*Last Name, First Name* *Student No.*

**University of Toronto**
**Department of Electrical & Computer Engineering**
**ECE110S – Electrical Fundamentals**
**Quiz 1 – January 31, 2007, 4:30-5:00 PM**

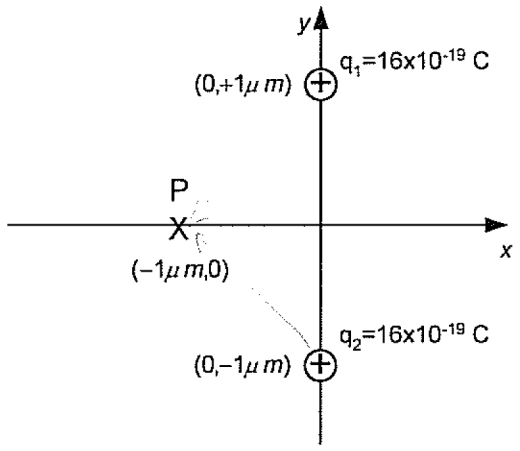
($e = 1.6\times10^{-19}$ C, $\varepsilon_0 = 8.85\times10^{-12}$ F/m, $\mu_0 = 4\pi\times10^{-7}$ H/m)

**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 [10 marks].** Two $16\times10^{-19}$ C positive point charges $q_1$ and $q_2$ are located in a Cartesian coordinate system at (0, 1 μm) and (0, -1 μm), respectively, as shown below.

(a) Calculate the electric field **E** (magnitude and direction) at point P with coordinates (-1 μm, 0). **(6 marks)**

(b) Also calculate the electric potential V, at point P. **(4 marks)**



2. **Capacitance [5 marks].** A parallel-plate capacitor consists of two 1-cm by 1-cm rectangular metal plates with 0.2mm distance and filled with material of dielectric constant $\kappa=2$.

(a) Calculate the capacitance. **(2 marks)**

(b) A potential difference of 4V is applied between two plates. Calculate the electrical charge stored on each plate, and also the energy stored in the capacitor. **(2 marks)**

(c) Add a second capacitor in parallel to the capacitor mentioned in part (a). What is the capacitance of the added capacitor such that the equivalent capacitance becomes 10pF? **(1 mark)**

3. **Magnetic Field and Faraday's law [5 marks].** A z-directed uniform magnetic field **B** (into the page), shown in a figure below, changes over time according to the following equation:

$$B(t) = \frac{10^{-3}}{2\pi^2} Sin(2\pi t)$$

where B is in Tesla and t is in second.

(a) Find the magnetic flux ($\Phi_B$) as a function of time, which goes through a circle-shape wire loop L with a radius of 10cm, shown in the figure below **(1 mark)**

(b) Find the magnitude of the induced voltage in the loop L as a function of time. **(2 marks)**

(c) What is the direction of the current (clockwise or counter-clockwise) in the loop L, in period between t=0 and t=0.25 second. Explain why? **(2 mark)**