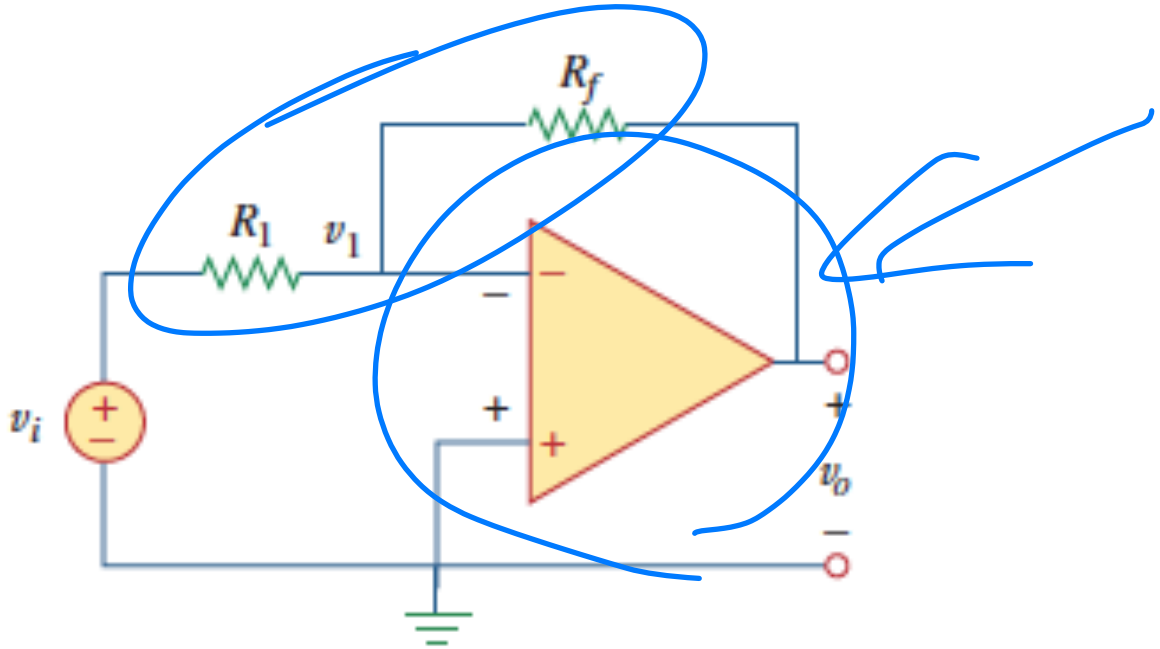
Op Amps – 2

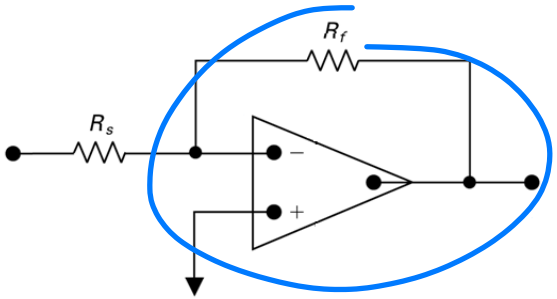
standard configurations

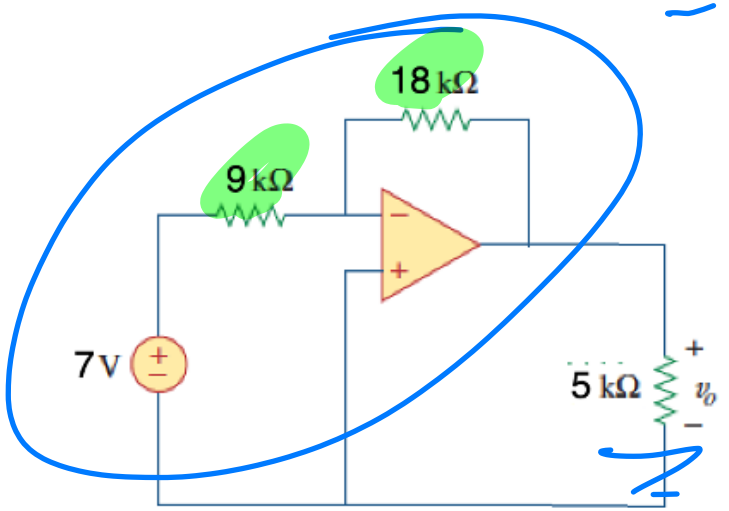
Some Standard Configurations

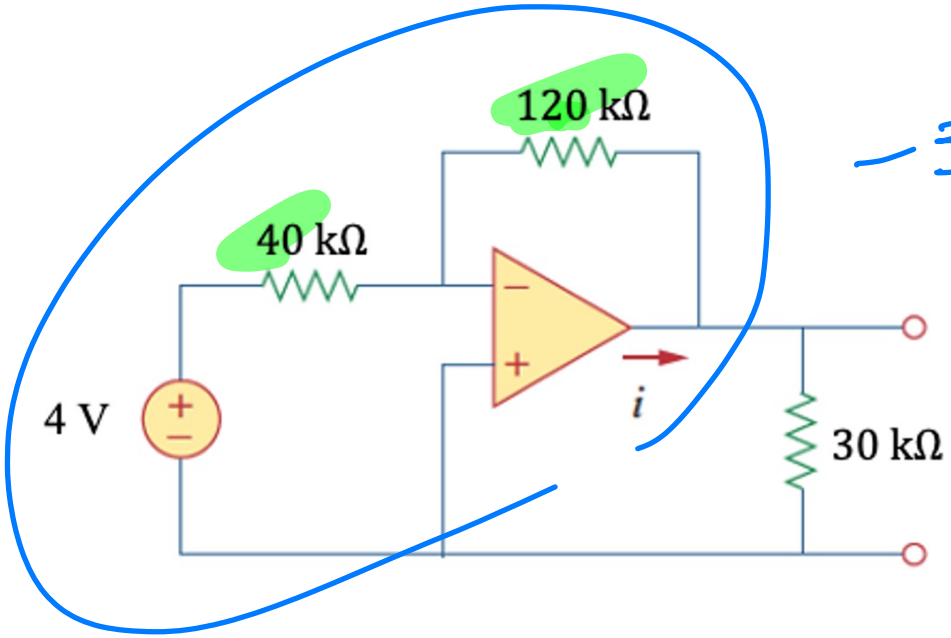
- Exploit equal input voltages, zero input currents
