1. **Electric force/field/potential/potential-energy, 5/ea.** Given: \( q_1 = q_2 = q_3 = 25 \mu C \) in Fig. 1.

   - **Note:** x- and y-axis in cm unit. Find:
     - (a) Force exerted on \( q_3 \) (magnitude) \( \text{Ans. } 4.91 \times 10^{-19} N \) (direction) \( \text{Ans. } +y \)
     - (b) Electric field at the origin \( O \) (0, 0)? (magnitude) \( \text{Ans. } 2.5 \times 10^8 \text{ V/m} \) (direction) \( \text{Ans. } y \)
     - (c) Electric potential at the origin \( O \) \( \text{Ans. } 2.25 \times 10^7 \text{ V} \)
     - (d) If charge \( q_4 = 50 \mu C \) is placed on the origin \( O \), what is the electric potential energy of \( q_4 \)? \( \text{Ans. } 1.25 J \)

2. **Magnetic force/field/flux, Faraday's-Lenz's Law, 4/ea.** A single square coil consists of four conducting wires (ab, bc, cd, and da) with length of 2 m each, and total resistance of 10 ohm placed into a linearly decreasing magnetic field zone indicated by X.

   - **Notes:**
     - a) Magnetic flux change rate? \( \text{Ans. } -2 \text{ mT/s} \)
     - b) Emf generated in the wires? \( \text{Ans. } 2 \text{ V} \)
     - c) Induced current in wires? \( \text{Ans. } 0.2 \text{ A} \)
     - d) The direction of induced current? \( \text{Ans. } \) (Must clearly indicate on the diagram on left)
     - e) Will the coil be forced to move? Yes. \( \) or No. 

3. **DC circuits, 4/ea.**

   - (a) The value of current \( i_1 \)? \( \text{Ans. } 2/4 \text{ A} \)
   - (b) The value of current \( i_2 \)? \( \text{Ans. } -1/4 \text{ A} \)
   - (c) The value of current \( i_3 \)? \( \text{Ans. } 3/4 \text{ A} \)
   - (d) The voltage on the 5-ohm resistor? \( \text{Ans. } 1.43 \text{ V} \)
   - (e) The power dissipated on the 20-ohm resistor? \( \text{Ans. } 3.67 \text{ W} \)

4. **a. c. circuits, 4/ea.**

   - Given: 1) a.c. source: \( i(t) = 10 \sin(376.8t) \)
     - 2) \( R = 200 \text{ ohm}; C = 35.2 \mu F; \) and \( L = 200 \text{ mH}. \) Find:
       - (a) The rms voltage on the resistor \( R. \) \( \text{Ans. } 1.4 \text{ kV} \)
       - (b) The max voltage on \( L. \) \( \text{Ans. } 154 \text{ V} \)
       - (c) The max voltage on capacitor \( C. \) \( \text{Ans. } 154 \text{ V} \)
       - (d) Is the circuit in a resonance? \( \text{Ans. } \) Yes. \( \) or No. 
       - (e) The value of average power dissipated on the resistor? \( \text{Ans. } 10 \text{ kW} \)

5. **Geometric optics, 4/ea.** Given: A thin lens's focus length, \( f = 20 \text{ mm} \).

   - (a) Where is the image location when \( p = 10 \text{ mm?} \) \( \text{Ans. } -20 \text{ mm} \)
   - (b) If \( h_o = 10 \text{ mm in (a)}, \) what is the value of \( h_i? \) \( \text{Ans. } 20 \text{ mm} \)
   - (c) Referred to (a) and (b), verify your answers using ray diagram on left \( \text{Ans. } \) (must show at least 2 rays: 11° and 22° or 33°)
   - (d) If another converging lens with focus length of 10 mm is placed at the dashed-line position, find the final image location. \( \text{Ans. } 15 \text{ mm} \). (e) is image real \( \sqrt{ } \) or virtual \( \).