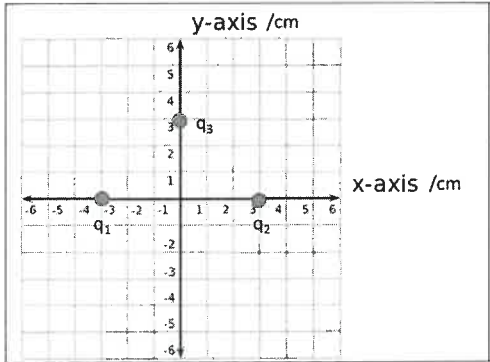


(Note: Answers must be placed at the given space. Answers written on the reverse side of this sheet will not be credited.)

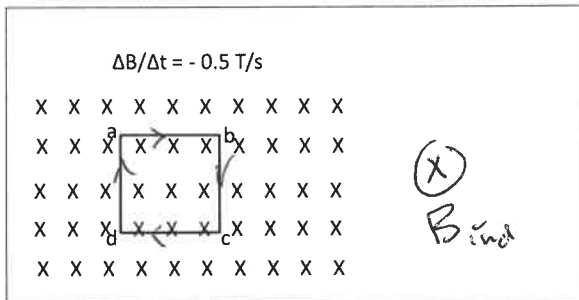
1. (Electric force/field/potential/potential-energy, 5/ea.) Given:  $q_1 = q_2 = q_3 = 25 \mu\text{C}$  in Fig. 1.



Note: x- and y-axis in cm unit. Find:

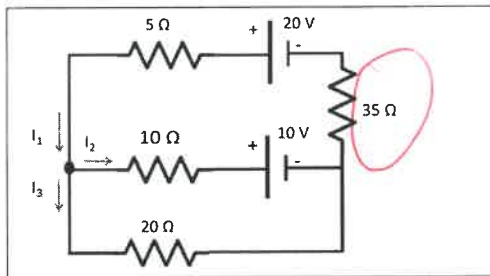
- (a) Force exerted on  $q_3$ ? (magnitude) Ans.  $4419 \text{ N}$  (direction) Ans.  $+y$   
 (b) Electric field at the origin O (0, 0)?  
 (magnitude) Ans.  $2.5 \times 10^8 \text{ V/m}$   
 (direction) Ans.  $-x$   
 (c) Electric potential at the origin O? Ans.  $7.25 \times 10^7 \text{ V}$   
 (d) If charge  $q_4 = 50 \mu\text{C}$  is placed on the origin O, what is the electric potential energy of  $q_4$ ? Ans.  $1125 \text{ J}$

2. (Magnetic force/field/flux, Faradays-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.



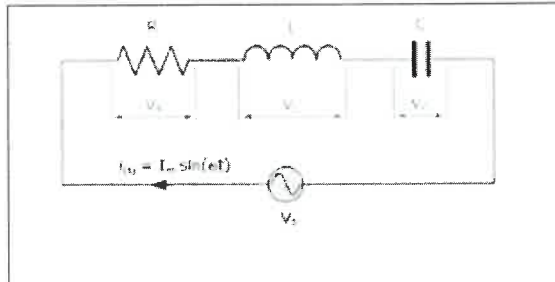
- (a) Magnetic flux change rate? Ans.  $-2 \text{ Tm}^2/\text{s}$   
 (b) Emf generated in the wires? Ans.  $2 \text{ V}$   
 (c) Induced current in wires? Ans.  $0.2 \text{ A}$   
 (d) The direction of induced current? Ans. (Must clearly indicate on the diagram on left)  
 (e) Will the coil be forced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

3. (DC circuits, 4/ea.) A



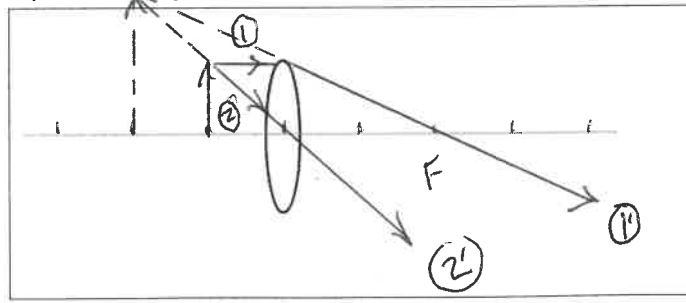
- (a) The value of current  $I_1$ ? Ans.  $2/1 \text{ A}$   
 (b) The value of current  $I_2$ ? Ans.  $-1/1 \text{ A}$   
 (c) The value of current  $I_3$ ? Ans.  $3/1 \text{ A}$   
 (d) The voltage on the 5-ohm resistor? Ans.  $1.43 \text{ V}$   
 (e) The power dissipated on the 20-ohm resistor? Ans.  $3.67 \text{ W}$

4. (a. c. circuits, 4/ea.)



- Given: 1) a.c. source:  $i(t) = 10\sin(376.8t)$   
 2)  $R = 200 \text{ ohm}$ ;  $C = 35.2 \mu\text{F}$ ; and  $L = 200 \text{ mH}$ . Find:  
 (a) The rms voltage on the resistor R. Ans.  $1.4 \text{ kV}$   
 (b) The max voltage on L. Ans.  $154 \text{ V}$   
 (c) The max voltage on capacitor C. Ans.  $154 \text{ V}$   
 (d) Is the circuit in a resonance? Ans. Yes.  or No. \_\_\_\_\_  
 (e) The value of average power dissipated on the resistor? 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  $p = 10 \text{ mm}$ ? Ans.  $-20 \text{ mm}$   
 (b) If  $h_o$  is 10 mm in (a), what is the value of  $h_i$ ? Ans.  $20 \text{ mm}$   
 (c) Referred to (a) and (b), verify your answers using ray diagram on left. 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. Ans.  $15 \text{ mm}$ . (e) is image real  or virtual \_\_\_\_\_