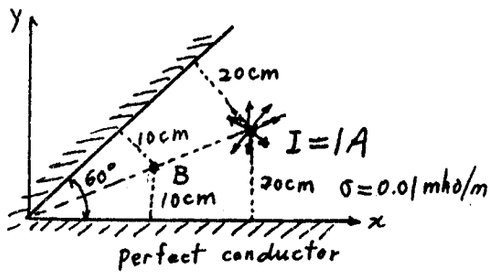
1. Write Poisson's equation, Laplace equation, equation of continuity and wave equation. How are they derived? (12%)

2. State in detail the various kinds of current you have learned in electromagnetics. (8%)

3. It seems that current could not flow through a perfect capacitor since the conductivity of the dielectric between the two conducting plates of the capacitor is zero. How can current, however, flow through a perfect capacitor? (10%)

4. What are the main factors or conditions for the material to be used as permanent magnet?
What is Curie Temperature? What are the approximate Curie Temperatures for most ferromagnetic materials? (8%)

5. A current electrode is near a perfectly conducting plate that is bent to form a 90° corner, as shown in the figure below. The electrode produces 1 A of current, and the material filling the region defined by $0<\phi<60°$ is water with conductivity equal to 0.01 mho/m. Find the potential at point B shown in the figure. (12%)



(背面仍有題目,請繼續作答)

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6. 請就 GaAs、Si 兩種材料，指出何者較適合製作下列之元件，並詳述理由： (10%)
   (a) MOSFET
   (b) 微波元件
   (c) 光電元件

7. 請說明隨著溫度升高： (10%)
   (A) 電子移動率 (electron mobility) 分別受晶格散射(lattice scattering) 及雜質散射 (impurity scattering) 影響之情形。
   (B) 請劃簡圖 (縱軸爲對數座標之電子移動率，橫軸爲線性座標之溫度) 說明矽之電子移動率在不同施體濃度 (donor concentrations) 下溫度之關係：
   (a) $N_D = 10^{14}\ cm^{-3}$
   (b) $N_D = 10^{17}\ cm^{-3}$
   (c) $N_D = 10^{19}\ cm^{-3}$

8. 請劃圖說明 P-N 接面空乏區之能帶圖及載子分佈： (10%)
   (a) 正向偏壓
   (b) 反向偏壓

9. (a) 一個光子(photon) 和在固體內的電子間有那三種主要的相互作用？ (5%)
   (b) 並請說明 LED、LASER 及 PHOTODETECTOR 是分別利用 (a) 中那個作用來 operation。 (5%)

10. 請劃圖說明下列不同型式 MOSFET 之 cross section、output characteristics 及 transfer characteristics：(10%)
    (a) n-channel enhancement
    (b) n-channel depletion
    (c) p-channel enhancement
    (d) p-channel depletion