

- Given an irrotational function $F = a_1(4y - c_1z) + a_2(c_2x + 4z) + a_3(c_3y + x)$. (a) Find the constants c_1 , c_2 , and c_3 , (b) Determine the scalar function V whose negative gradient equals F , (c) Find the magnitude and direction of the maximum rate of increase of V at the point $(1, 1, 1)$. (20%)
- The simplification of cathode-ray oscilloscope is shown in Fig. 1. (a) Assuming no breakdown in insulation, determine the maximum voltage that can be measured, (b) What is the restriction on L ? (c) What can be done with a fixed geometry to double the maximum measurable voltage? (15%)
- Lightning strikes a lossy dielectric sphere ($\epsilon = 1.2\epsilon_0$, $\sigma = 10 \text{ S/m}$) of radius 0.1 m at time $t = 0$, depositing uniformly in the sphere a total charge 1 mC . (a) Determine the electric field intensity both inside and outside the sphere for all t , (b) Find the current density in the sphere for all t . (20%)
- The circuit in Fig. 2 is put into a magnetic field $B = a_z 3\cos(5\pi \cdot 10^7 t - 2\pi x/3) (\mu\text{T})$. Assuming $R = 15 \Omega$, determine the current i . (15%)
- Determine the intrinsic impedance, attenuation constant (both in Np/m and dB/m), and skin depth of three metals ($\sigma_1 = 5.0 \times 10^7 \text{ S/m}$, $\sigma_2 = 6.0 \times 10^7 \text{ S/m}$, and $\sigma_3 = 1.0 \times 10^7 \text{ S/m}$) at the following frequencies: (a) 60 Hz , (b) 1 MHz , and (c) 1 GHz . (15%)
- Explain (a) A transmission line is matched, (b) Group velocity, and (c) Principle of virtual displacement. (15%)

