所別：光電科學研究所碩士班 一般生 科目：電磁學
學位在職生

（共八大題，每大題 12.5 分，總分 100 分）

1. An electric dipole $\mathbf{p}_1 = p_1\mathbf{e}_z$ is located at the origin of the coordinate system. A second dipole $\mathbf{p}_2 = p_2\mathbf{e}_z$ is located at (a) on the $+z$ axis a distance r from the origin, or (b) on the $+y$ axis a distance r from the origin. Show that the force between the two dipoles is attractive in case (a) and repulsive in case (b).

2. A conducting sphere with total charge Q is cut into half. What force must be used to hold the two halves together?

3. Two uniform infinite sheets of electric charge densities $+\sigma$ and $-\sigma$ intersect at right angles. Find the magnitude and direction of the electric field everywhere and sketch the lines of $\mathbf{E}$.

4. Two infinite current sheets, each of current density K_0, are parallel and have their currents oppositely directed. Find the force per unit area on the sheets. Is the force repulsive or attractive?

5. A) When a light wave is incident from one medium to another one, and if I want to find the phases of the reflected and transmitted waves in terms of that of the incident wave, I should use which of the following equations:
   a) Maxwell equations
   b) The wave equation
   c) Fresnel equations
   d) Snell's law

   Just choose the answer you think that is right and write it down on the answer sheet. You don't need to give reason.

   B) Snell's law results from
   a) Coulomb's law
   b) Faraday's law
   c) Maxwell equations
   d) The continuity of the tangential components of $\mathbf{E}$ and of $\mathbf{H}$ at the interface between 2 dielectric media.

   Just tell me which one is the most appropriate answer. You don't have to give reason.

注意：背面有試題

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C) For a wave guide made of infinitely conducting material, show that the tangential component of the E field at the inner surface of the guide is zero.

6. For a wave guide made of infinitely conducting material,
   a) Must the normal components of the **E** field to the guide wall be zero at the inner surface?
   b) Show that the **H** field must lie on the guide wall at the inner surface.
   c) Show that the tangential component of **H** at the inner surface is perpendicular to the current density in the guide wall.
   d) Show that the tangential component of **H** at the inner surface is equal to the current density in magnitude expressed in amperes/meter.

7. a) Show that the phase velocity of a plane wave propagating in z-direction such as $\mathbf{E}_0 \cos(\omega t - kz)$ is ω / k. Explain your mathematical steps with words clearly.
   b) Given that the relative permittivity ε_r and relative permeability μ_r of a material are 2 and 1.1, respectively. Find the wave length of a beam of light wave whose frequency is 10^{14} Hz propagating in it

8. a) Consider an optical plane wave incident normally upon a perfectly conducting material. Show that it is 100% reflected from it, and the phase of the incident wave and the reflected wave is reverse to each other.
   b) Is there any charge induced on the surface of the perfectly conducting material?