1. An EM-wave with electric field intensity $\bar{E}_i = \hat{a}_y A e^{-jkz}$ is traveling in free space as shown in Fig. 1.
   (a) What is the direction of propagation of the EM-wave? *(2 points)*
   (b) Find the magnetic field intensity $\bar{H}_i$ *(3 points)*
   (c) What is k? *(3 points)*
   (d) If the wave impinges on a perfect conducting plate placed at $z = 0$, find the resultant electric field intensity $\bar{E}_t$ and the resultant magnetic field intensity $\bar{H}_t$ in medium 1. *(10 points)*
   (e) Find the electric and magnetic field intensity in medium 2 *(2 points)*

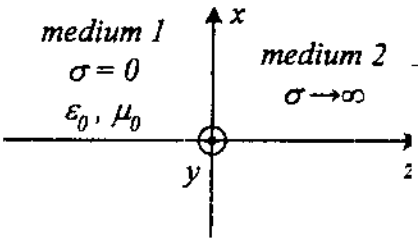

Fig. 1

2. There are two waves $g_1(z,t)$ and $g_2(z,t)$. $g_1(z,t) = A\cos(\omega_1 t - k_1 z)$, $g_2(z,t) = A\cos(\omega_2 t - k_2 z)$. If ω_1=1,000,001, ω_2=999,999, k_1=1001×10^{-2}, k_2=999×10^{-2},
   (a) Find the resultant wave $f(z,t) = g_1(z,t) + g_2(z,t)$ *(5 points)*
   (b) Find the phase velocity v_p and the group velocity v_g of the resultant wave. *(5 points)*

3. A uniform plane wave with electric field intensity E in x-direction is traveling in z-direction in a source-free and lossless free space with permittivity $\varepsilon_0 (= (36\pi)^{-1} \times 10^{-9}\, F/m)$ and permeability $\mu_0 (= 4\pi \times 10^{-7}\, H/m)$.
   (a) Try to write the wave equation of the electric field intensity, *(5 points)*
   (b) How could Maxwell derive this wave equation from the Maxwell's equations? *(10 points)*
   (c) What is the speed of this wave in free space? *(5 points)*

4. Two *IC* are connected together with two sections of transmission lines. The voltage at the output of the driver *IC* is as shown in Fig. 2. Find the characteristic impedance (Z_{01} and Z_{02}) and time delays (t_{d1} and t_{d2}) of both lines, and the unknown load R_L. *(15 points)*

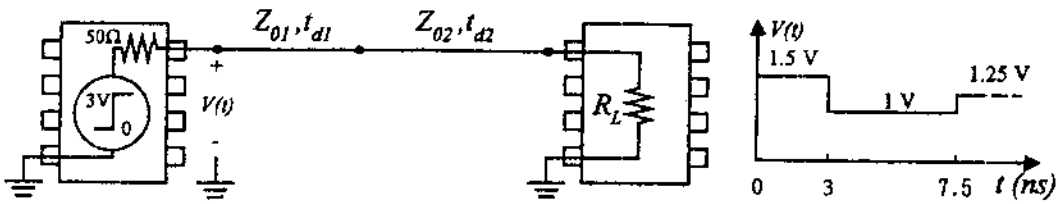

Fig. 2

(背面仍有題目,請繼續作答)

5. A rectangular waveguide is to be designed to propagate the dominant TE_{10} mode and to exclude al other modes. The frequency of operation is to be 15 GHz and the guide is air-filled. Determine a set of guide dimensions such that 15 GHz is 25 percent above the TE_{10} cutoff frequency and 25 percent below the cutoff frequency of the next higher-order mode. Calculate the wave impedance and wavelength along the direction of the waveguide for TE_{10} mode at 15 GHz. (*20 points*)

6. Given a characteristic impedance 50 Ω and a load impedance $Z_L = 100 - j\,50\ \Omega$, match the line to the given load using only transmission line sections. (Hint: you may use the Smith chart below, *temporarily*. But don't forget to write down important procedures and results on your answer sheet Otherwise it will not be graded.) (*15 points*)