Last Name, First Name *Student No.*

University of Toronto
Department of Electrical & Computer Engineering
ECE110S – Electrical Fundamentals
Quiz 1 – February 1, 2006, 4:30-5:00 PM

($e = 1.6 \times 10^{-19}$ C, $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m, $\mu_0 = 4\pi \times 10^{-7}$ H/m)

Instructions: Non-programmable calculators allowed. No other aids. Answer in the space provided on these sheets. The back sides of these sheets can be used as well. For full marks you must show methods, state UNITS and compute numerical answers when requested. **Please write in PEN, not pencil.**

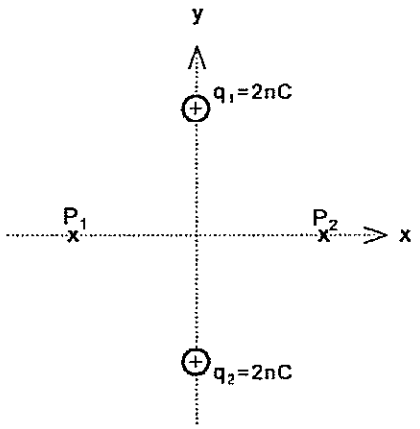
1. **Electrostatics.** Two 2 nC point charges q_1 and q_2 are located in a Cartesian coordinate system at (0,4 cm,0) and (0,-4 cm,0), respectively, as shown below.

(a) Calculate the electric field $\underline{\mathbf{E}}$ (magnitude and direction) at point P_1 with coordinates (-4 cm,0,0). **(4 marks)**

(b) Which point charge Q would have to be placed at point P_2 with coordinates (0,4 cm,0) such that its electric field at point P_1 cancels the electric field due to q_1 and q_2? **(3 marks)**

(c) Calculate the electrostatic force $\underline{\mathbf{F}}_{el}$ on Q. **(2 marks)**

(d) If charge Q is to be moved from (4 cm,0,0) to (8 cm,0,0), is there work to be done by an external force? Explain your answer. No further calculation required. **(1 mark)**



2. **Magnetic Field.** At all points on the *y*-axis of a Cartesian coordinate system the magnetic field has a magnitude of 2 μT and the direction shown below. An infinitely long wire carrying a current of 15 A is located along the *y*-axis.

(a) Calculate the force **per unit length** on the wire. **(3 marks)**

(b) Assume the magnetic field is due to a second, parallel wire, also carrying a current of 15 A. Consider only the **magnitude** of **B** on the *y*-axis and determine its distance from the first wire. **(4 marks)**

(c) Find the location of the second wire in order to produce both the **magnitude and direction** of **B** on the *y*-axis. **(2 marks)**

(d) Is there more than one possible answer to part (c)? Explain. **(1 mark)**