

[Question 1]

- (a) Find the capacitance per unit length of two coaxial metal cylindrical tubes, of radii  $a$  and  $b$ , as shown in Fig. 1(a). (15%)
- (b) The coaxial cylindrical metal tubes (inner radius  $a$ , outer radius  $b$ ) stands vertically in a tank of dielectric oil (susceptibility  $\chi_e$ , mass density  $\rho$ ). The inner one is maintained at potential  $V$ , and the outer one is grounded, as shown in Fig. 1(b). To what height ( $h$ ) does the oil rise in the space between the tubes? (15%)

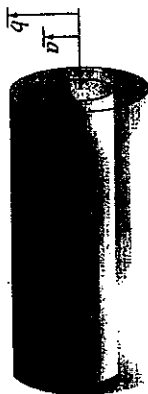


Fig. 1(a)

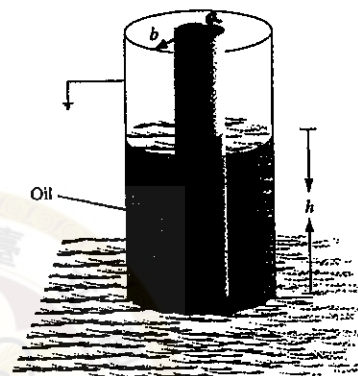


Fig. 1(b)

[Question 2]

- (a) Please write down the Maxwell equations. (8%)
- (b) Starting from Maxwell equations, please derive the boundary conditions for the *electrical field* at the interface of two dielectrics, when a surface charge density  $\sigma$  is shown at the interface. (12%)

[Question 3]

A spherical shell, of radius  $R$ , carrying a uniform surface charge  $\sigma$ , is set spinning at angular velocity  $\omega$ .

- (a) Find the magnetic field inside the spinning spherical shell  $B_{in}$ . (20%)
- (b) Find the magnetic field outside the spinning spherical shell  $B_{out}$ . (20%)

[Question 4]

- (a) Please explain Poynting vector. (4%)
- (b) Please explain Ferromagnetism. (3%)
- (c) Please explain Paramagnetism. (3%)