A capacitor is made from two hollow, coaxial, iron cylinders, one inside the other. The inner cylinder is negatively charged and the outer is positively charged; the magnitude of the charge on each is 10.0 pC. The inner cylinder has a radius of 0.200 mm, the outer one has a radius of 5.40 mm, and the length of each cylinder is 25.0cm.

a) What is the capacitance?

The capacitance of such a capacitor (called a cylindrical capacitor) of length L is given by

$$C = \frac{2\pi\epsilon_0\, L}{ln(b/a)}$$

Here *b* is the radius of the outer cylinder and *a* is the radius of the inner cylinder.

Now a = 0.200 mm = $2.00*10^{-4}$ m; b = 5.40 mm = $5.40*10^{-3}$ m

L = 25.0 cm = 0.250 m

Substituting in the equation above, we get

$$C = \frac{2\pi\epsilon_0\, L}{ln(b/a)} = \frac{2*3.14*8.854*10^{-12}*0.250}{ln(5.40/0.200)} = \frac{1.39*10^{-11}}{3.30} = 4.22 * 10^{-12}F$$

Or the capacitance of the cylinder is **4.22 pF**.

b) What applied potential difference is necessary to produce these charges on the cylinders?

The charge on the capacitor is related to the potential difference across it as

Q = CV

Or V = Q/C = (10 pC)/(4.22 pF) = **2.37 V**.