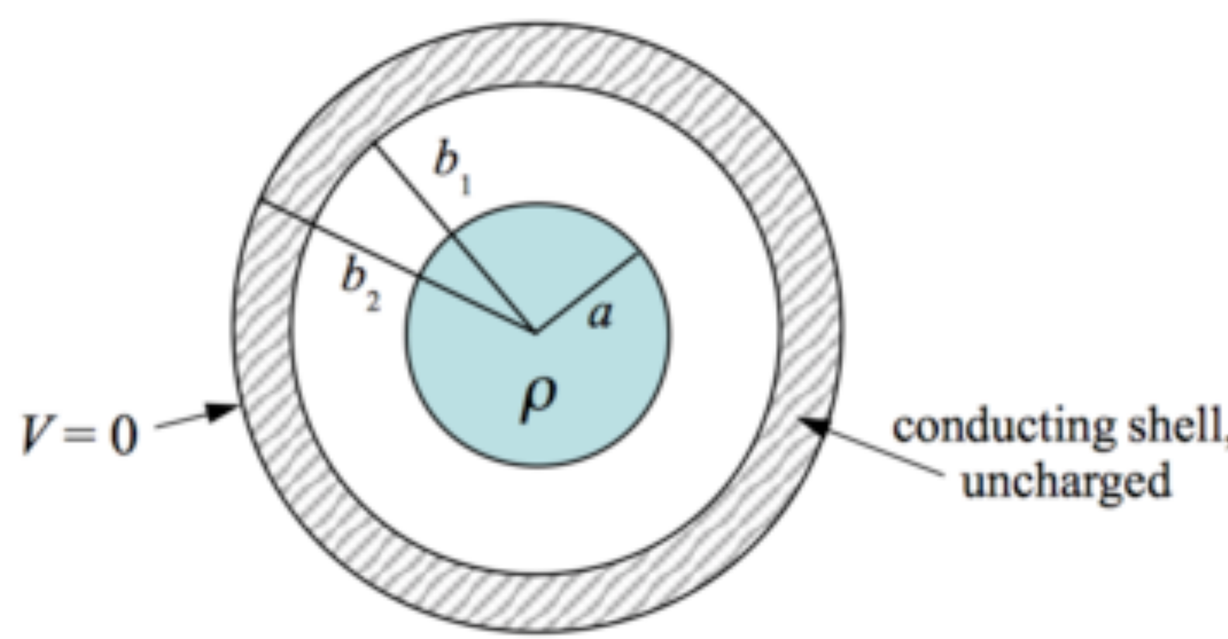
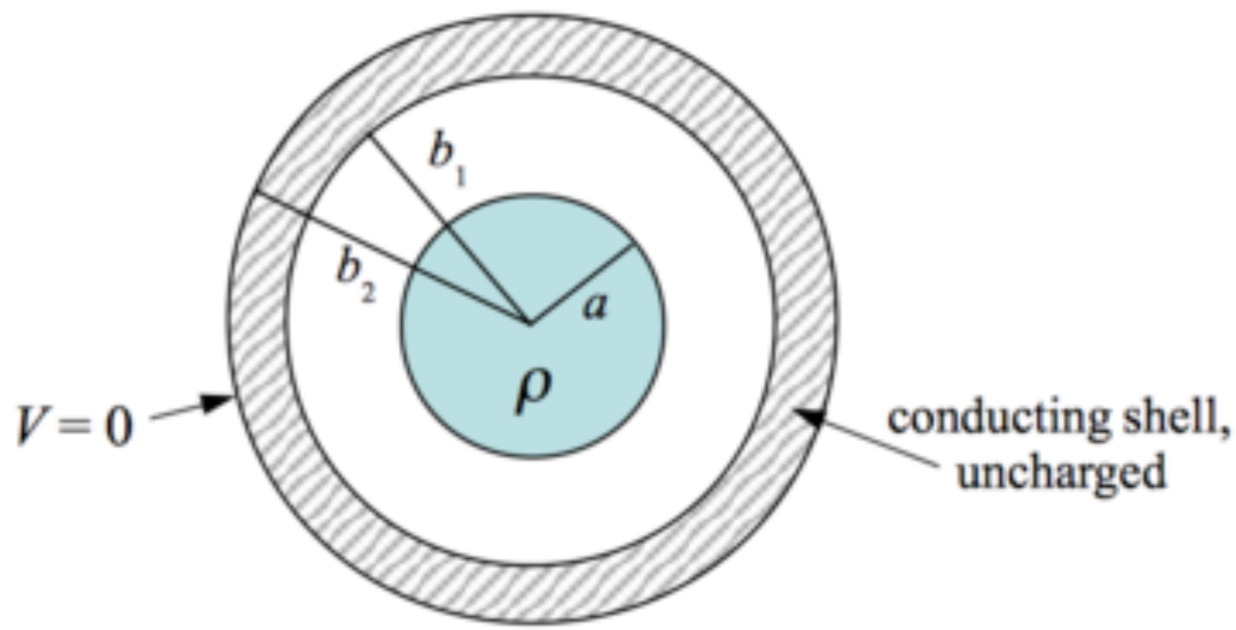
Electric Potential in a System with Cylindrical Symmetry



Consider a non-conducting cylinder of infinite length and radius a, which carries a volume charge density ρ. Surrounding this object is an uncharged conducting cylindrica shell. The metal tube is also of infinite length, and its inner and outer radii are b_1 and b_2 respectively. In this problem, we will define the potential to be zero at the outer surface of the conducting shell.

(a) What is the electric potential at a radius of 10 cm from the center of the cylinders?



