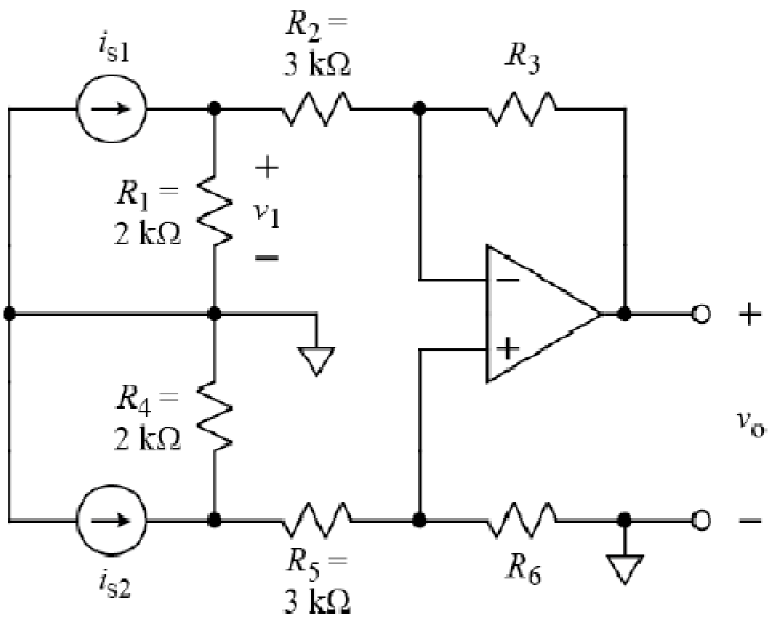
(Each problem is worth double points)

1.



The above circuit operates in linear mode. Derive a symbolic expression for v_o. The expression must contain not more than the parameters i_{s1}, i_{s2}, R_1, R_2, R_3, R_4, R_5, and R_6.

2. If $i_{s1} = 100\ \mu\text{A}$ and $i_{s2} = 0$ A, find the value of $R_3 = R_6$ that will yield an output voltage of $v_o = -6$ V.

3. Assuming $R_1 = R_4$, $R_2 = R_5$, and $R_3 = R_6$ derive a symbolic expression for v_o in terms of common mode and differential input voltages:

$$i_{cm} \equiv \frac{(i_{s2} + i_{s1})}{2} \quad \text{and} \quad i_{dm} \equiv i_{s2} - i_{s1}$$

The expression must contain not more than the parameters i_{cm}, i_{dm}, R_1, R_2, and R_3. Write the expression as i_{cm} times a term plus i_{dm} times a term. Hint: start by writing i_{s1} and i_{s2} in terms of i_{cm} and i_{dm}:

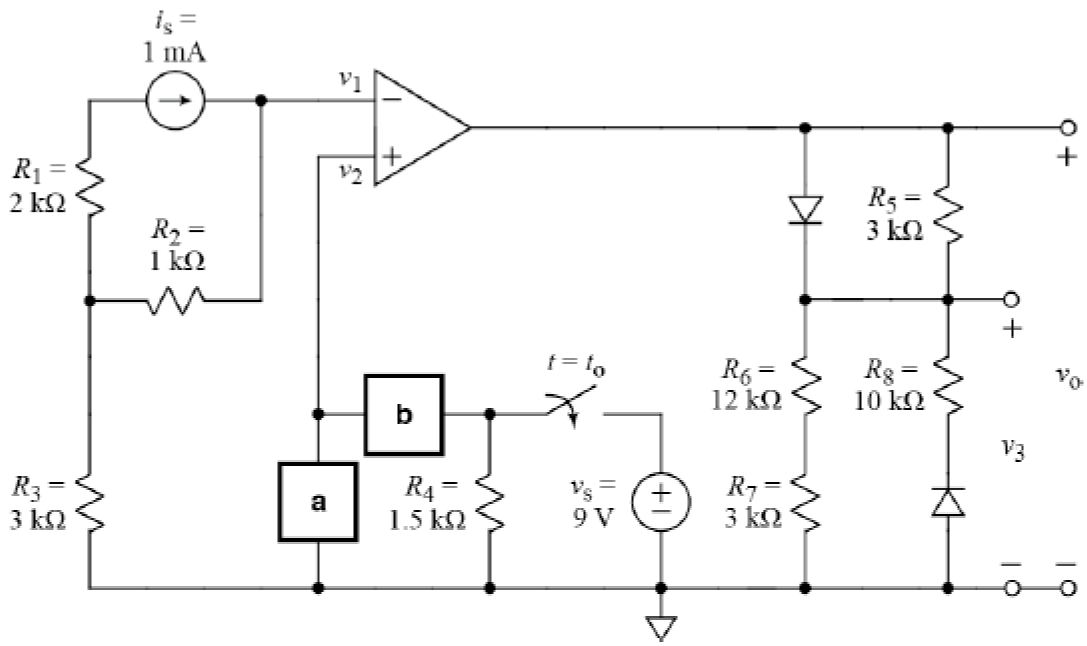
$$i_{s1} = i_{cm} - \frac{i_{dm}}{2} \quad \text{and} \quad i_{s2} = i_{cm} + \frac{i_{dm}}{2}$$