- Inverting amplifier:

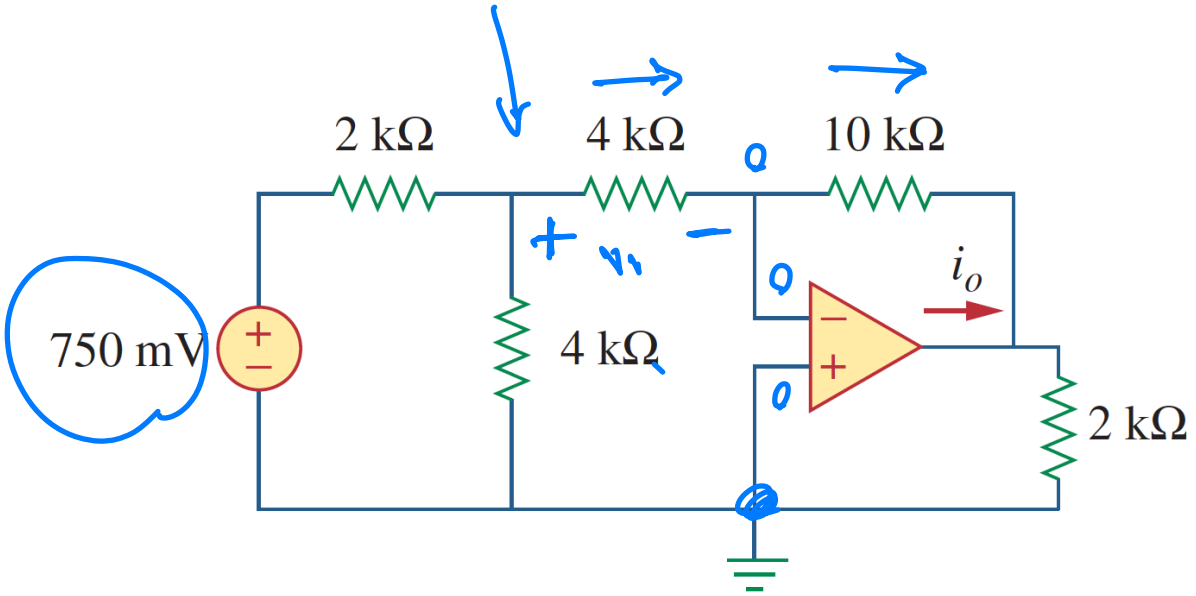


$$v_o = -\frac{R_F}{R_S} v_s$$



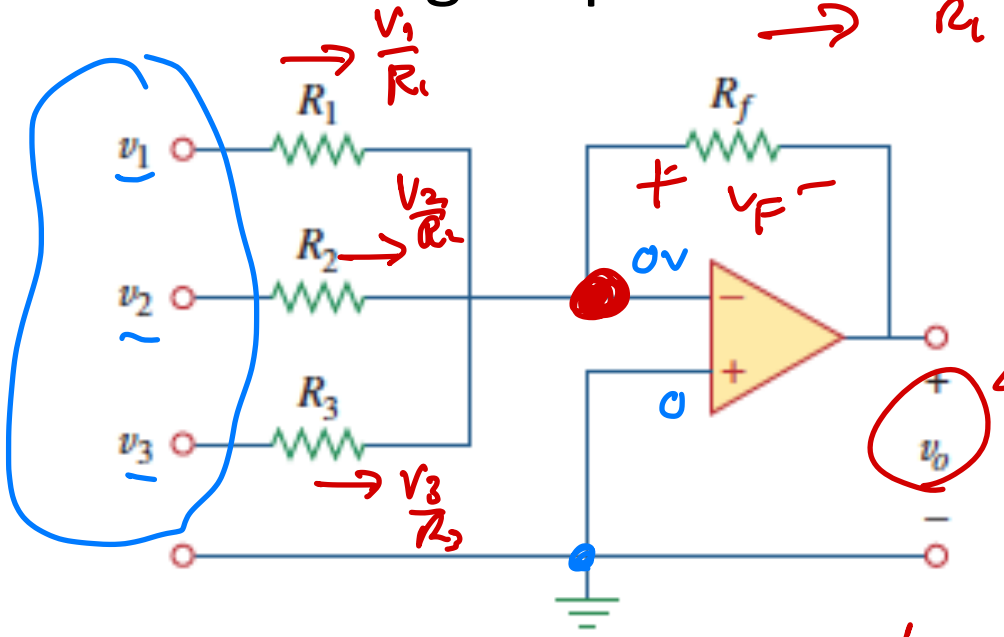

18 kΩ
9 kΩ
7 V
5 kΩ
v_o


120 kΩ
40 kΩ
4 V
i
30 kΩ


2 kΩ
4 kΩ
10 kΩ
750 mV
4 kΩ
i_o
2 kΩ

Input voltages equal
Input currents zero

- Summing amplifier:

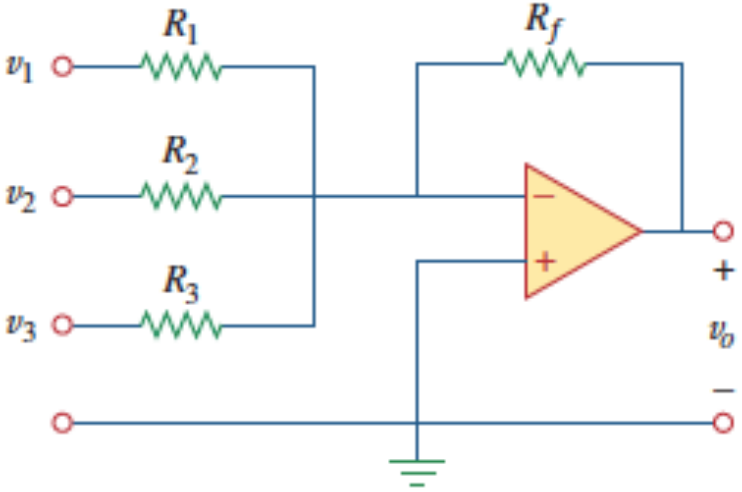


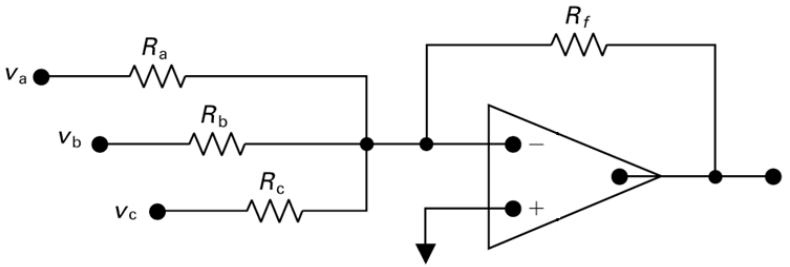
$$\frac{v_1}{R_1} + \frac{v_2}{R_2} + \frac{v_3}{R_3}$$

$$v_F = R_F\left(\frac{v_1}{R_1} + \frac{v_2}{R_2} + \frac{v_3}{R_3}\right)$$

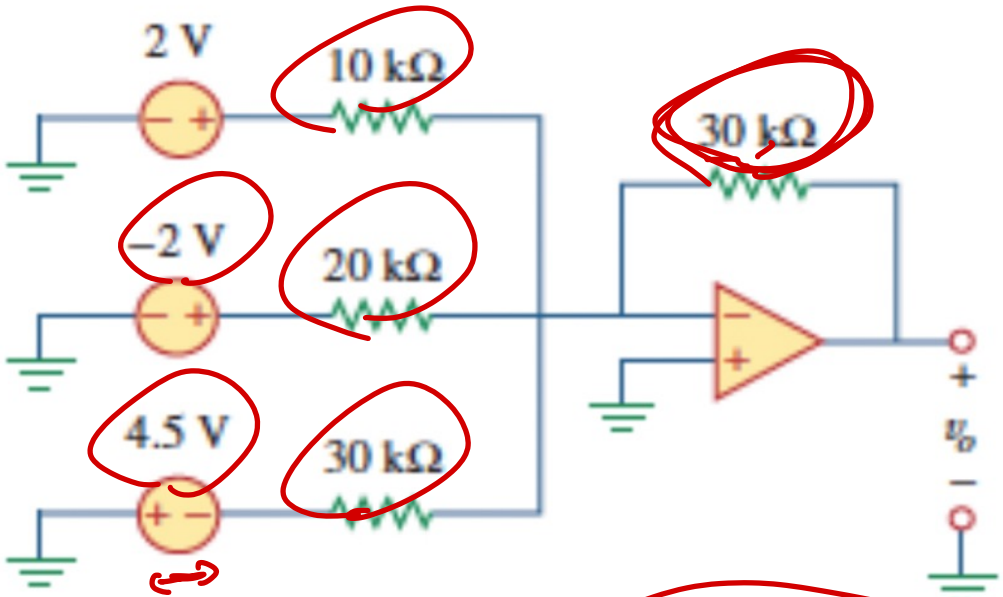
$$-v_F$$

$$v_o = -\left(\frac{R_F}{R_1}v_1 + \frac{R_F}{R_2}v_2 + \frac{R_F}{R_3}v_3\right)$$





$$v_o = -\left(\frac{R_F}{R_1}v_1 + \frac{R_F}{R_2}v_2 + \frac{R_F}{R_3}v_3\right)$$