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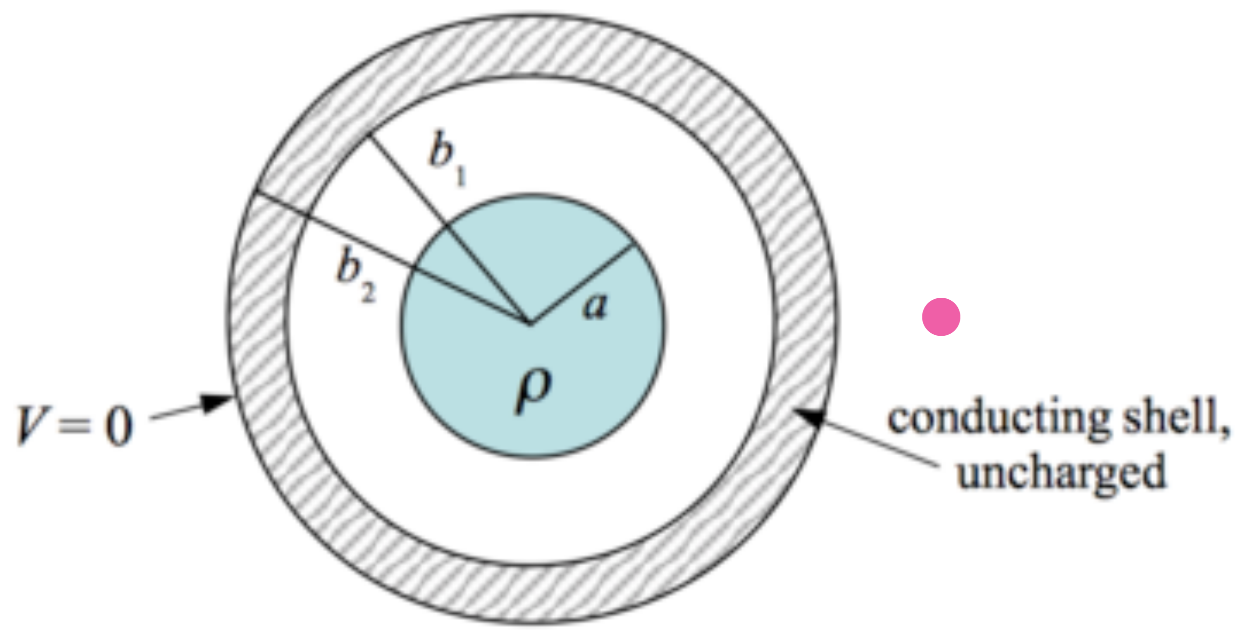

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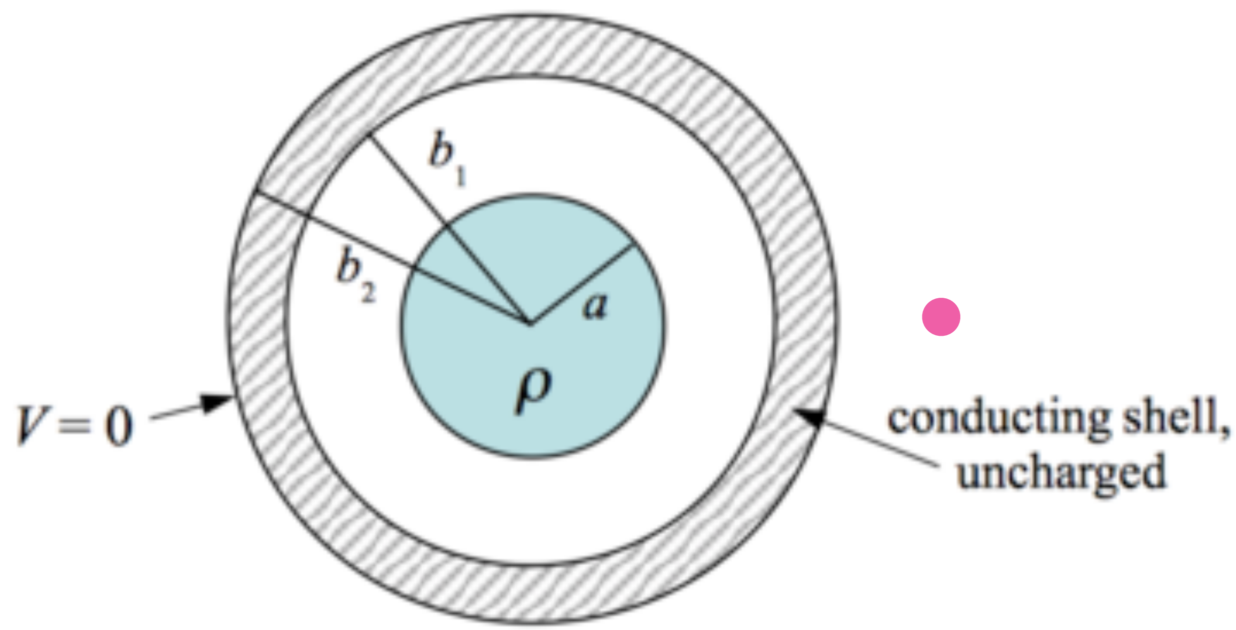

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Notice that V=0 point is not at infinity.

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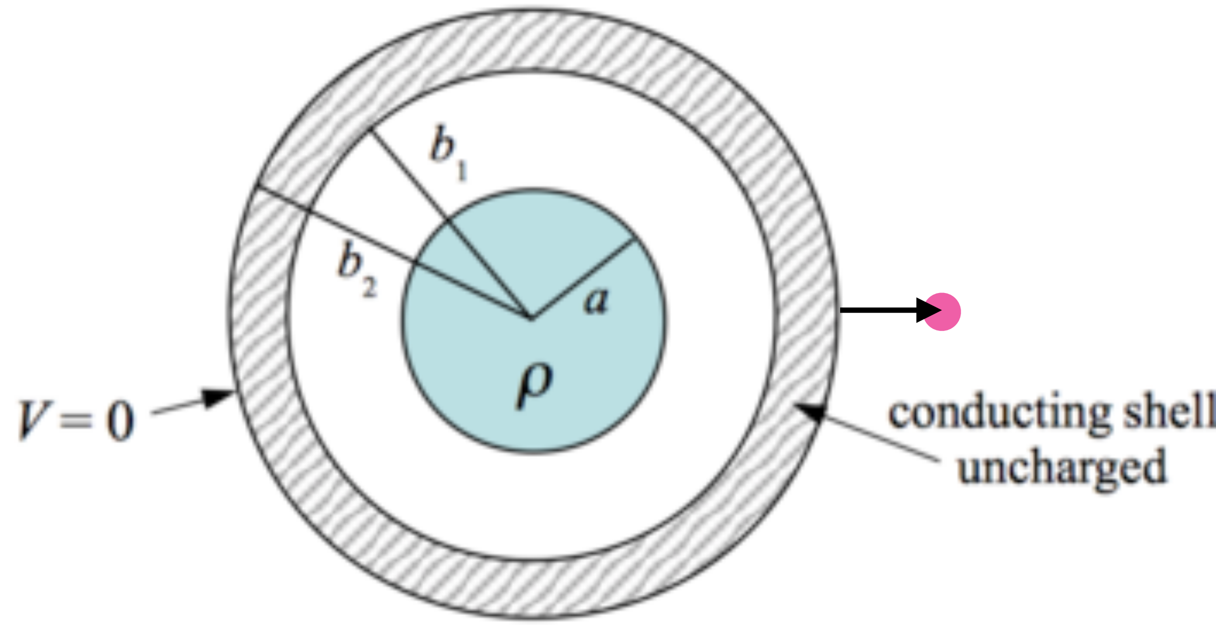

