# USING VECTOR CALCULUS TO SOLVE PROBLEMS IN ELECTRICITY AND MAGNETISM

**Summer 2020**
**Zoom Lecture: F: 2:00-4:00 p.m.**
**National Science Foundation (NSF) Center for Integrated Quantum Materials (CIQM), DMR -1231319**
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## PROBLEM SET VIII
**(due Tuesday, August 18, 2020)**

**Problem 1**

**In Lecture 8 we found the electrostatic potential $V$ and electric field $\vec{E}$ at a distance $z$ above the center of the charge distribution of two identical charges $q$ separated by a distance $d$. Repeat this calculation for the case where we changed the right-hand charge from $q$ to $-q$. What then is the electrostatic potential $V$ at the point $\vec{P}$? What field does that suggest? Compare your answer to Problem 5 in Problem Set 5 and carefully explain any discrepancy.**

**Problem 2**

**In Lecture 8 we found the electrostatic potential $V$ and electric field $\vec{E}$ at a distance $z$ above the origin of a finite line charge of length $2L$ and uniform linear charge density $\lambda$. Repeat this calculation with the integration steps we skipped in lecture.**

**Problem 3**

**In Lecture 8 we found the electrostatic potential $V$ and electric field $\vec{E}$ everywhere for a spherical shell of radius $a$. Repeat this calculation with the integration steps we skipped in lecture.**

**Problem 4**

**Repeat Problem 2 for the case where the wire is infinite.**

**Problem 5**

**Using the following equation for the electrostatic potential $V(r)$**

$$V(r) = -\int_{\infty}^{r} \vec{E} \cdot d\vec{r'}$$

**find the electrostatic potential $V$ and electric field $\vec{E}$ everywhere for a uniformly charged solid sphere of radius $a$ and whose total charge is $q$. Use infinity as your reference point. Check that your results are in agreement with the results we previously obtained in this course for this problem. Sketch $V$.**

**Problem 6**

**Given the system discussed in Problem 4 of Problem Set VII, find the electrostatic potential $V$ at the center using infinity as your reference point. Use the following equation for the electrostatic potential $V(r)$**

$$V(r) = -\int_{\infty}^{r} \vec{E} \cdot d\vec{r'}$$

**Problem 7**

**Given the system discussed in Problem 7 of Problem Set VII, find the electrostatic potential difference between a point on the axis and a point on the outer cylinder. Note that it is not necessary to commit yourself to a particular reference point if you use the appropriate equation. Start with the following equation for the electrostatic potential $V(r)$**

$$V(r) = -\int_{\infty}^{r} \vec{E} \cdot d\vec{r'}$$