Wednesday February 4,2026	Physics 250: UnTest 01 : page 1	Name _____

Instructions: You have a total of 50 minutes to complete this test. Answer each question completely. In order to obtain full credit for the problems, **you must** supply sketches, words, and details (including all assumptions) showing clearly how you obtained your answer. Correct SI units must be provided for numerical answers where required.

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] In order to obtain full credit for this problem, **you must** supply sketches, words, and details (including all assumptions) showing clearly how you obtained your answer.
A sphere of radius a has a uniform volume charge density per unit volume given by $\rho(r)=\frac{Q}{\pi a^4}r$ when a total charge Q is placed on the sphere.

(**a)** Find the **vector electric field** , $\vec{E}$ **outside** the sphere of charge in terms of Q,a and r.

(b) Find the **vector electric field** , $\vec{E}$ **inside** the sphere of charge in terms of Q, a and r.

(c) Find the **electric potential** at the surface of the sphere where r=a.

[2] An infinitely long wire along the z-axis has a uniform linear charge density per unit length given by λ_0 .

(a) Find the **vector electric field** , $\vec{E}$ at a distance s from the wire. You should use for the cylindrical coordinate unit vector the symbol $\hat{s}$.

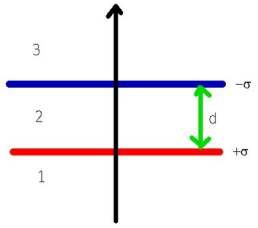
(b) Suppose that $\lambda_0 = 1 \frac{\mu C}{m}$. What is the **vector electric field** at a distance of 2000 m from the wire with correct SI units?

(c) If a charge $q_p = +3 \mu C$ is placed 10 m from the wire, what is the **vector electric force** on the charge with correct SI units?

(d) An electric potential varies as $V(z) = bz^2$ in a region of space. Find the electric field associated with this potential.

[3] An ideal parallel plate capacitor is in the x-y plane a shown. The capacitor is charged with a surface charge density +σ on the plate located at z=0 and -σ on the plate located at z=d.

(a) Make a sketch of the electric field, including electric field directions on the diagram below. You will need to use several lines here to correctly show this. In each of the 3 regions, use a double line arrow to represent fields from +σ and use a single line arrow to represent the field from -σ.



(b) Find the **vector electric field** , $\vec{E}$ between the plates of the capacitor (in region 2). You must show details and assumptions here (and a sketch).

(c) If $\sigma = 1 \times 10^{-10} \frac{C}{m^2}$. Find a numerical result for the **vector electric field** in region 2 with correct SI units.

(d) If a sphere has a radius of 1 m, and has a charge Q placed upon it, find the capacitance of the sphere.

(e) Capacitors C_1 and C_2 are placed in series. Find the equivalent capacitance if $C_1 = C_2$.

(f) Capacitors C_1 and C_2 are placed in parallel. Find the equivalent capacitance if $C_1 = C_2$.

[4] Two charges have the following coordinates: #1:(+q;-a,0) and #2:(-q.+a,0).
(a) Find the **vector electric field** , $\vec{E}$ at the origin which has coordinates (0,0) in terms of k,q, and a.

(b) If a charge q_p is placed at the origin, what is the **vector electric force** on this charge in terms of k,q,q_p, and a?

(c) Provide a numerical result for the **vector electric force** with correct SI units on this charge for the case a=1m, and with both q_p and q given by 1 μC.

(d) Find the electric potential at the point (0,0).

(e) Find the vector electric dipole moment $\vec{p}$ **.**