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Instructions: You have a total of 55 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: $k = 8.987x10^{9}\,\frac{Nm^2}{C^2} : \varepsilon_0 = 8.854x10^{-12}\,\frac{C^2}{Nm^2}$

(1) A charge q=3μC is located at x=7 and y=9.

(1:a) Find the **vector** electric field at the point p: x=3,y=11.

(1:b) If a charge q_p=-2μC is placed at p, find the **vector** electric force on q_p.

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(2) A charge 1: [-2μC:0,+1] and a charge 2: [+2μC:0,-1] are located along the y-axis.

(2:a) Find the **vector** electric field along the positive x-axis at a point p:[5,0].

(2:b) If a charge q_p=3μC is placed at p, find the **vector** electric force on q_p.

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(3) A sphere of charge of radius a has a uniform volume charge density $\rho = \frac{Q}{\frac{4}{3}\pi a^3}$ where Q is the total charge on the sphere.

(3:a) Find the **vector** electric field **inside** the sphere (showing complete details with sketches).

(3:b) Find the **vector** electric field **outside** the sphere (again, showing complete details with sketches).

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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 +σ. A second plane is located (parallel to the first) at z=+d and has a surface charge density -σ.
(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 with correct SI units for the case that the surface charge density is $\sigma = 3\frac{\mu C}{m^2}$.

4c:(a): E=____________________ 4c:(b): E=___________