1. Calculate \( v_1 \).

2. Calculate \( i_1 \).

3. Derive an expression for \( i_1 \). The expression must contain no other parameters than \( i_a \), \( R_1 \), \( R_2 \), \( R_3 \), and \( \alpha \). **Note:** \( \alpha < 0 \). (Hint: It is not just a voltage or current divider.)
4.

a) Derive an expression for $v_3$ containing not more than circuit parameters $v_a$, $i_a$, $R_1$, $R_2$, and $R_3$.

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

5.

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 $i_a$, $v_a$, $R_1$, $R_2$, and $R_3$. 
Answers:
1. -3 V
2. 30 mA (what tool can you use?)
3. Hint: you need a voltage loop and a current summation
4. You can ignore R1. Why? \( v_3 = -v_a \frac{R_3}{R_2 + R_3} + i_a \frac{R_2 R_3}{R_2 + R_3} \)
5. Hint: R's in series with a current source may be ignored (usually). Also, the voltage drop from the – input to the + input is 0 V. Use a v-loop on the right side.