Friday, March 5, 2021	**Physics220: UnTest 01**	Name _____

Instructions: You have a total of 50 minutes to complete this test.
Answer each question completely showing complete details.
For complete credit you must include correct SI units with numerical answers.

Time Start_____ Time finish _____pledged _____

Constants: $k=8.987\text{x}10^{9}\frac{Nm^2}{C^2}$: $\epsilon_0=8.854\text{x}10^{-12}\frac{C^2}{Nm^2}$

(1) A charge q is described by $q:[1\mu C;2m,-8m]$.

(1:a) Find the **vector** electric field, $\vec{E}$ (with correct SI units) at the point p: x=3m,y=5m.

(1:b) Find the magnitude of the vector electric field, $|\vec{E}|$, with correct SI units.

(1:c) If a charge $q_p=+2\mu C$ is placed at p, find the **vector** electric force on q_p.

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(2) Consider two charges: 1:[-2μC;-1m,0m] and 2:[+2μC;+1m,0m].

(2:a) Provide a sketch of the electric field map showing direction and relative strength. Note: one line here is completely insufficient.

(2:b) Find the **vector** electric field at the point given by p:[0m,4m].

(2:c) Find the **vector dipole moment** of the charge distribution with correct SI units.

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(3) A sphere of total charge Q and of radius b has a uniform volume charge density given by $\rho = \frac{Q}{\frac{4}{3}\pi b^3}$.

(3:a) Find the **vector** electric field **inside** the sphere (providing complete details with sketches). Express your answer in terms of Q, r and b, using the unit vector $\hat{r}$.

(3:b) Find the **vector** electric field **outside** the sphere (again, providing complete details with sketches). Express your answer in terms of Q and r using the unit vector $\hat{r}$.

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(4) An infinite plane is located in the x-y plane at z=0 and has a uniform surface charge density $-\sigma$. A second plane is located (parallel to the first) at z=+d and has a surface charge density $+\sigma$.

(4:a) Showing complete details, **with sketches**, find the **vector** electric field at z<0 and z>d.

(4:b) Again, showing complete details, **with sketches**, find the **vector** electric field in the region z>0 and z<d.

(4:c) Provide a numerical answer to part b **with correct SI units and vector signs** for the case that the surface charge density is $\sigma = 2\mu C/m^2$ in between the planes.

4c: $\vec{E}_{z>0 \text{ and } z<d}$ =_____