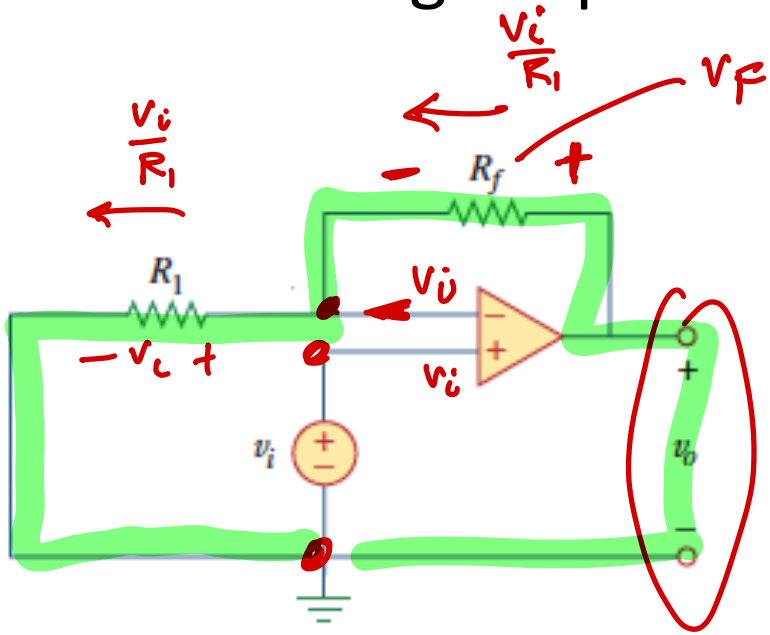


$-6 + 3 - 4.5$

$v_o = -7.5\ V$

- Input voltages equal
- Input currents zero

- Non-inverting Amplifier

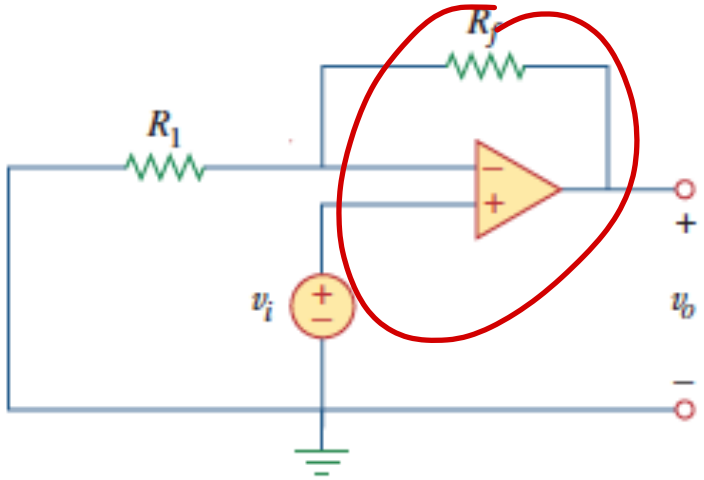


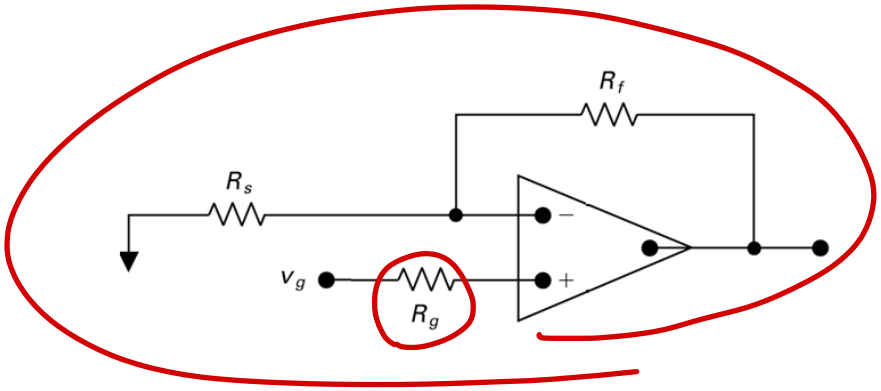
$v_F = \frac{R_F}{R_1} v_i$