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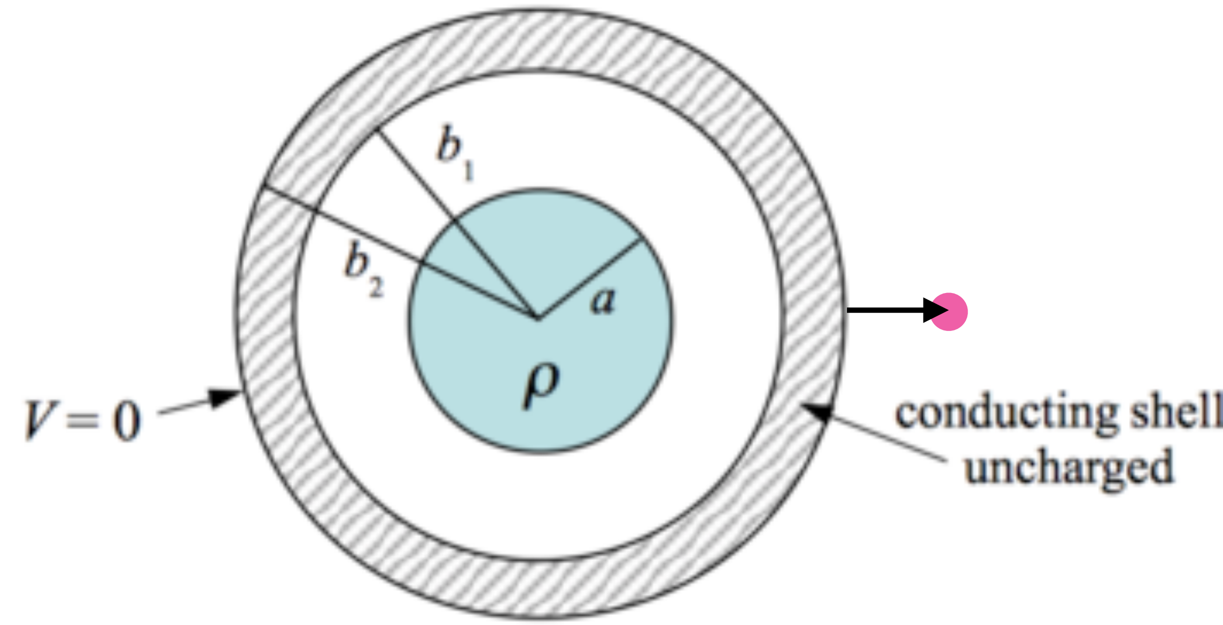

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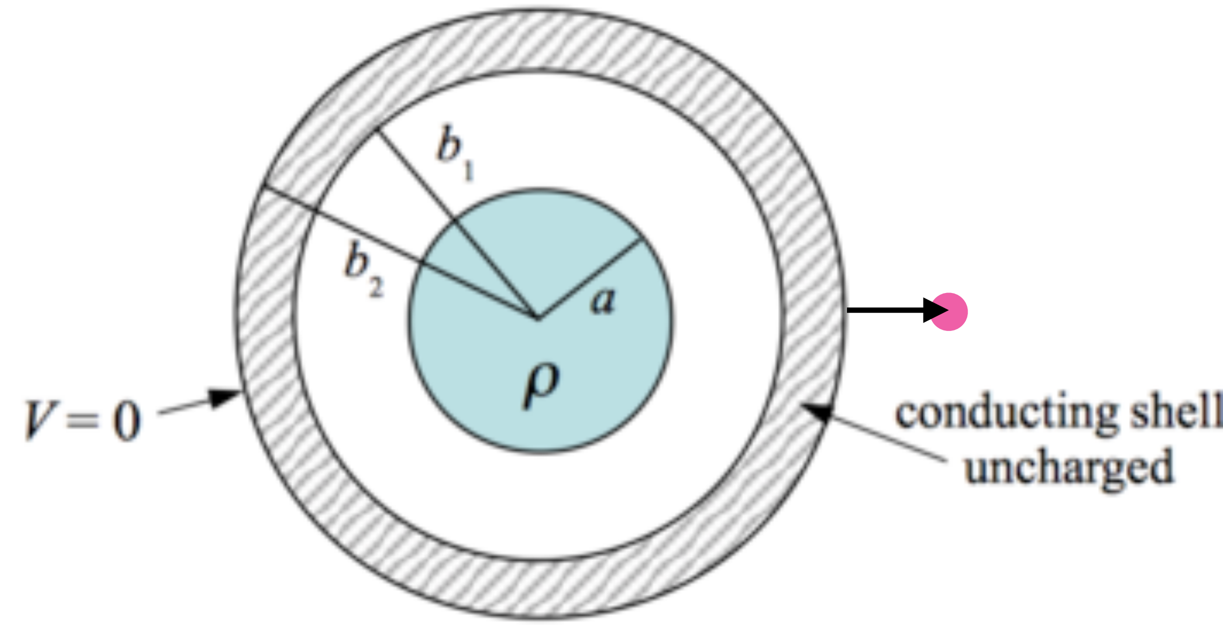

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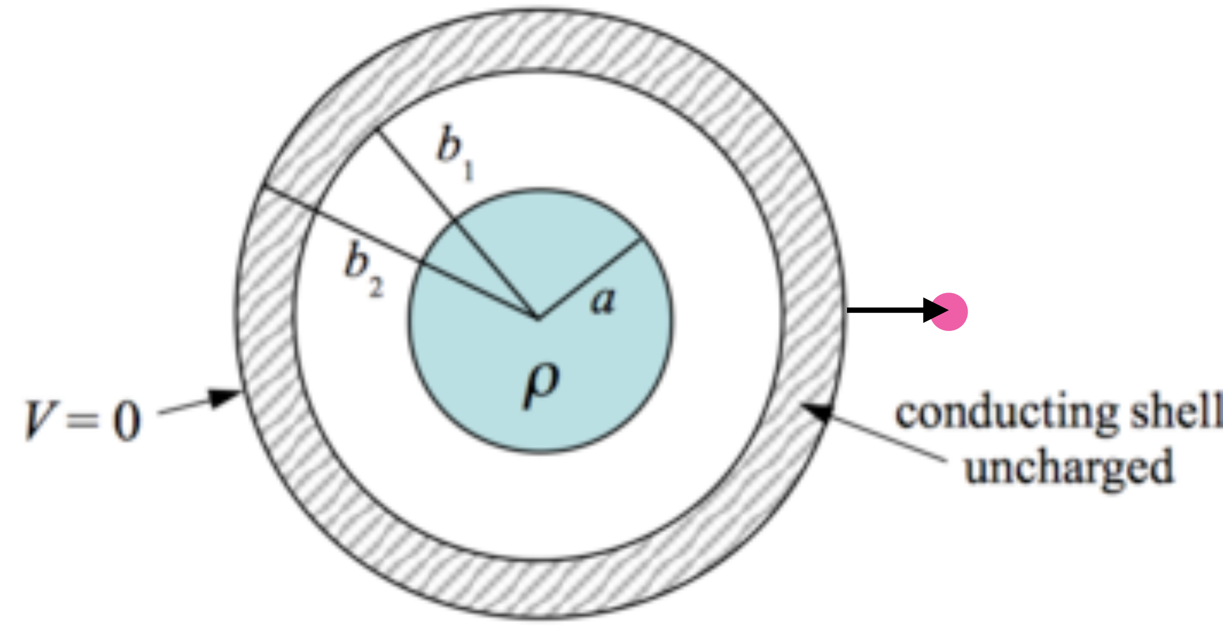

