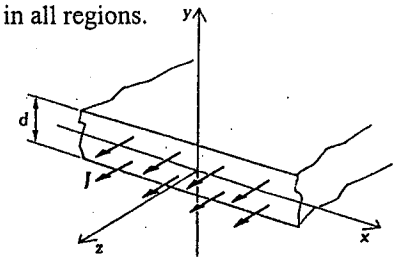
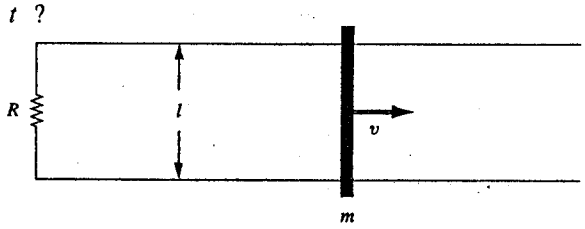
所別：太空科學研究所碩士班 科目：電磁學

1. (20%) Consider a large conducting plate of thickness $d$ located at $-d/2 \le y \le d/2$, as shown in the figure. Uniform current of density $J$ is flowing in the $\hat{z}$ direction. Find the magnetic field $H$ in all regions.




2. (20%) A metal bar of mass $m$ slides frictionlessly on two parallel conducting rails a distance $l$ apart. A resistor $R$ is connected across the rails and a uniform magnetic field $B$, pointing into the page, fills the entire region.
   (a) If the bar moves to the right at speed $v$, what is the current in the resistor? In what direction does it flow?
   (b) What is the magnetic force on the bar? In what direction?
   (c) If the bar starts out with speed $v_0$ at time $t = 0$, and is left to slide, what is its speed at a later time $t$ ?




3. (20%) If $\vec{E} = \hat{x}\alpha \exp(-jkz)$ where $k$ is a constant and $j = \sqrt{-1}$ in a region, find the corresponding $\vec{B}$.

4. (20%) A metal sphere of radius $a$ carries a charge $Q$. It is surrounded, out to radius $b$, by linear dielectric material of permittivity $\varepsilon$. Find the potential at the center (relative to infinity)

5. (20%) Explaining (1) the Maxwell's equations (2) Poynting theorem (3) Plane wave and (4) homogeneous medium