$v_i + v_F = v_o$

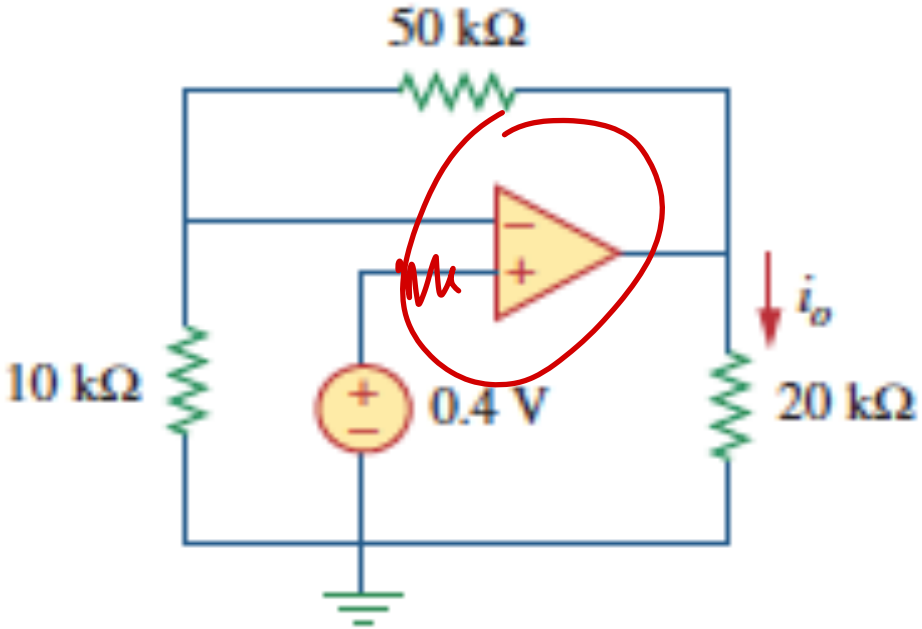
$v_i + \frac{R_F}{R_1} v_i = v_o$

$$v_o = \left(1 + \frac{R_F}{R_1}\right) v_i$$



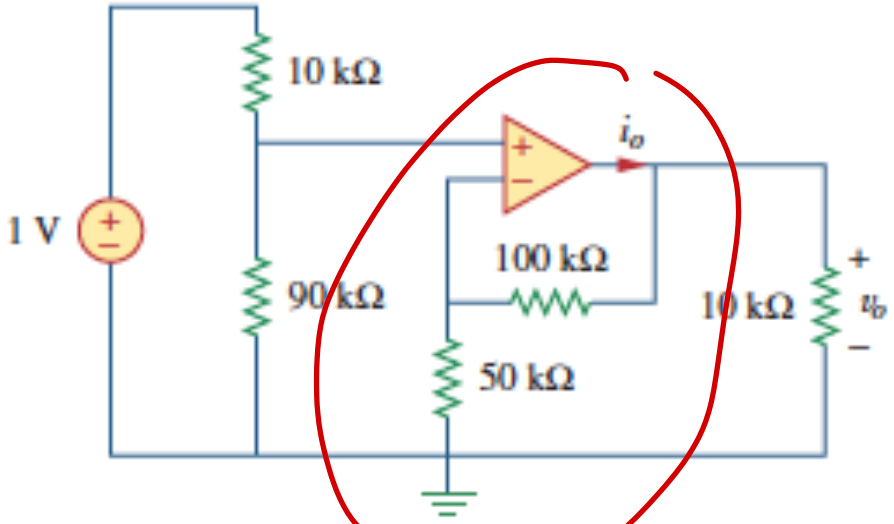


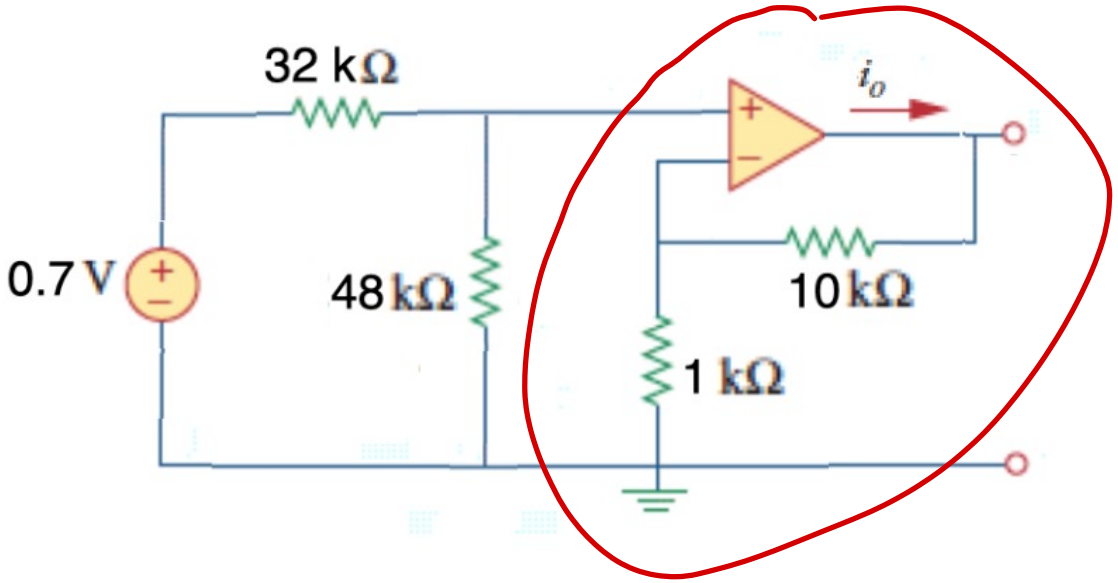
$$v_o = \left(1 + \frac{R_F}{R_1}\right) v_s$$