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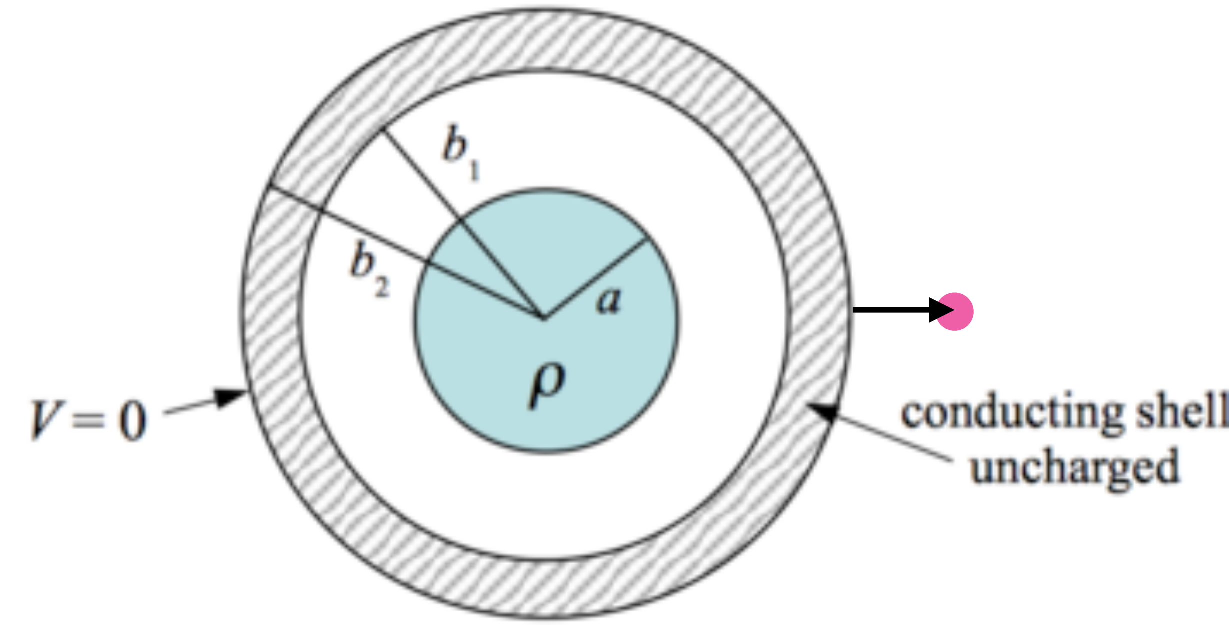

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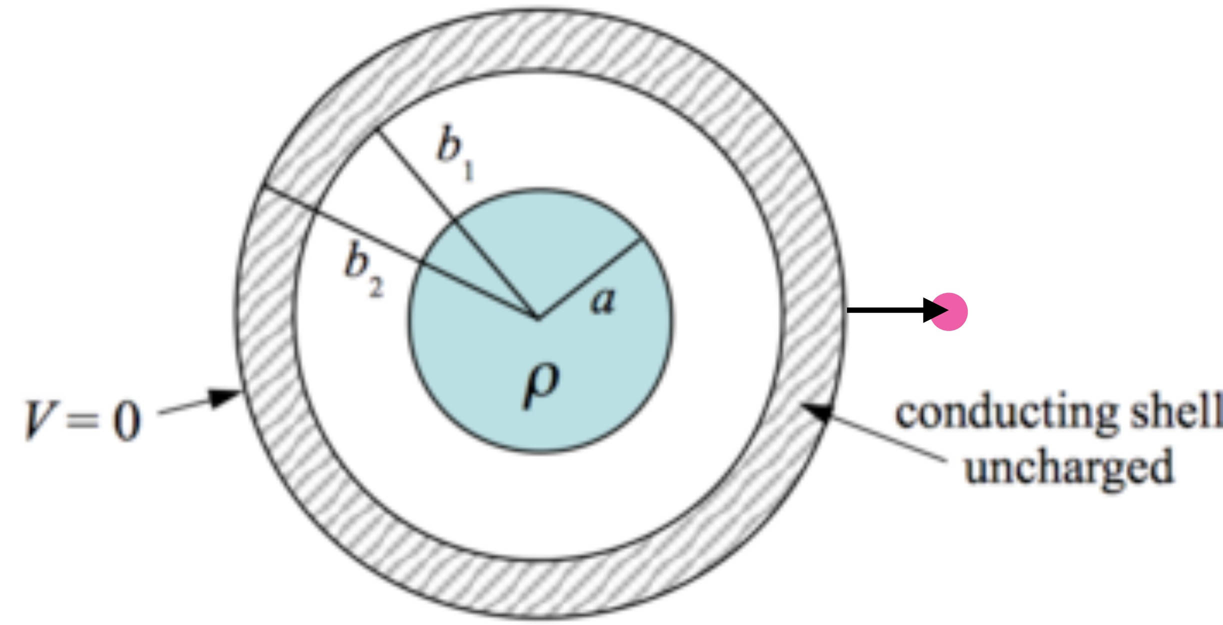

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use something like Python to evaluate:

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Python

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>>> b2=8e-2
>>> rho=7.5
>>> r=10e-2
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>>> rho*(a**2)*log(r/b2)/(2*eps0)

