EE 381 Electric & Magnetic Fields Examination #2
(Fall 2xxx)

Name __**Example**_____

Instructions: Place answers in indicated spaces. Use notation as given in class for coordinates and vectors. **Show all work for full credit**. Attach equation sheet and hand-in with exam.

1) Given the vector field $\bar{L} = \frac{2\sin^2\phi}{\rho}\hat{a}_\rho - 6\rho^2 z\,\hat{a}_\phi + 7z\cos\phi\,\hat{a}_z$, find the flux $\Psi = \oiint_S \bar{L} \bullet d\bar{s}$ through the closed surface enclosing the volume described by $0 \le \rho \le 3$, $0 \le \phi \le \pi/2$, and $0 \le z \le 5$.

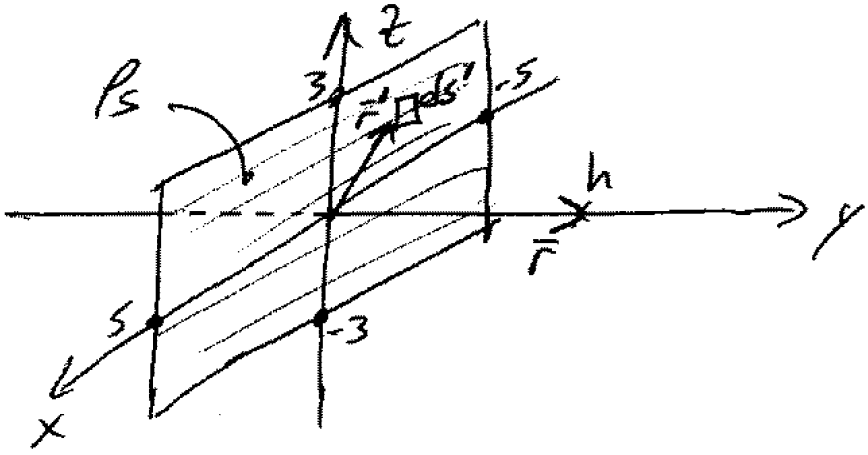
Ψ = **_157.5_**

2) Given point charge Q_1 at (4, -2, 3) and Q_2 at (-6, 2, -3) determine the absolute potential V at point (2, 0, 1) when Q_1 = 10 μC and Q_2 = -20 μC. All spatial coordinates are in units of km.

V = **6.3325 V**

3) A uniform surface charge density of $\rho_s = 1\ \mu C/m^2$ is located on a surface described by $-5 \le x \le 5$ m, $y = 0$, $-3 \le z \le 3$ m located in free space. Find the indicated quantities needed to directly calculate the electric field at the point $(0, h, 0)$ along the y-axis. (Do NOT attempt to solve, simplify, or perform any coordinate transformations.)

a) Draw sketch of problem geometry with appropriate information and labels.



b) The appropriate general integral, in position vector form, to find $\bar{E}$ for this problem is:

$$\bar{E} = \int\int_S \frac{\rho_s(\bar{r}-\bar{r}')}{4\pi\epsilon_0|\bar{r}-\bar{r}'|^3}\, ds'$$

c) field position vector $\bar{r}$ = $h\,\hat{a}_y$

d) source position vector $\bar{r}'$ = $x'\hat{a}_x + z'\hat{a}_z$

e) dl', $d\bar{l}'$, (ds'), $d\bar{s}'$, dv', $d\bar{v}'$ = $dx'\,dz'$

(Circle one) (write-out expression)

f) Q, ρ_l, (ρ_s), ρ_v = $1\ \mu C/m^2$

(Circle one) (write-out expression)

f) $\int$, $\int_{z'=-3}^{3}\int_{x'=-5}^{5}$, or $\int\int\int$?

(Circle one and fill-in limit(s))

4) A hollow, plastic, spherical shell ($1 \le r \le 2$ cm and $\varepsilon = 3\,\varepsilon_0$), suspended in free space, supports a uniform volume charge density of $\rho_v = 4\ \mu C/m^3$. Find the electric field everywhere. [Hint: Gauss]

$$\vec{E} = \begin{cases} 0 & r < 1\text{cm} \\ \hat{a}_r\ 50{,}197\left(r - \frac{10^{-6}}{r^2}\right)\ V/m & 1 \le r \le 2\text{cm} \\ \hat{a}_r\ \frac{1.05414}{r^2}\ V/m & r \ge 2\text{cm} \end{cases}$$