$$i_o = -0.12\ mA$$

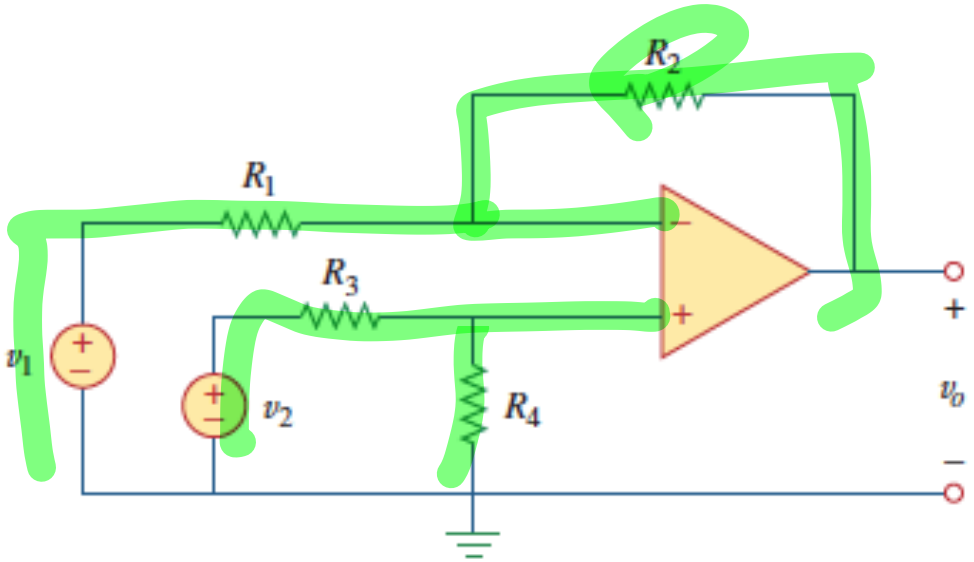
More obscure examples:

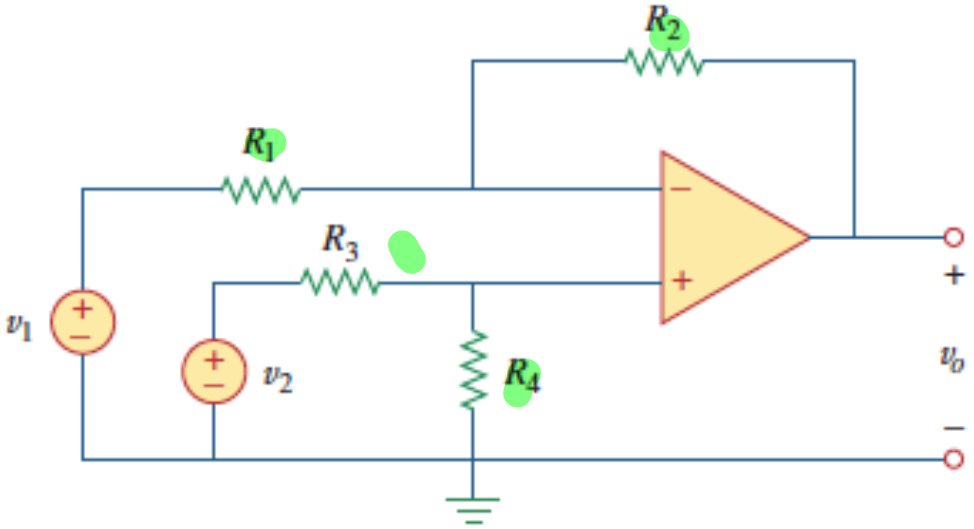


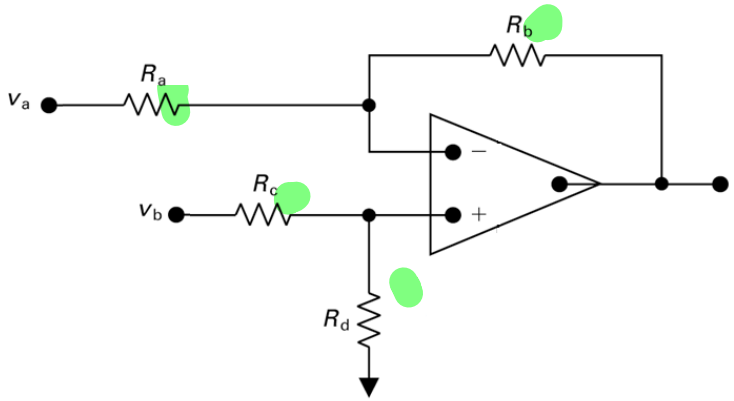


Input voltages equal
Input currents zero

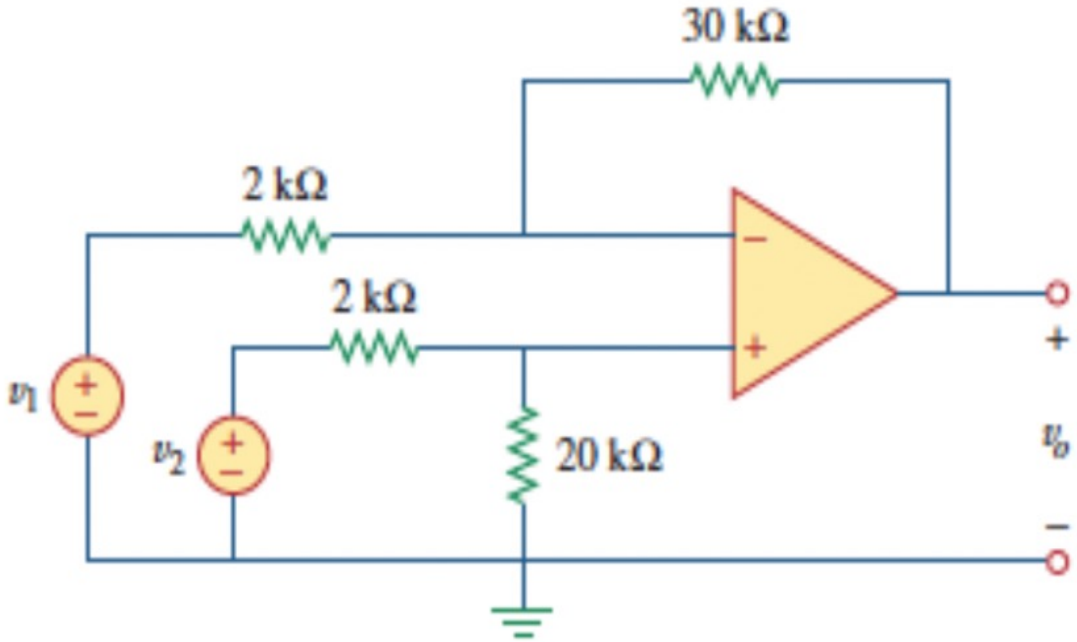
- Difference amplifier







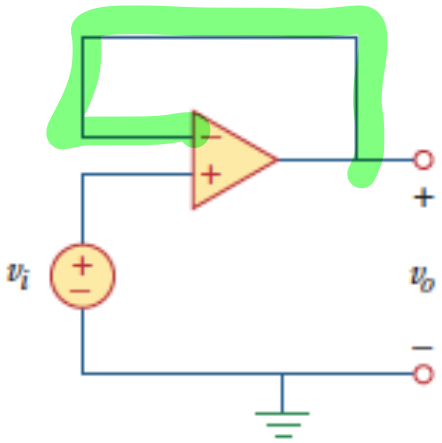
$$v_o = \frac{R_4}{R_3 + R_4}\left(1 + \frac{R_2}{R_1}\right)v_2 - \frac{R_2}{R_1}v_1$$

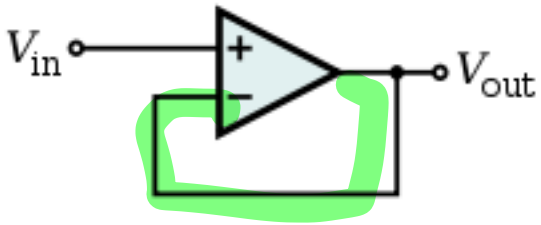


$$v_o = (160v_2 - 165v_1)/11$$

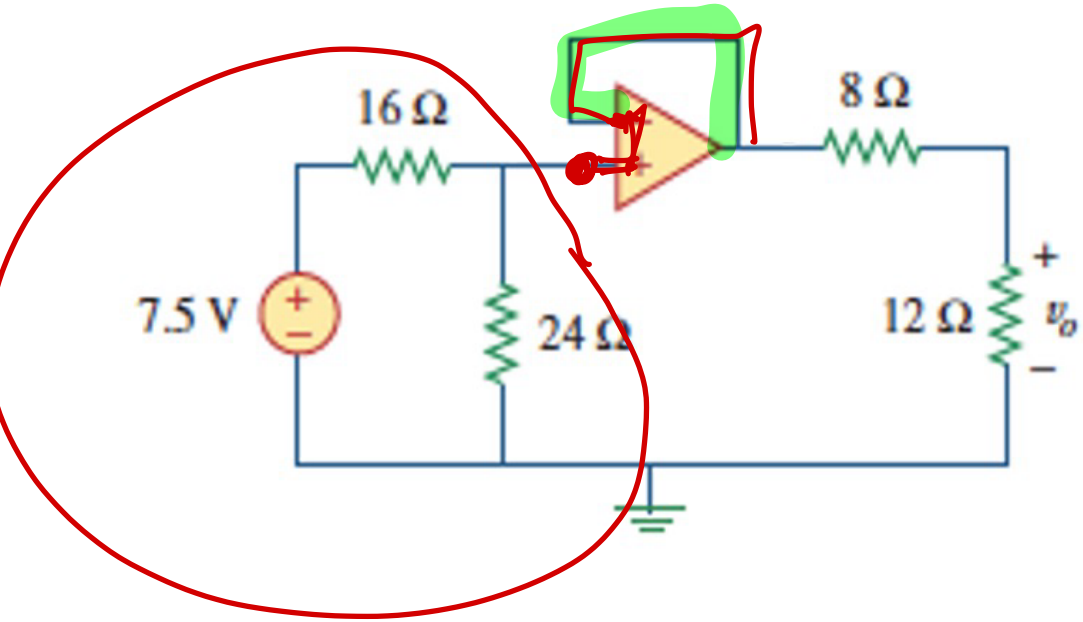
Input voltages equal
Input currents zero