85058672.42889746
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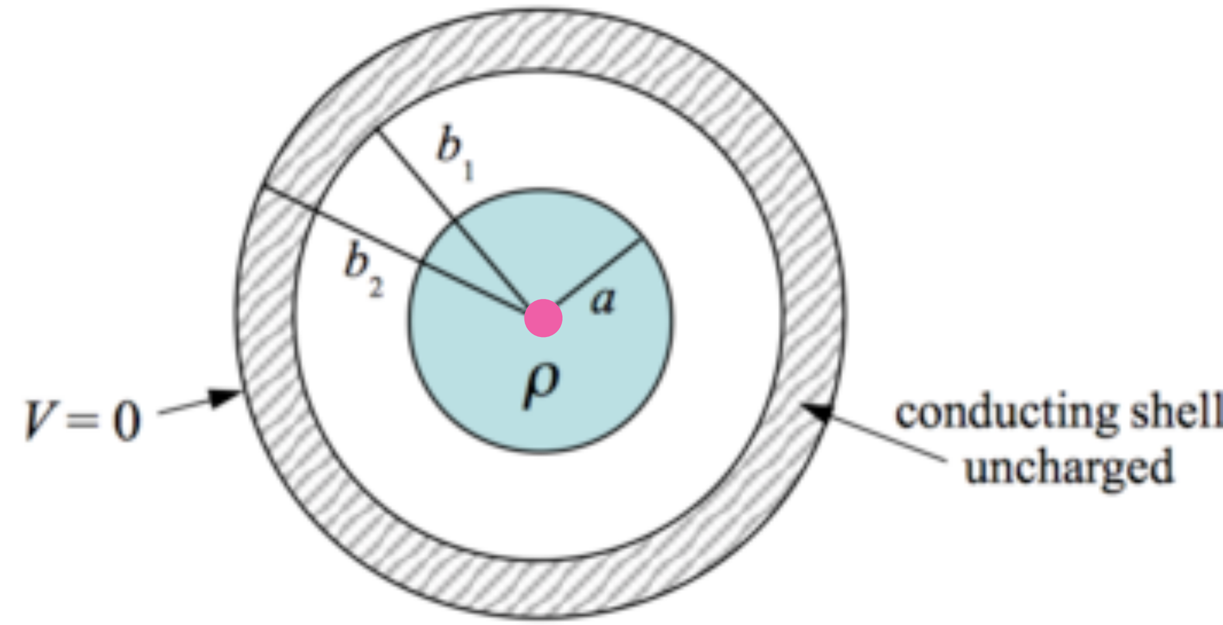

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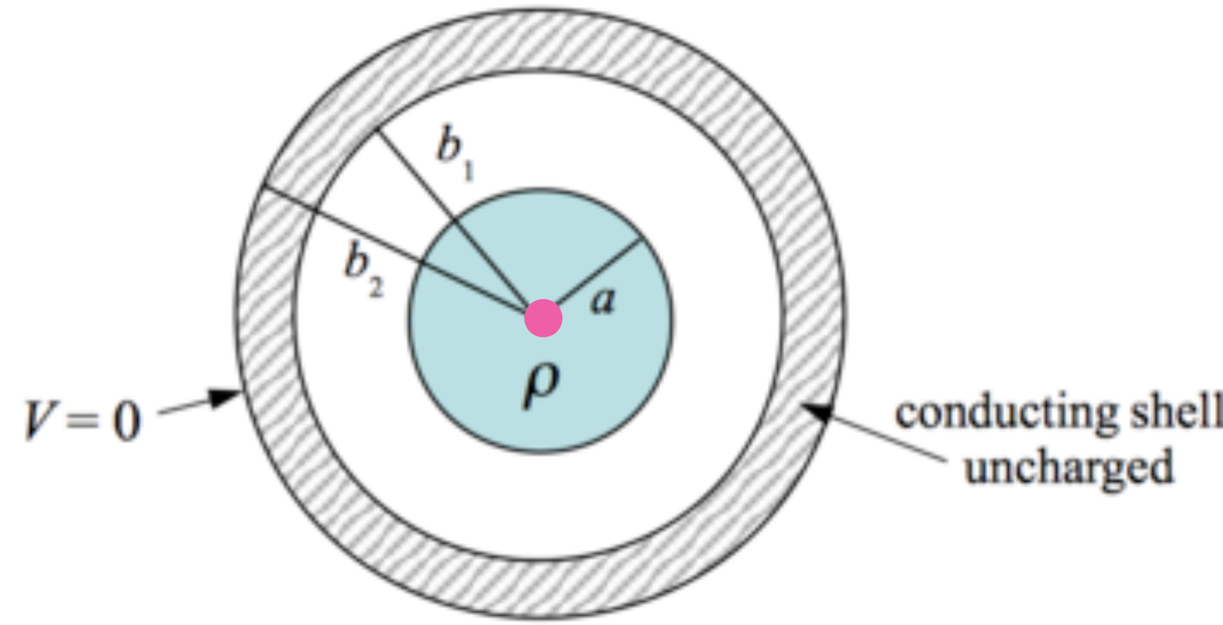

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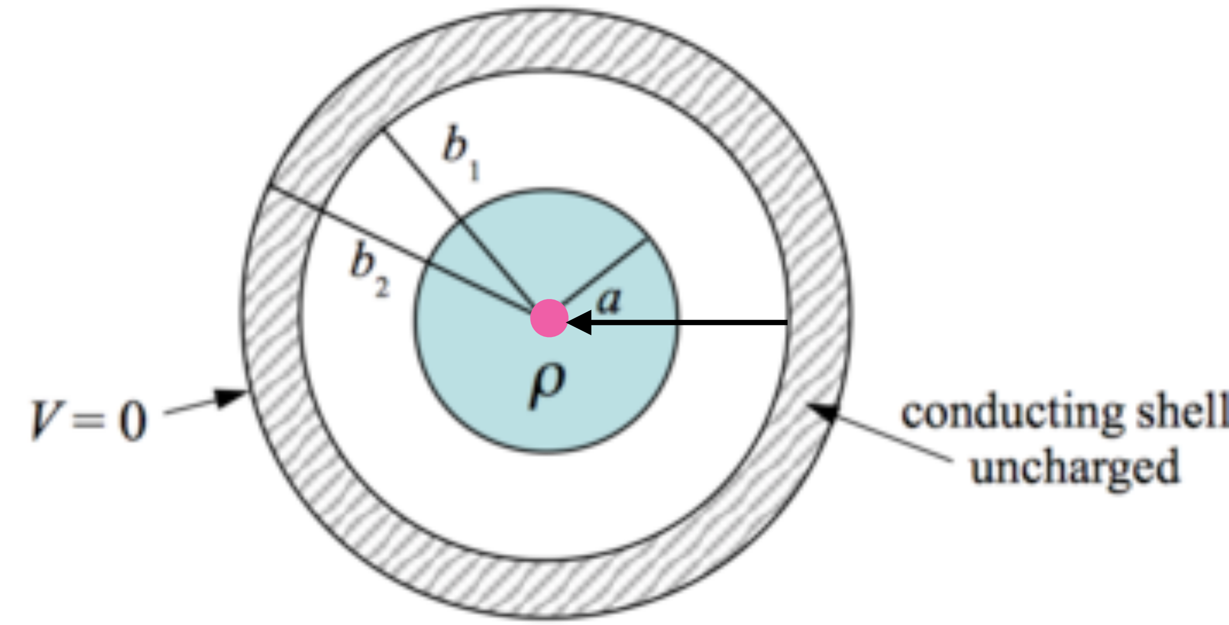

