Physics UN2802 Professor Christ
due 02/10/2022

Assignment #14

Reading:

Feb 8 Purcell Chapter 6.3-6.6

Problems:

110. Purcell 4.9

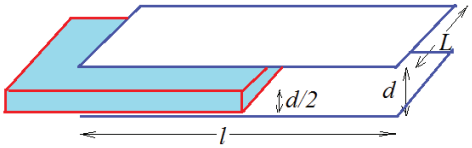
111. Purcell 4.17

112. Purcell 4.19

113. Purcell 4.26

114. Purcell 4.33

115. Consider the problem solved in class in which two parallel plates are separated by a distance d, and have length L and width l. A conducting slab of thickness $d/2$ and width l protrudes into the gap between the two plates as shown in the figure.



- Repeat the calculation given in class for the force pulling the slab into the gap between the plates in the case in which the plates carry charges $+Q$ and $-Q$.
- Solve for this force again for the case in which the two plates are connected to a battery of voltage V. (Be careful to consider both the energy stored in the plate-plate-slab capacitor and in the battery.)
- Show that the force is the same for the two cases considered above when the potential difference V between the plates is the same. Explain.

116. Purcell 5.1

117. Purcell 6.1

118. Three charges, $q_1 = 2$ esu, $q_2 = -2$ esu and $q_3 = 0.5$ esu are located in three dimensions at the positions $\vec{r}_1 = (2, 3, 3)$, $\vec{r}_2 = (3, 2, -1)$, and $\vec{r}_3 = (6, 8, 2)$ expressed in units of cm. Draw a plot showing equipotential lines in the two-dimensional rectangle $0 \leq x \leq 10$ cm, $0 \leq y \leq 10$ cm, $z = 1$ cm. Show lines corresponding to 101 values for ϕ lying between $\phi = -1$ esu/cm and $\phi = +1$ esu/cm separated by 0.02 esu/cm. Show the contours for positive values of ϕ as solid lines and those for negative values of ϕ as dashed lines. (You might start with the Python example on the course website: http://www.columbia.edu/~nhc1/UN2802/Python/Python_index.htm labeled "`dipole.ipynb`" and then gradually modify it to become the solution to the problem posed here.)