General Physics II

Midterm Exam

Spring Semester 2023

1. Consider an annular disk of inner radius r_a, outer radius r_b, and uniform charge density σ. (30 points)
   (a) Calculate the electric potential $V(z)$, where z is a point on the axis of the disk.
   (b) Calculate $\vec{E}(z)$ (Hint: You can use $V(z)$).
   (c) Calculate $V(z)$ and $\vec{E}(z)$ for $z = 0$ and $z >> r_b$, and explain the results on physical grounds.

2. Consider a cylindrical capacitor with inner radius r_a, outer radius r_b, length L, and charge q. (35 points)
   (a) Calculate the electric field for $r_a < r < r_b$.
   (b) Calculate the potential difference between the two plates ΔV, and the capacitance C.
   (c) Calculate the electric potential energy stored within the cylindrical region of radius r. Letting $r = r_b$, relate the result to those of part (b).

3. A battery with emf $\mathcal{E}$ is connected across two parallel metal plates of area A and separation d. A beam of particles with charge q is accelerated from rest through a potential difference of ΔV and enters the region between the plates perpendicular to the electric field, as shown in Fig. E27.25. What magnitude and direction of magnetic field are needed so that the particles emerge undeflected from between the plates? (35 points)

Figure E27.25