| Friday, March 5, 2021 | **Physics250: 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 $q_p$.

**(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 volume charge density given by $\rho = \frac{5Q}{4\pi b^3}\left(\frac{r^2}{b^2}\right)$ .

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