PHY 207 Practice Test I

Name: ________________________________

Student ID: ____________________________

Answer all four problems. Partial credits are based on the clarity and the quality of the work you show.

$\vec{E} = \frac{kq}{r^2}\hat{r}$, $k = \frac{1}{4\pi\varepsilon_o}$ $= 9x10^9$ NM^2C^{-2}

$\vec{F} = q\vec{E}$

$\oint \vec{E} \cdot d\vec{A} = \frac{Q_{in}}{\varepsilon_o}$

$V = \frac{kq}{r}$

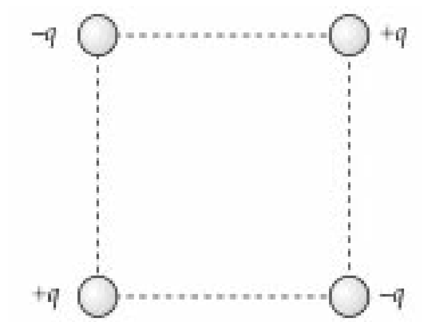
$dV = -\vec{E} \cdot dl = -(E_x dx + E_y dy + E_z dz)$

$A_{sph} = 4\pi r^2, V_{sph} = \frac{4}{3}\pi r^3, dV_{sph} = 4\pi r^2 dr$

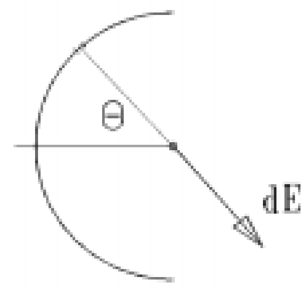
$A_{cyl} = 2\pi rL, A_{cir} = \pi r^2$

$dq = \lambda dl = \sigma dA = \rho dV$

1. Four charges of equal magnitude are arranged at the corners of a square of side L as shown in the Figure. (*a*) Find the magnitude and direction of the force exerted on the charge in the lower left corner by the other charges. (*b*) Show that the electric field at the midpoint of one of the sides of the square is directed along that side toward the negative charge and has a magnitude E given by $E = k\frac{8q}{L^2}\left(1-\frac{\sqrt{5}}{25}\right)$.



2. A semicircular ring of radius *R* carries a uniform line charge of λ. Find the electric field at the center of the semicircle.



3. An electric field is $\boldsymbol{E}$ = 300 N/C $\boldsymbol{i}$ for $x > 0$ and $\boldsymbol{E}$ = –300 N/C $\boldsymbol{i}$ for $x < 0$. A cylinder of length 20 cm and radius 4 cm has its center at the origin and its axis along the x axis such that one end is at x = +10 cm and the other is at x = –10 cm. (*a*) What is the flux through each end? (*b*) What is the flux through the curved surface of the cylinder? (*c*) What is the net outward flux through the entire cylindrical surface? (*d*) What is the net charge inside the cylinder?

4. A nonconducting sphere of radius R has a volume charge density $\rho = \rho_0 r/R$, where ρ_0 is a constant. (*a*) Find the total charge. (*b*) Use Gauss's law to find the electric field E_r everywhere. (*c*) Use $dV = -E_r\ dr$ to find the potential V everywhere, assuming that $V = 0$ at $r = \infty$. (Remember that V is continuous at $r = R$.)