Physics 10164 - Exam 1B

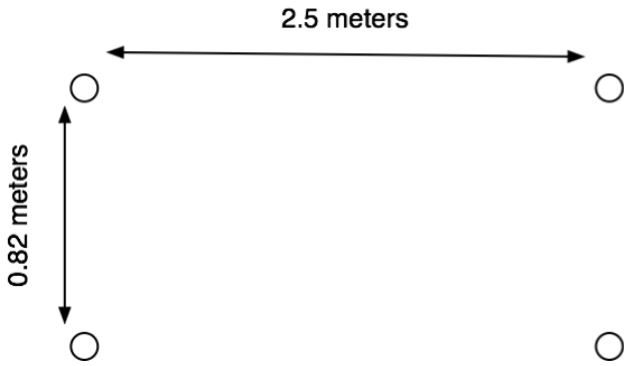
Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work even if you get the right answer. Clearly indicate your answer with a circle or a box and remember to include correct units and significant figures.

#1. (40 pts) A 3.0 μC charge (A) is fixed at the origin. Nearby, at a coordinate x = 2.4 mm, a -5.5 μC charge (B) with a mass of 320 grams is initially at rest. An applied force causes charge B to move to coordinate x = 5.6 mm, and the charge has a speed of 12 m/s when it gets there.

Assuming only the electric force and the applied force are relevant in this problem, how much work is done by the applied force?

2. (30 pts) Four identical +4.0 nC charges are arranged in a rectangle as shown below. The charge on the top left of the rectangle is located at the origin.

Find the magnitude and direction of the electric force acting on the charge on the bottom right of the rectangle.



#3. (30 pts) A parallel-plate capacitor has a cross-sectional area of 3.5 cm^2 and a plate separation of 4.4 mm. It is connected to a 12 Volt battery.

a) What is the charge on the positive plate of the capacitor?

b) What is the magnitude of the electric field between the plates?

c) Keeping the capacitor plates connected to the battery, the plates are pulled apart to a new separation of 6.6 mm. What happens to the charge on the positive plate? Justify your answer qualitatively or mathematically.

d) The capacitor is restored to its original 4.4 mm separation. Now a dielectric with K = 3.0 is inserted between the plates, and the system is allowed time to reach a new equilibrium with the plates still connected to the battery. What is the new charge on the positive plate?

e) What is the new electric field between the plates after they have reached equilibrium with the dielectric inserted?