PHY 218
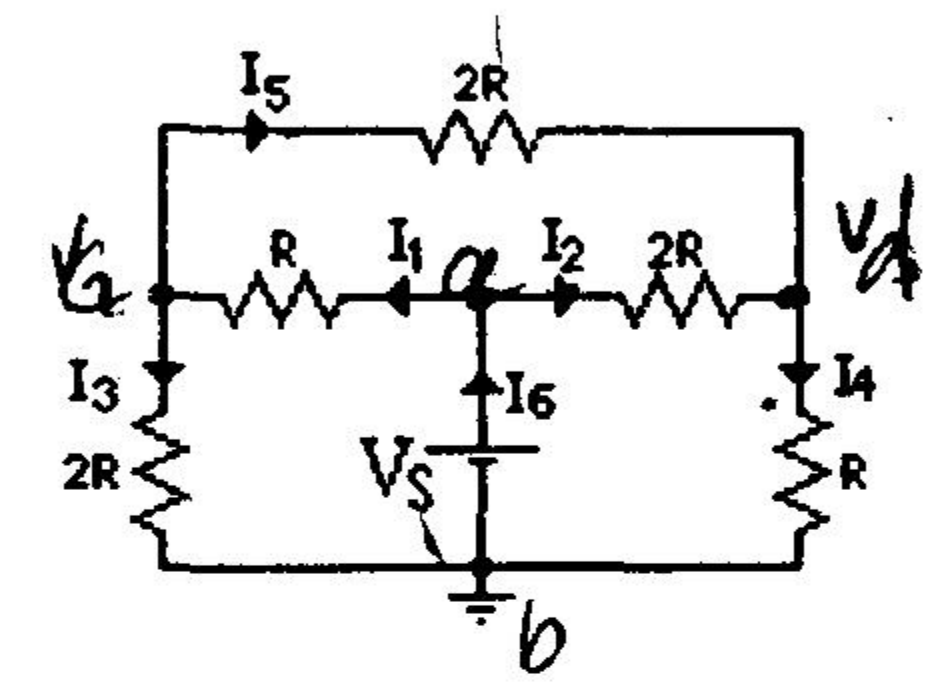## Quiz I
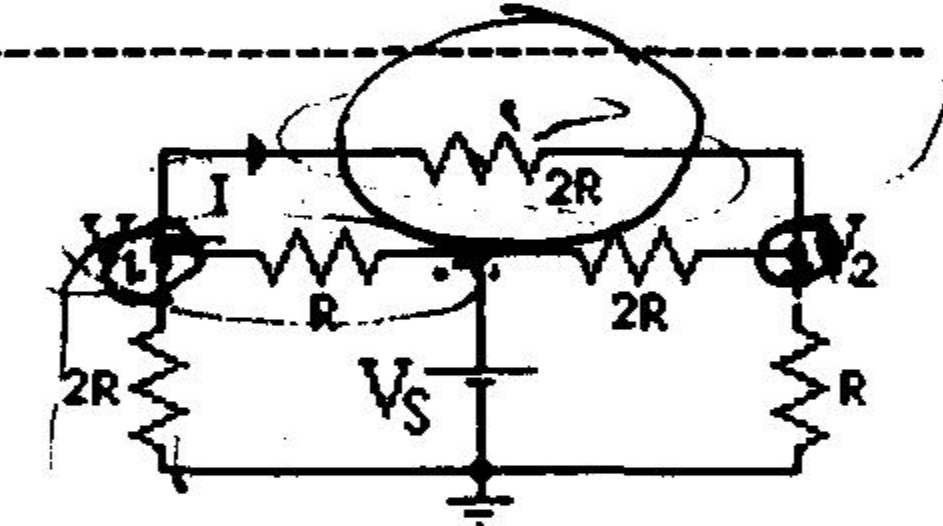
1. For the circuit shown in the figure
   a. Write down the KCL equations. *(3 pts)*
   b. Write down the KVL equations. *(9 pts)*
   c. Redraw the circuit as a bridge and argue (without algebra) that $I_4 = I_1$ *(3 pts)*

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2. For the circuit shown in the figure
   a. Write down the nodal equations for V_1 & V_2 *(8 pts)*
   b. Take $V_s = 15v$, $R = 1.5K$ and show (based on part a) that $I = 1mA$ *(7 pts)*

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3. The figure shows a source (S) and receiver (R) connected by a transmission line. Take $Z_o = 50\Omega$, $v = 2.4 \times 10^8$ m/s, $L = 75$ cm, and the resistance of the receiver $Z = 75\Omega$
   a. Calculate the upper limit on the frequency. *(6 pts)*
   b. Show that based on v & Z_o we have $L = 100$ pF/m *(4 pts)*

