1. Explain the meaning of curl **A** (i.e., ∇×A) and divergence **A** (i.e., ∇ • **A**). **(10%)** Explain ∇ • (∇×**A**)=0 and ∇×∇A=0, where A is a scalar and **A** is a vector **(10%)**. Do not derive the equation, explain them with the meaning of ∇A, ∇×**A**, ∇ • **A** themselves.
2. $\mathbf{A}=5e^{-2z}(\rho\mathbf{a}_\rho+\mathbf{a}_z)$, determine the flux of **A** out of the surface defined by $\rho=1$, $0\leqq z\leqq 1$, $0\leqq \phi \leqq 2\pi$, where $\mathbf{a}_\rho$ and $\mathbf{a}_z$ are unit vectors. **(20%)**
3. $\mathbf{J}=r^{-3}(2\cos\theta\ \mathbf{a}_r+\sin\theta\ \mathbf{a}_\theta)$ A/m^2, where **J** current density; A, ampere; m, meter. Calculate the current passing through (1) a hemispherical shell of radius 10 cm **(10%)** and (2) a spherical shell of radius 5 cm **(10%)**.
4. A conducting bar can slide freely over two conducting rails shown in the following figure. Calculate the induced voltage in the bar: (1) if the bar is stationed at x=5cm and $\mathbf{B}=2\cos 10^5 t\ \mathbf{a}_z$ mWb/m^2 **(8%)**; (2) if the bar slides at a velocity $\mathbf{u}=10\ \mathbf{a}_x$ m/s and $\mathbf{B}=2\ \mathbf{a}_z$ mWb/m^2 **(7%)**; (3) if the bar slides at a velocity $\mathbf{u}=10\ \mathbf{a}_x$ m/s and $\mathbf{B}=2\cos(10^5 t-x)\ \mathbf{a}_z$ mWb/m^2 **(5%)**. Note that Wb is Weber.
5. A certain transmission line operates at $\omega=10^7$ rad/s with $\alpha=2$ Np/m, $\beta=1$ rad/m, and $Z_o=50+j20\ \Omega$ and 2 m long. If the line is connected to a source of $V_s=4\angle 0°$ V with $Z_s=50\ \Omega$ and terminated by a load of $10+j20\ \Omega$, determine (1) the input impedance **(8%)**, (2) the sending-end current **(7%)**, (3) the current at the middle of the line **(5%)**.
$\tanh(x\pm jy)=[(\sinh 2x)/(\cosh 2x+\cos 2y)]\ \pm\ j[(\sin 2y)/(\cosh 2x+\cos 2y)]$

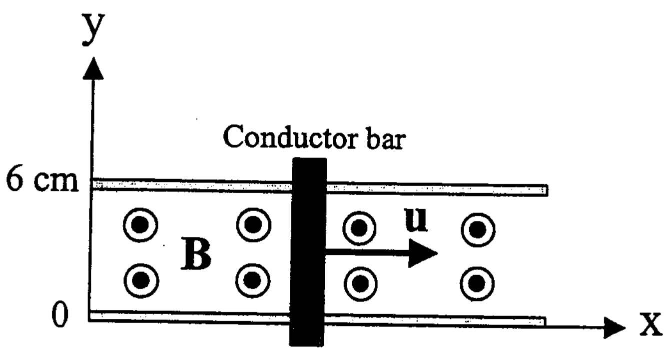

Figure of Problem 4