1.

![Circuit Diagram]

a. Calculate \( v_1 \).

b. Calculate \( i_1 \).

2.

![Circuit Diagram]

Derive an expression for \( i_3 \). The expression must not contain more than the circuit parameters \( V_a, V_b, i_a, R_1, R_2, \) and \( R_3 \).
3. a. Derive an expression for $i_2$. The expression must not contain more than the circuit parameters $\beta, V_a, i_a, R_1$, and $R_2$.

b. Make at least one consistency check (other than a units check) on your expression. Explain the consistency check clearly.

4. The op amp operates in the linear mode. Using an appropriate model of the op amp, derive an expression for $v_o$ in terms of not more than $i_s, R_1, R_2$, and $R_3$.

5. Find the Thevenin equivalent circuit at terminals $a$ and $b$. $v_x$ must not appear in your solution. Note: $\alpha \neq 0$. 

1.2
6.

a) For the circuit shown, write three independent equations for the node voltages \( v_1, v_2, \) and \( v_3 \). The quantity \( v_x \) must not appear in the equations.

b) Make a consistency check on your equations for part (a) by setting resistors and sources to numerical values for which the values of \( v_1, v_2, \) and \( v_3 \) are obvious. State the values of resistors, sources, and node-voltages for your consistency check, and show that your equations for part (a) are satisfied for these values. (In other words, plug the values into your equations for part (a) and show that the left side and the right side of each equation are equal.)