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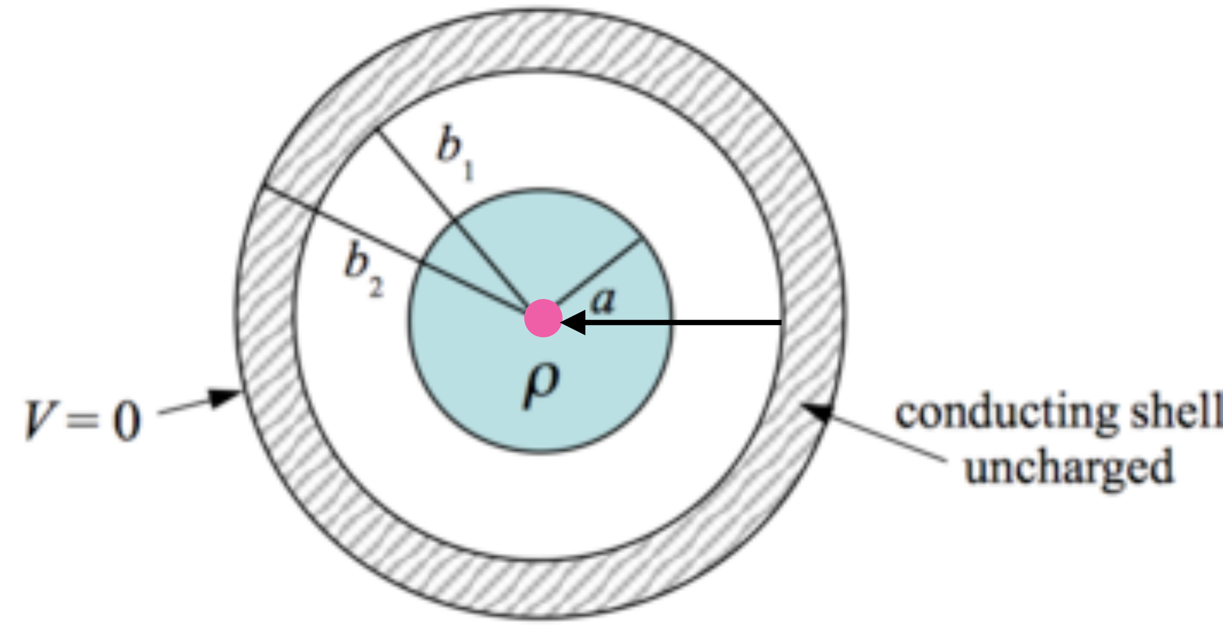

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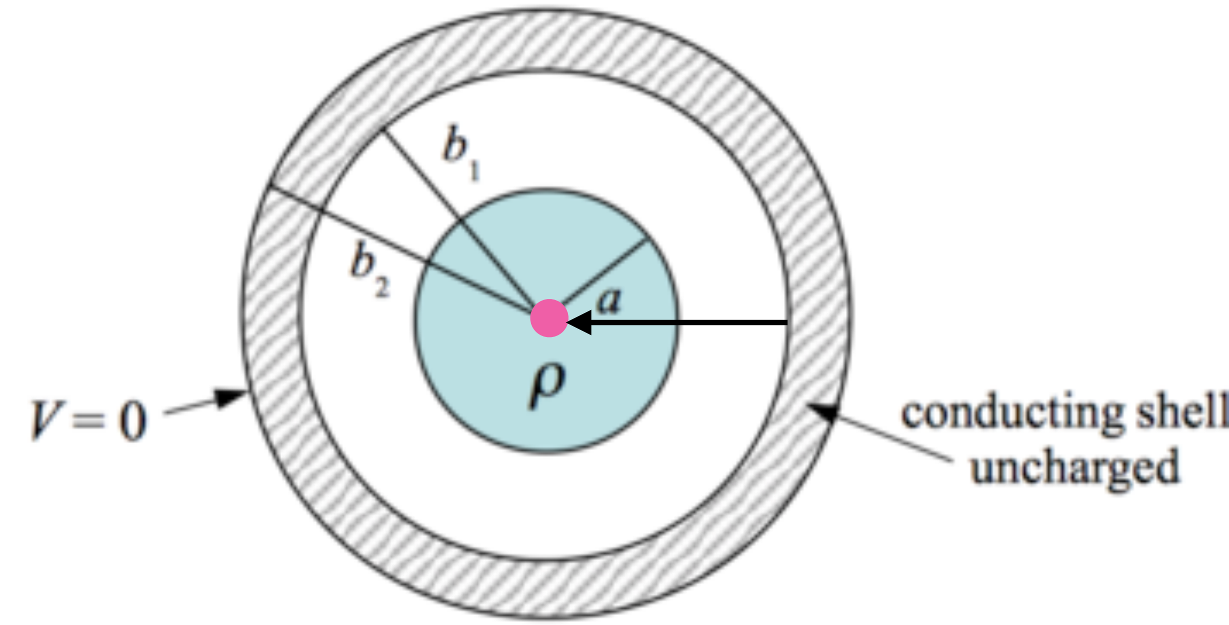

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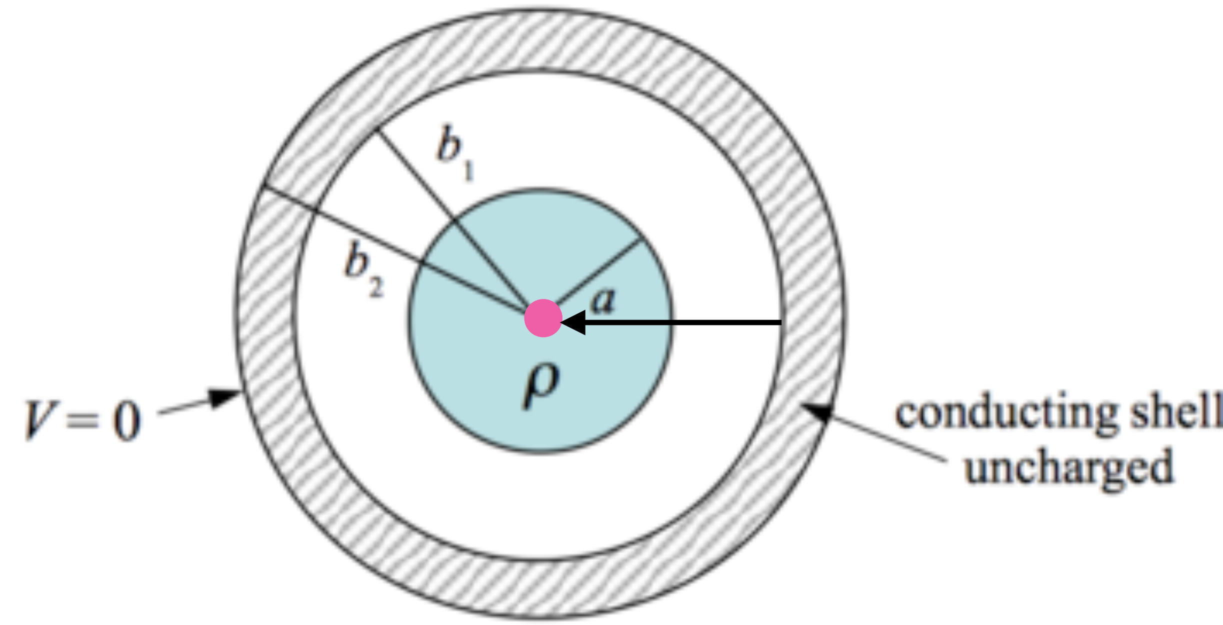

