

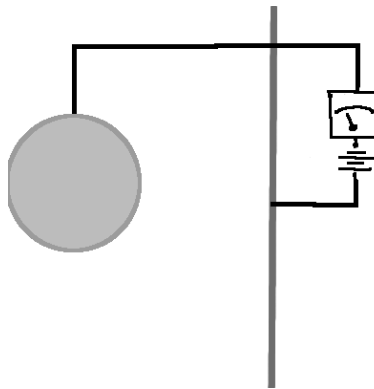
Caltech Physics League: Fall 2009 Challenge 2

Available Friday 11/13/09, Due Monday 11/23/09

Problems

Consider a metal cylinder of radius 1 cm immersed in a solution with resistivity $.2\Omega\text{m}$.¹ Its center is a distance 100 cm from a metal plate and its axis is parallel to the plate. A battery big enough for the task applies a voltage between the cylinder and the plate.

1. What is the resistance-per-cylinder-length between the cylinder and the plate? (The answer need not be more accurate than 2%)
2. The battery is disconnected, and the cylinder is quickly brought to a distance of 3 cm from the plate. How long does it take for the potential of the cylinder to decay? (Hint: the the answer is simple and general.)



CPL rules

1. Many CPL problems can be solved using numerical integration and equation solving, e.g. with Mathematica.
 - Numerical solutions will receive full credit
 - However, using brave approximations it will always be possible to find a closed form simple expression that is correct to the desired accuracy. These solutions will receive **bonus points**.
2. You may only spend **2 hours** on these problems.
3. When you are done, leave your solutions in Gil's mailbox at Sloan Annex, or email a scan of the solution to Gil: refael@caltech.edu or to John: joschu@caltech.edu.

¹ The resistivity of sea water, according to http://people.seas.harvard.edu/~jones/es154/lectures/lecture_2/0hm%27sLaw/0hm%27sLaw.html