PHYS305 Homework# 4

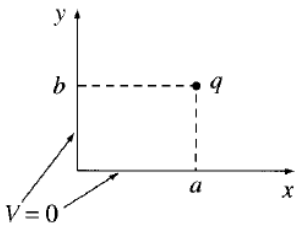
Due on 02 Nov 2021

Q#1:

(a) Find the general solution to Laplace's equation in spherical coordinates assume V depends only on radial distance r.
(b) Find the general solution of Laplace's equation using cylindrical coordinates assume V depends only on the radial distance r.

Q#2: Show that in a volume V containing conductors and specific charge density in the region between the conductors the electric field is uniquely determined if the charge on each conductor is known.

Q#3: Two semi-infinite grounded conducting planes meet at right angles as shown in the figure. If there is a point charge placed at point P(a,b) find:



(a) electric potential in the region x>0 and y>0.

(b) find the surface charge density on the conducting planes.

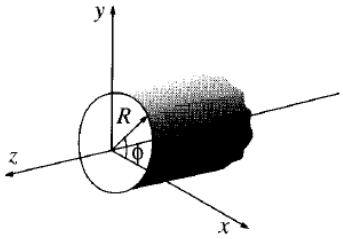
(c) Find the force on the charge exerted by the conducting planes.

(d) How much work did it take to bring the charge from infinity to location P(a,b).

Q#4: The potential at the surface of a sphere of radius R is given as: $V = k\cos(3\theta)$, where k is a constant. Find the potential inside and outside of the sphere and also the surface charge density of the sphere. (Assume there is no charge inside and outside of the sphere)

Q#5: Solve Lapalce's equation by separation of variables in cylindrical coordinates, assuming there is no dependence on z (cylindrical symmetry). Check your results for the case of infinite line of charge.

Q#6: An infinite cylinder of radius R (shown in the figure below) has as a surface charge density of $\sigma(\phi) = a\sin(5\phi)$, Find the potential inside and outside of the cylinder.



Q#7: Four particles (one of charge q, one of charge 3q, and two of charges -2q) are placed as shown in the figure.

(a) Find a simple approximate formula for the potential far away from the origin
(b) Find electric field far away from the origin.