Roster ID: _____

Physics 272. Practice Midterm I
There are 4 problems. Each is assigned 25 points.
Show your work.

Problem 1: 25 points

Two equal charges of 3.0 μC are on the y-axis. One is at the origin and the other is at $y = 6$ m. A third charge $q_3 = 2.0\mu$C is on the x-axis at $x = 8$ m.

Find the electric field at the location of q_3. (Hint: first draw a diagram)

Problem 2: 25 points

Suppose a non-conducting sphere of radius R has a *non-uniform* charge density $\rho(r) = B/r$ inside.

(a) Draw a sketch of this sphere.

(b) Find the electric field inside the sphere. (show the Gaussian surface used on your sketch).

(c) Find the electric field outside of the sphere. (show the Gaussian surface used on your sketch).

Problem 3: 25 points

A ring of radius 5 cm is in the y-z plane with its center at the origin. The ring carries a uniform charge of 10 nC. A small particle of mass $m = 10$ mg and charge $q_0 = 5$ nC is placed at $x = 12$ cm and released.

(a) What is the initial potential energy of the particle ?

(b) What is the speed of the particle when it is a great distance away from the ring ?

Problem 4: 25 points

(a) **[5 pts]** If the charge on an isolated spherical conductor is doubled, its capacitance *quadrupules, doubles, drops by half, remains the same.* ? Explain.

(b) **[5 pts]** Two charges of the same magnitude and sign are placed a certain distance apart. At what points in space is the electric field zero (draw a sketch) ?

(c) **[10 pts]** One electron is accelerated through a potential difference of 10 kV. Another electron is accelerated through a potential difference of 40 kV. What is the ratio of the final velocities of the two electrons ?

(d) **[5 pts]** The electrostatic potential is measured to be $V(x, y, z) = 4|x| + V_0$. The charge distribution responsible for this potential is a *a point charge at the origin, a uniformly charged thread in the x-y plane, a uniformly charged sheet in the y-z plane, a uniformly charged sphere of radius* $1/\pi$ *at the origin* (pick one).