1090E03

國立臺北科技大學 109 學年度碩士班招生考試

系所組別：2402 光電工程系碩士班

第二節　電磁學　試題（選考）

注意事項：

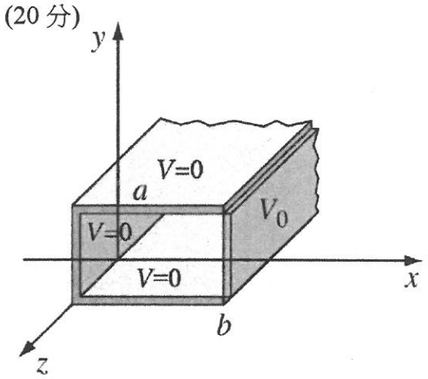
1. 本試題共 5 題，每題 20 分，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

For your reference:

$$\sin A \sin B = \frac{1}{2}[\cos(A-B) - \cos(A+B)]$$

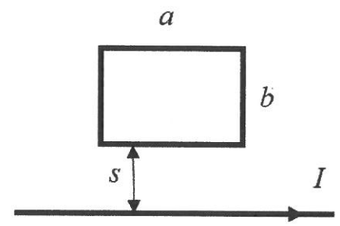
1. An isolated parallel-plate capacitor is made up of two conducting plates of area A separated a distance d. One plate has a charge $+Q$, the other a charge $-Q$.
   (a) What is the electrostatic force between the plates? (10 分)
   (b) If the plates move closer together by an infinitesimal distance ε, as a result of this attractive force, what is the energy lost in this process? (10 分)

2. An infinitely-long rectangular pipe, assumed to be infinite in extent in z-direction, has three grounded metal sides, at $y = 0$, $y = a$, and $x = 0$. The fourth side on the right, at $x = b$, is insulated from the grounded sides and maintained at a constant potential V_0 as shown in the figure below. Determine the potential inside the pipe. (20 分)



3. A steady current I flows down a long cylindrical wire of radius a. The current is distributed in such a way that the current density J is proportional to s, the distance from the axis. Find the magnetic field $\vec{B}$, both inside and outside the wire. (20 分)

4. A rectangular loop of wire with length a, width b, and resistance R, a distance s from a very long straight wire carrying a current I, as shown in the figure below. If someone pulls the loop directly away from the wire, at a speed v, find the magnitude and the direction (clockwise or counterclockwise) of the current generated in the loop? (20 分)



5. A y-polarized uniform plane wave ($\vec{E}_i$, $\vec{H}_i$) with a frequency *100* (MHz) propagates in air in the x-direction and impinges normally on a perfectly conducting plane at $x = 0$. The amplitude of $\vec{E}_i$ is *6* (mV/m).
   (a) Please write down the phasor expressions for $\vec{H}_i$ of the incident wave, and $\vec{H}_r$ of the reflected wave. (10 分)
   (b) Find the induced current on the conducting wall. (10 分)