supported in a horizontal plane by strings 6.0 cm long. If both wire carry the same current, the wires repel each other so that the angle θ between the supporting strings is 16° .

- Explain why currents must run in the opposite directions?
- What is the magnitude of the current?

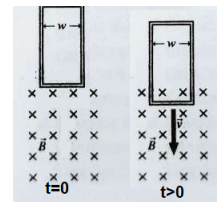


Q2 Two parallel rails with negligible resistance are distance d apart and are connected with the resistor R_3 . Two metal rods with resistances R_1 and R_2 are pulled away from the resistor at constant speed v_1 and v_2 . The whole construction is placed in a uniform magnetic field B that is perpendicular to its plane. What is the current through the resistor R_3 ?

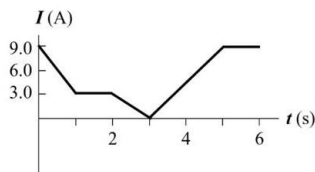
Hint: since there are two loops, you need first to find the induced emf in each of them, and then use Kirchhoff's rules to find the current.

Q3 A conducting rectangular loop falls is released right above the magnetic field-filled region and starts falling down. During the time interval before the top edge of the loop reaches the field, the loop approaches a constant terminal velocity. If M is the mass of the loop, R is its resistance, w is its width, and the magnetic field is B , show that the value of the terminal velocity is

$$v_t = \frac{MgR}{w^2 B^2}.$$



Q4 A time-varying current I (see figure) is sent through a 200-mH inductance. Make a graph of the potential difference across the inductance as a function of time.



Q5 LC oscillators have been used in circuits connected to loudspeakers to create some of the sounds of “electronic music”. You are given a 10 mH inductor and two capacitors of $6\mu\text{F}$ and $3\mu\text{F}$. Find the resonant frequencies that can be generated by connecting these elements in various combinations.