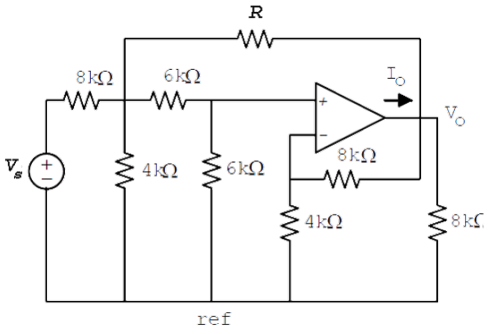
12. (12 points)

Question: In the circuit in figure below, obtain the output voltage V_o, in volts, and current I_o, in mA. This exercise attempts to erase the misconception that the output current of the op amp is zero, that is almost never true! The values R = 7 kΩ and Vs = 16 volts.

Figure:



I_O = ___ mA

V_O = ___ V

Correct Answers:

- 1.98462
- 7.75385

13. (12 points)

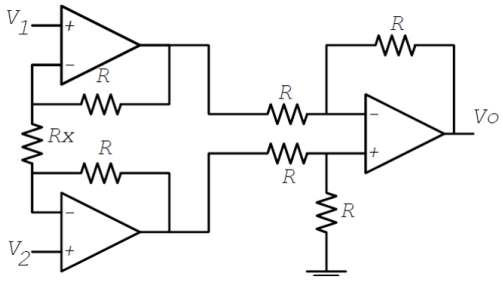
For the instrumentation amplifier in the figure, R = 21 kilo ohms, R_x = 34 kilo ohms, V_1 = 30 millivolts, V_2 = 15 millivolts.

(a) Compute and report V_O, in millivolts;

(b) Now assume that the op amp is powered by a source V_{cc} = +/- 11 volts. What is the maximum input voltage difference (V_1 - V_2) that will not saturate the op amp.

Hint: Work out V_O as a function of R_x, R, V_1 and V_2 first, and then substitute numerical values.

Figure:



V_O = ___ mV

$(V_1 - V_2)_{max}$ = ___ V

Correct Answers:

- -33.5294
- 4.92105

14. (12 points)

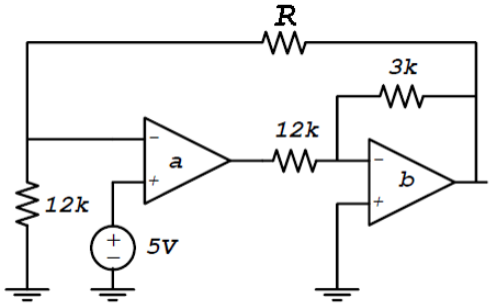
In the circuit shown, R is 10 kilo-ohms. Both op amps are identical and powered from a -22/22 volts power supply. Determine:

(a) what is the output voltage of each op amps, V_{oa}, V_{ob} and V_{na}, if we ignore the power supply; :

(b) what is the output voltage of each op amp, V_{oa}, V_{ob} and V_{na}, if we consider the power supply;

(c) To reduce the chance of saturation, should we increase or decrease R (enter 1 for increase, and minus 1 for decrease and 0 for no change).

Figure:



(a) V_{oa} = ___ V

V_{na} = ___ V

V_{ob} = ___ V

(b) V_{oa} = ___ V

V_{na} = ___ V

V_{ob} = ___ V

(c) To reduce the chance of saturation, should we increase or decrease R ___

Correct Answers:

- -36.6667
- 5
- 9.16667
- 22
- -3
- -5.5
- 0

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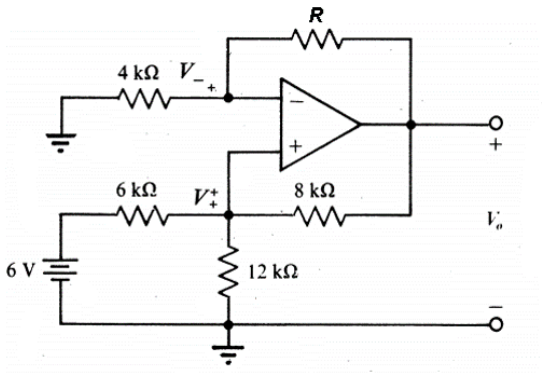
15. (12 points)

In the circuit shown in the figure below, the feedback resistor R = 3 kilo-ohms.

(a) What is the output voltage, V_o, in volts?;

(b) If the op amp is powered from a -16/24 V power supply, what should be the value of R to saturate the amplifier, R_{sat} in kilo-ohms?

Figure:



V_o = ___ V

R_{sat} = ___ kΩ

Correct Answers:

- 11.2
- 5

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16. (12 points)

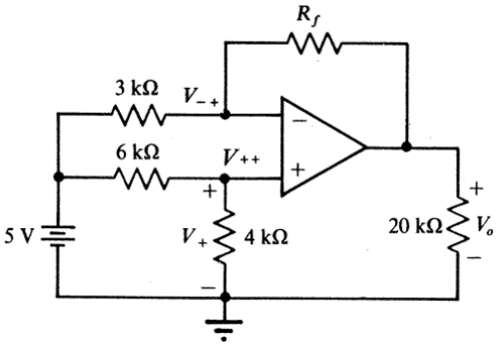
In the op amp circuit shown below, the feedback resistor is Rf = 5 kilo-ohms.

(a) What is the output voltage, V_o, in volts, if we ignore the limits imposed by the power supply?;

(b) If the op amp is powered from a -27/24 V power supply, what should be the minimum value of R_f that gets the amplifier into saturation, R_{sat} in kilo-ohms?

(c) Under the saturation conditions attained in part (b) above, what is the output current of the op amp, I_o in milliamps, (assume the current I_o pointing to the right)?

Figure:



(a) V_o = ___ V

(b) R_{sat} = ___ $k\Omega$

(c) I_O = ___ mA

Correct Answers:

- -3
- 29
- -2.35

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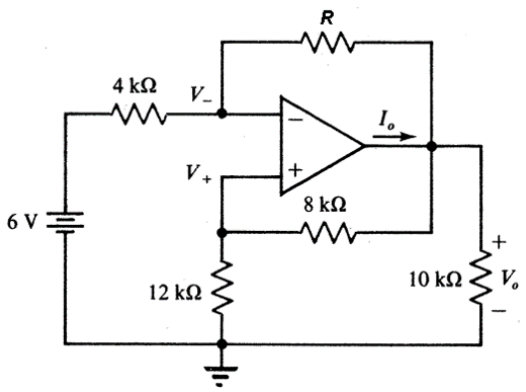
17. (12 points)

In the circuit of the figure, R = 8 $k\Omega$.

(a) What is the output voltage, V_o, in volts?;

(b) What is the output current, I_o, in milliamps?

Figure:



(a) V_o = ____ V

(b) I_o = ____ mA

Correct Answers:

- 15
- 3