4. Assuming $i_{s2} = 0$ A, find the numerical value of the circuit's input resistance, R_{in}, as seen by source i_{s1}. In other words, write a formula for voltage, v_1, divided by i_{s1}:

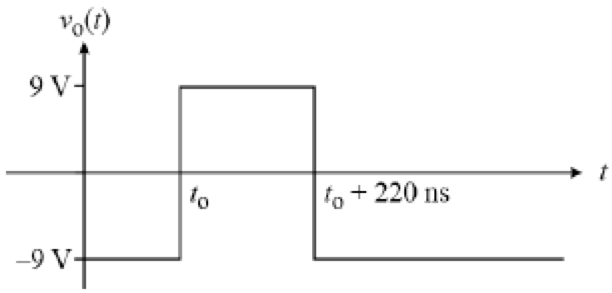
$$R_{in} \equiv \frac{v_1}{i_{s1}}$$

Write R_{in} in terms of not more (and possibly less) than R_1, R_2, and R_3.

5.



Rail voltages = ±9 V
After being open for a long time, the switch closes at time $t = t_o$.



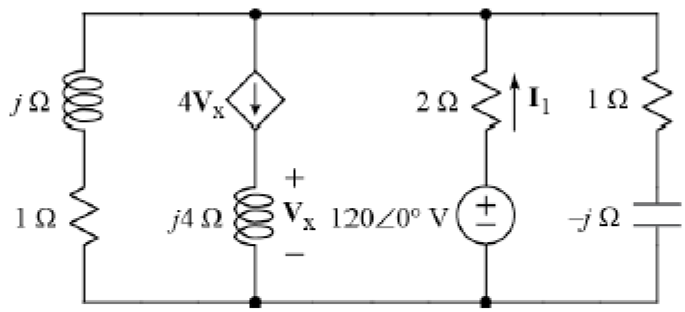
Choose either an *R* or *L* to go in box **a** and either an *R* or *L* to go in box **b** to produce the $v_o(t)$ shown above. Note that v_o stays low forever after t_o + 220 ns. Specify which element goes in each box and its value.

6. a) Sketch $v_1(t)$, showing numerical values appropriately.

   b) Sketch $v_2(t)$, showing numerical values appropriately.

7. Sketch $v_3(t)$. Show numerical values for $t < t_o$, for $t_o < t < t_o + 220$ ns, and for $t > t_o + 220$ ns. Use the ideal model of the diode: when forward biased, its resistance is zero, (a wire); when reverse biased, its resistance is infinite, (an open).

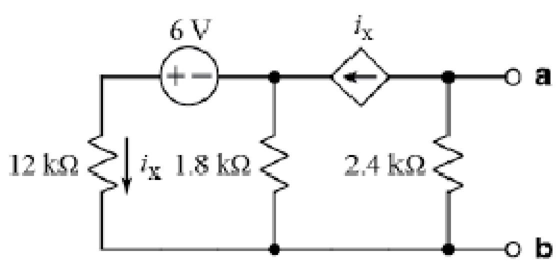
8.



A frequency-domain circuit is shown above. Write the value of phasor current $\mathbf{I}_1$ in polar form.

9. Given ω = 377 rad/s, write a numerical time-domain expression for $i_1(t)$, the inverse phasor of $\mathbf{I}_1$.

10.



a) Find the Thevenin equivalent of the above circuit relative to terminals **a** and **b**.

b) If we attach R_L to terminals **a** and **b**, find the value of R_L that will absorb maximum power.

c) Calculate the value of that maximum power absorbed by R_L.