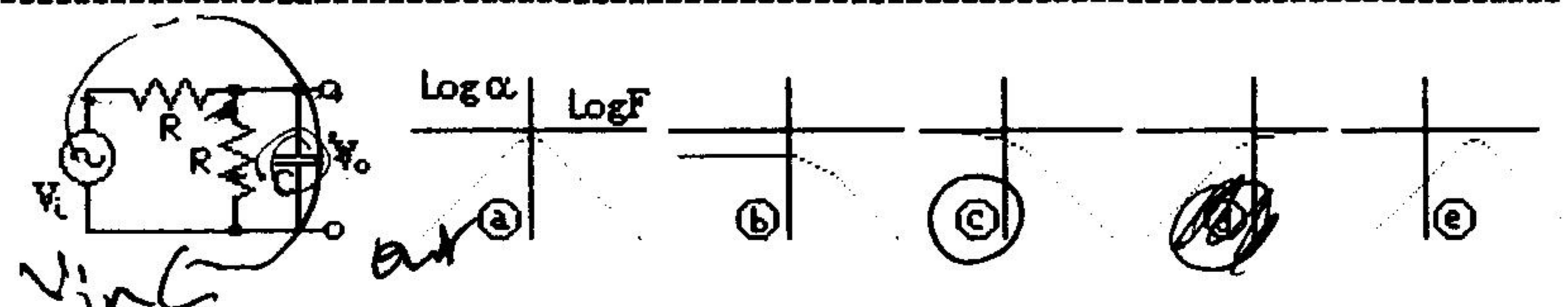---
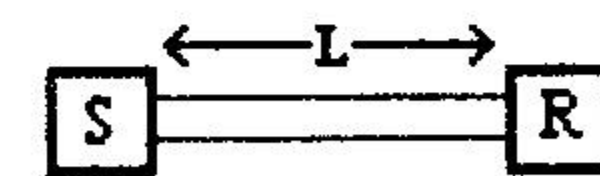
4. a. Show that for the circuit shown $F_o = 1$KHz and $Q = 5$. (For simplicity take $\pi^2 = 10$)
   b. Which of the four plots best represents the response function? Justify your answer quantitatively. *(5+5 = 10 points)*

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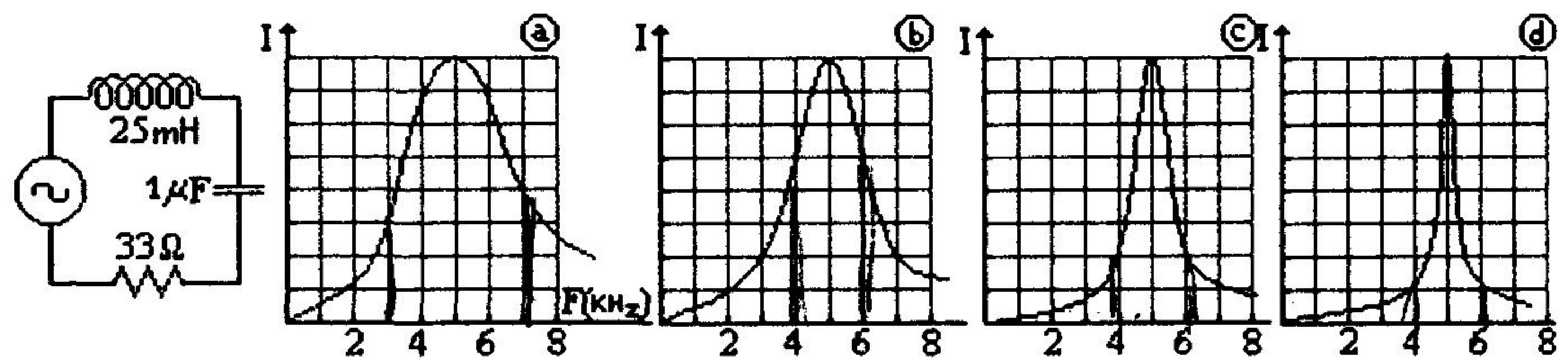
5. a. Show that $V_o = V_i/(2 + j\omega RC)$
   b. Which of the Bode plots belongs to the circuit? Justify briefly. *(5+5 = 10 points)*

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6. Answer 5 of the following 7 questions. *The 6th answer will be ignored. (5x8= 40 points)*
   a. Draw the model of a real Capacitor. Why is its RC independent of its size?
   b. Why are large capacitors physically large whereas the larger resistors are usually physically the smaller?
   c. Draw an Analogue Differentiator circuit and specify the (upper or lower) limit of frequency.
   d. What are the two properties of an ideal transformer?
   e. How are transformers used in "Impedance Matching"?
   f. Give two reasons why is an a.c. voltage more dangerous to humans than D.C. of the same strength?
   g. Why is the dielectric constant of water ($\kappa \sim 80$) much larger than that of paper ($\kappa \sim 3$?

Good Luck!   *2x15 + 3x10 + 40 = 100*

Bonus: Why are the two properties in 6.d practically incompatible?