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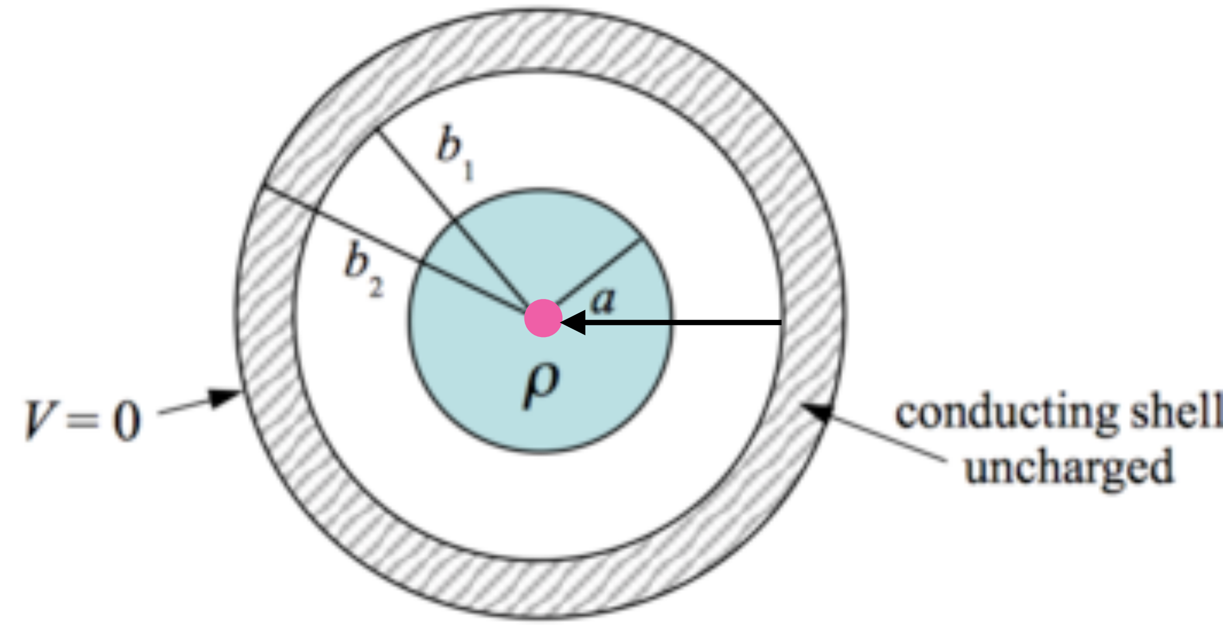

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The field there is like this…

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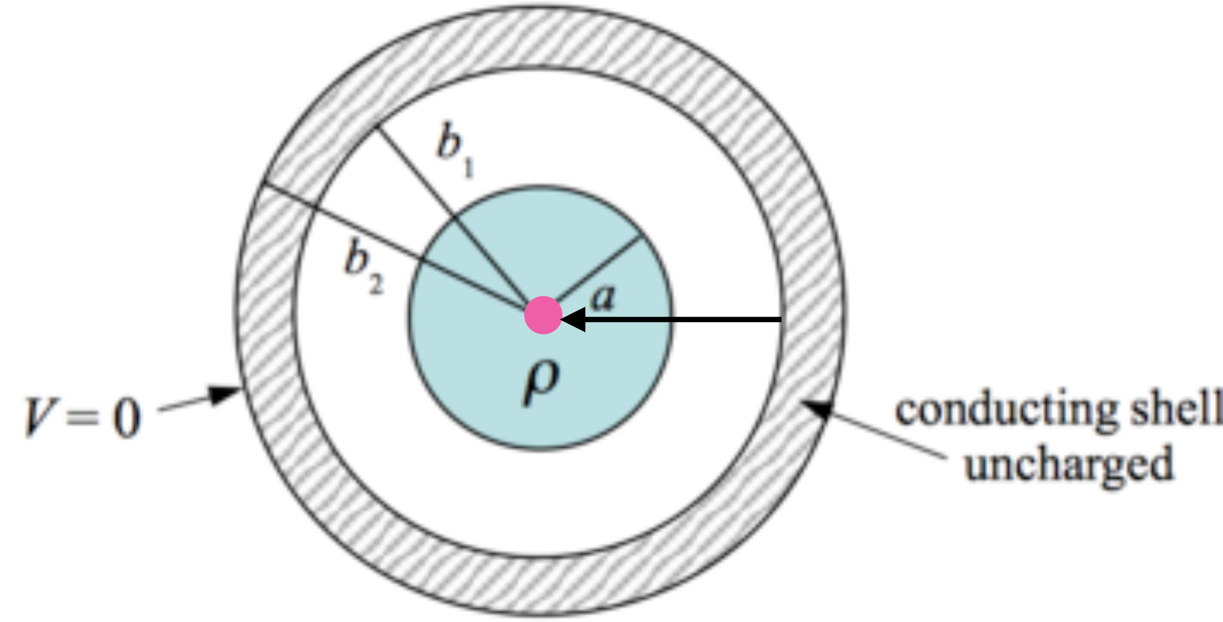

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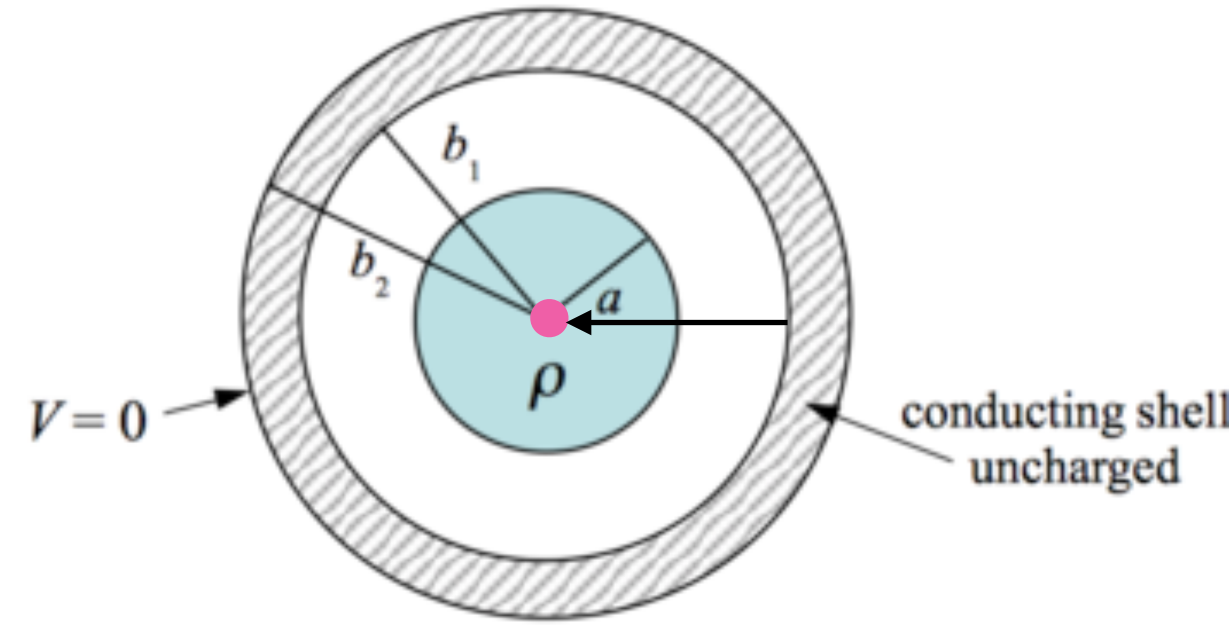

