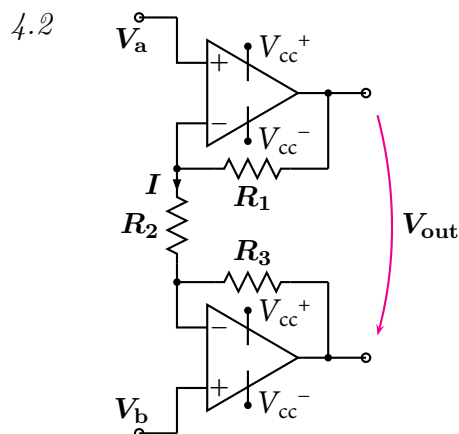
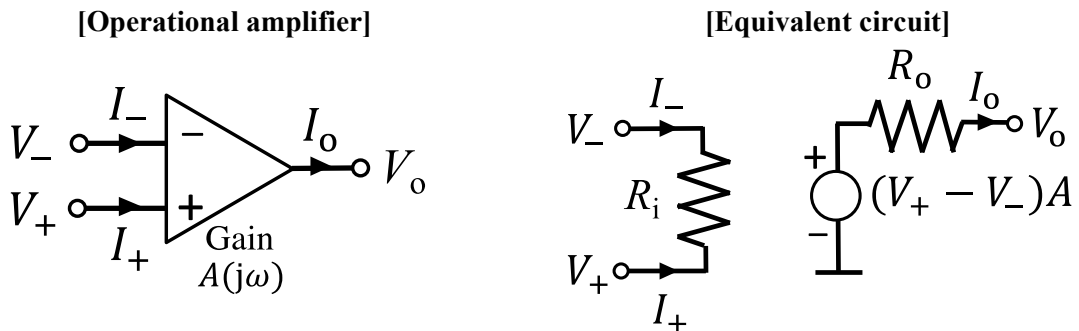


ELEC-C9610 Basics in Electronics

Calculation assignment 4. Deadline 14:00, October 12th, 2021

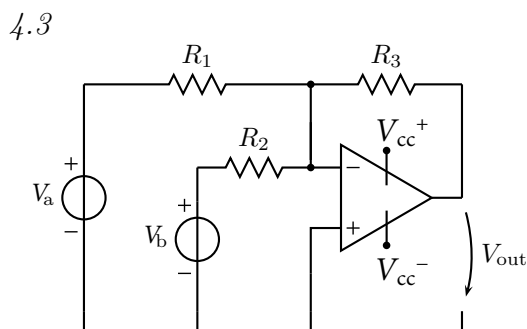
- 4.1 The following diagrams show an operational amplifier (opamp) circuit (left) and its equivalent representation (right). Please name three important assumptions we make when we consider the opamp **ideal** (you can take help from the equivalent representation).



For the circuit on the left side, relate the output voltage V_{out} with V_a and V_b . According to the relation, which of the following is the manipulation that the circuit realizes?

- Multiplying input voltages V_a and V_b .
- Adding input voltages V_a and V_b .
- Subtracting input voltage V_b from V_a .
- Dividing the input voltage V_a by V_b .

Let us assume ideal operational amplifiers with $V_{cc}^+ = \infty$ V and $V_{cc}^- = -\infty$ V, i.e., the amplifiers operate in a linear region.



- Express the output voltage V_{out} using the resistors and voltage sources connected to the input of operational amplifier. Derive all intermediate steps and mention necessary assumptions of operational amplifier.
- Find V_{out} with the following parameters of the circuit.
 $R_1 = 10$ k Ω , $R_2 = 20$ k Ω , $R_3 = 200$ k Ω ,
 $V_a = 0.2$ V, $V_b = 0.4$ V, $V_{cc}^+ = 15$ V, $V_{cc}^- = -12$ V.
- If $V_b = 0.4$ V, what is the condition of V_a so that the amplifier operates in a saturation region?
- If $V_a = 0.2$ V, what is the condition of V_b so that the amplifier operates in a linear region?