Principles of Physics II (PHY 112)

Practice Exam 2

Question 1 (4 points) Consider the electric potential produced by two point charges, one positive and the other negative, separated by 3 cm. Where is the electric potential higher—near the positive charge or near the negative charge? Explain how you know.

Question 2 (4 points) If the electric field is zero in some *region* of space, does that imply that the electric potential is zero in that region? If so, why? If not, what does it imply about the electric potential?

Question 3 (4 points) Consider a parallel-plate capacitor with charge $+Q$ on one plate and charge $-Q$ on the other plate. If you pull the plates apart slightly, so that the distance between them increases, what happens to the electric field, the potential difference between the plates, and the capacitance? Explain how you know.

Question 4 (4 points) Can you think of a way to assemble a positive charge and a negative charge so that the electric field produced by them is zero somewhere? If so, show how. If not, why can't it be done?

Question 5 (4 points) An early model for a hydrogen atom was a proton at the center with an electron orbiting around it. Does this model seem reasonable, given the physics we have studied? Why or why not?

Question 6 (4 points) For his birthday, my son Carl asked for a parallel-plate capacitor that aquires a charge of 1 C when a voltage of 1 V is applied. Explain why it would be very difficult to make such a capacitor.

Problem 1 (8 points) A 2 nC charge is held fixed. A proton is released from rest at a point 1 m away from the 2 nC charge. How fast is the proton moving when it reaches a point 10 m away?

Problem 2 (8 points) Two flat circular metal plates, each with radius 0.5 m, are separated by 1 mm. One plate has a charge of 3 nC on it and the other has an equal and opposite charge. If we choose the zero of electric potential to be at the center of the negative plate (the plate with the negative charge), what is the electric potential at the center of the positive plate?

Problem 3 (8 points) Consider the electric field produced by the following three particles. Particle 1 with $q_1 = 5\text{nC}$ is located at $\mathbf{r}_1 = 3\text{ m}\hat{\mathbf{i}} + 3\text{ m}\hat{\mathbf{j}}$. Particle 2 with $q_2 = -2\text{nC}$ is located at $\mathbf{r}_2 = 2\text{ m}\hat{\mathbf{k}}$. Particle 3 with $q_3 = -4\text{nC}$ is located at $\mathbf{r}_3 = -2\text{ m}\hat{\mathbf{k}}$. Find the electric flux through a cylinder with radius 4 m, where the axis of the cylinder lies along the z axis, the top of the cylinder lies in the plane $z = 3\text{m}$, and the bottom of the cylinder lies in the plane $z = 0$.