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$$V(0) - V(r) = \frac{\rho}{2\epsilon_0}\int_0^a r dr = \frac{\rho a^2}{4\epsilon_0}$$

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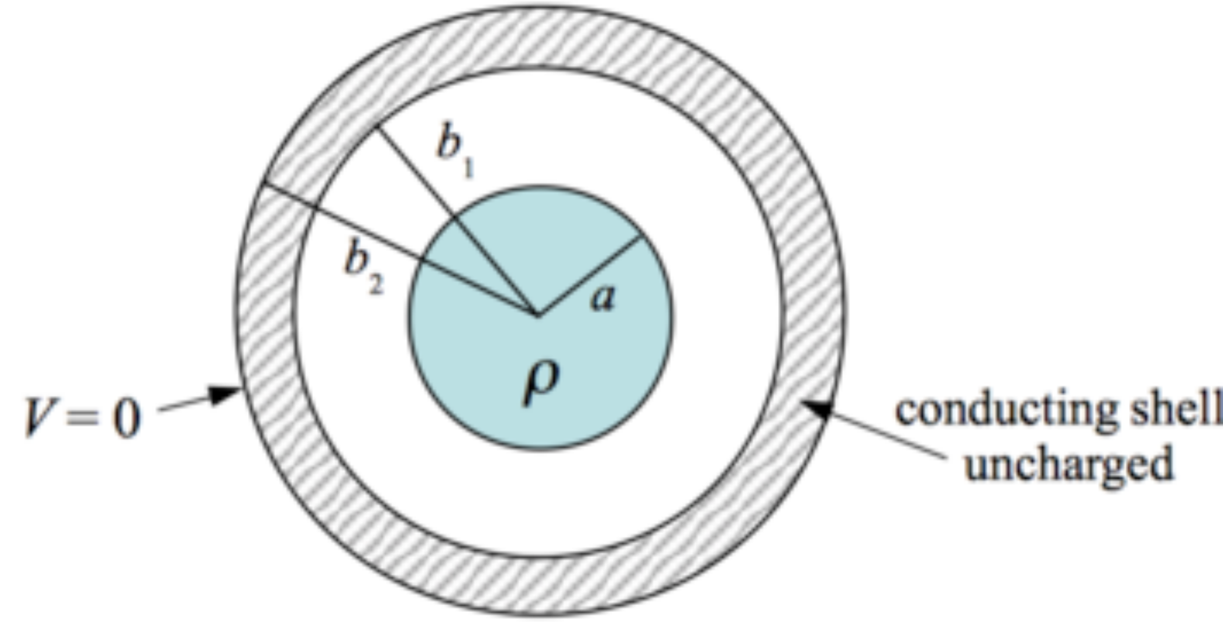

$$V(0) = V(a) + \frac{\rho a^2}{4\epsilon_0} = \frac{\rho a^2}{2\epsilon_0} \ln \frac{b_1}{a} + \frac{\rho a^2}{4\epsilon_0}$$

= 4.55 x 10^8 V

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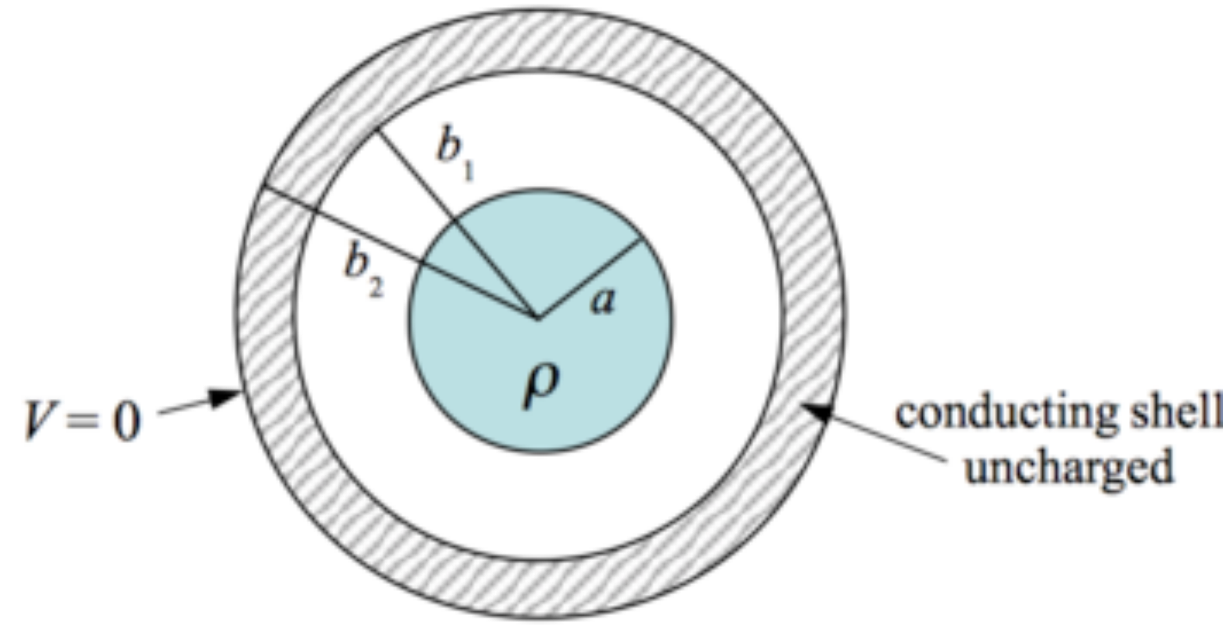

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Why don't we choose V=0 at infinity like in other cases?

Cylindrical Potential

Is it clear?

A. Very Clear
B. Still have Questions
C. Don't understand