Problem 1:
The conductor of an infinitely long single-wire transmission line is 5 mm in diameter and 10 mm above ground (i.e. \( \overline{CD} = 10 \text{mm} \)). If the line is at 1 Volt with respect to ground, find the surface charge density at the point \( A, B, \) and \( C \) on the conductor surface, and at the point \( D \) and \( E \) at ground, where \( \overline{DE} = 10 \text{mm} \). (Hint: As we had shown in the class, this is equivalent to a problem of two line charges. Find the locations of this two line charges. Then use these two line charges to find the potential, the electric flux, and the charge density)

![Diagram of a conductor with points A, B, C, D, and E]

Problem 2:
A coaxial cable is formed by two concentric cylinders of radii 1 cm and 3 cm. With only air as the dielectric between the two conductors, the cable can withstand a potential difference of 30 KV before breakdown. That means at 30 KV (or higher), the \( E \) field at some point in the cable exceeds the maximum limit the air can withstand. (a) Where is the breakdown happened first? What is the breakdown electric field intensity for air? (b) If the space between the two cylinders is partially filled with a dielectric cylinder of relative permittivity \( \varepsilon_r = 10 \) for \( 1 \text{ cm} < r < 2 \text{ cm} \), where can you find the
strongest electric field intensity for the cable? (c) What is the new breakdown voltage for this partially filled cable? (d) repeat problem (b) and (c) for the case that the dielectric cylinder is located at $2 \text{ cm} < r < 3 \text{ cm}$. 