1. Two parallel-plate capacitors with dielectric materials are shown Fig. 1(a) and (b). κ_1 and κ_2 are the dielectric constants. The plane area is A. Find their capacitances in terms of h, κ, A or t. (20 分)


Fig.1
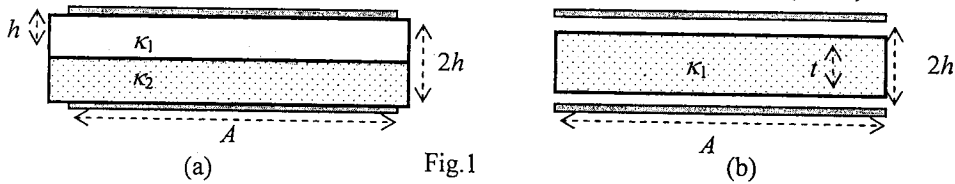
2. A spherical drop of water carrying a charge of 5×10^{-11} Coul has a potential of 500V at its surface.
   (a) What is the volume of the drop? (7 分)
   (b) If two such drops of the same charge and radius combined to form a single drop, what is the potential at the surface of the new drop? ($\varepsilon_0 = 8.854 \times 10^{-12}$ F/m) (8 分)

3. (a) Show that the x component of the electric field due to a dipole p is given at distance point (x,y) by

$$\vec{E}_x = \frac{1}{4\pi\varepsilon_0} \frac{3pxy}{\left(x^2 + y^2\right)^{5/2}} \hat{x}$$

   where x and y are coordinates of a point in Fig. 2. (7 分)
   (b) Find the y component of the electric field which due to the same dipole p at distance point (x,y). (8 分)

Fig.2
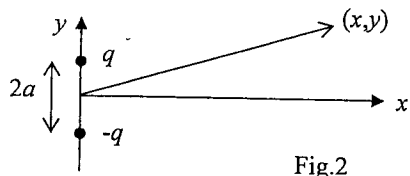
4. A current I flows in a very long folded wire with a turned 90° semicircular bend having a radius b, as depicted in Fig. 3. ($\mu_0 = 4\pi \times 10^{-7}$ H/m)
   (a) Find the magnetic flux density **B** of the semicircular center O. (10 分)
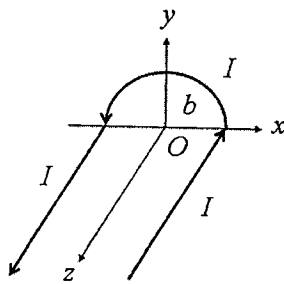   (b) If I=10 A, b=100 mm, calculate **B**. (5 分)

Fig.3

5. Determine the force per unit length between two infinitely long parallel conducting wires carrying currents I_1 and I_2 in the z-direction. The wires are separated by a distance d. (10 分)

6. A λ=500 nm harmonic electromagnetic wave whose electric field is in the z-direction in vacuum. (Put in all appropriate units.)
   (a) Determine both the angular frequency and propagation number for this wave. (6 分)
   (b) If the amplitude of the electric field intensity, E_0, is 500 V/m, what is the amplitude of the magnetic field intensity, H_0? (4 分)
   (c) Write an expression for both $E(z, t)$ and $H(z, t)$ given that each is each is zero at z=0 and t=0. (10 分)
   (d) Find the average power density of the wave. (5 分)