- Voltage Follower



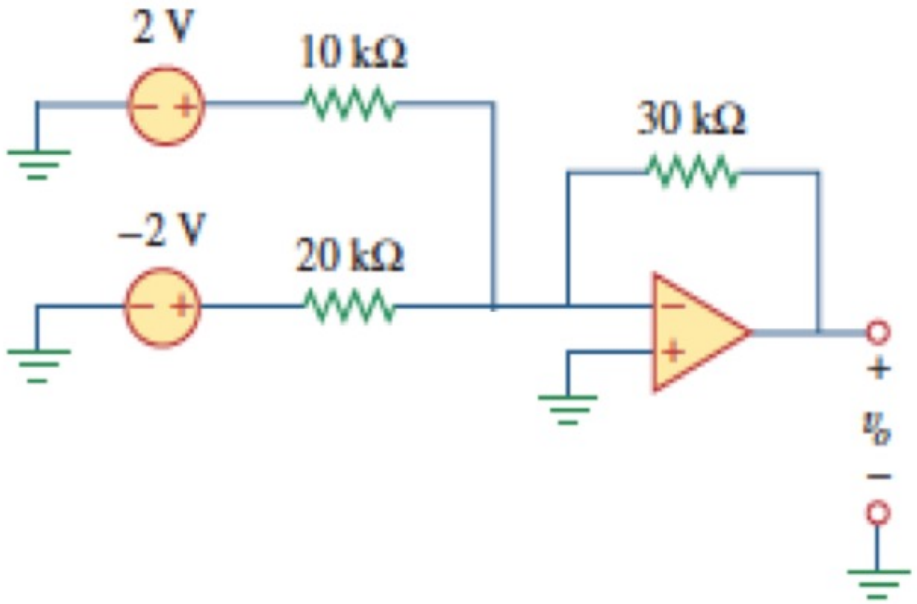


$$v_o = v_1$$



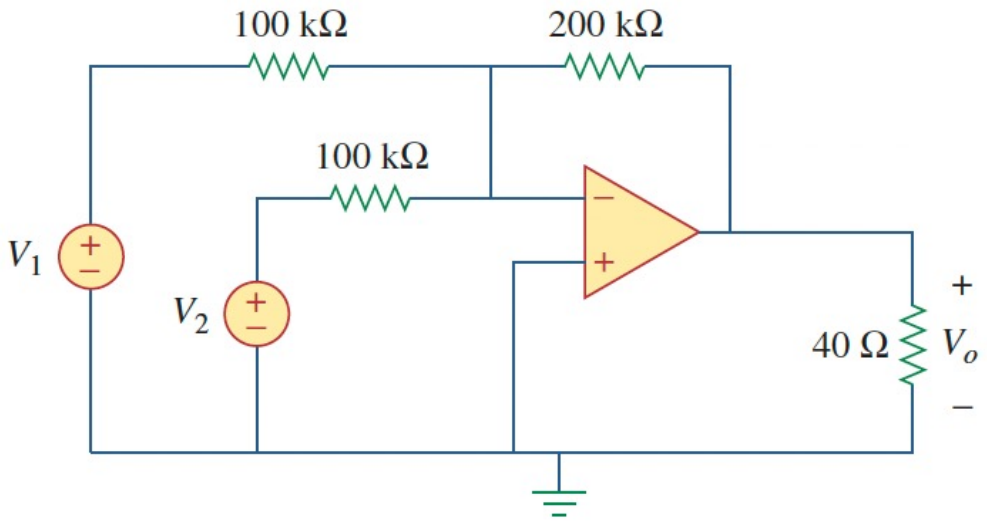
$v_o = -3\ V$

Practice problem: find v_o



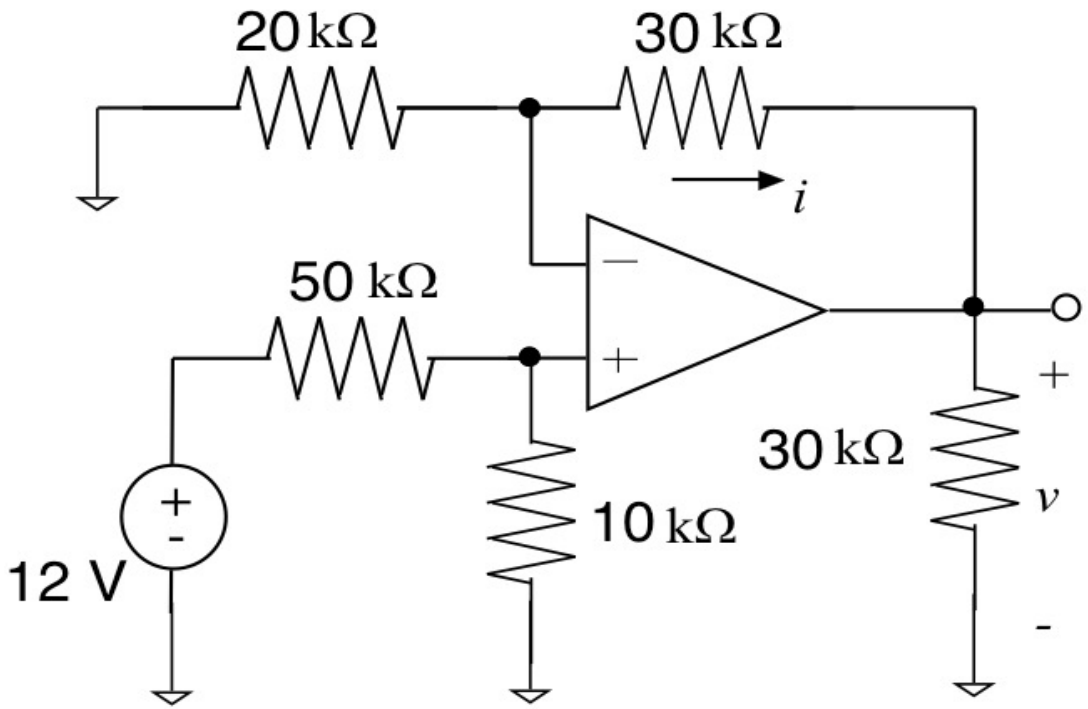
Practice problem: find v_o

$$v_o = -2(V_1 + V_2)$$

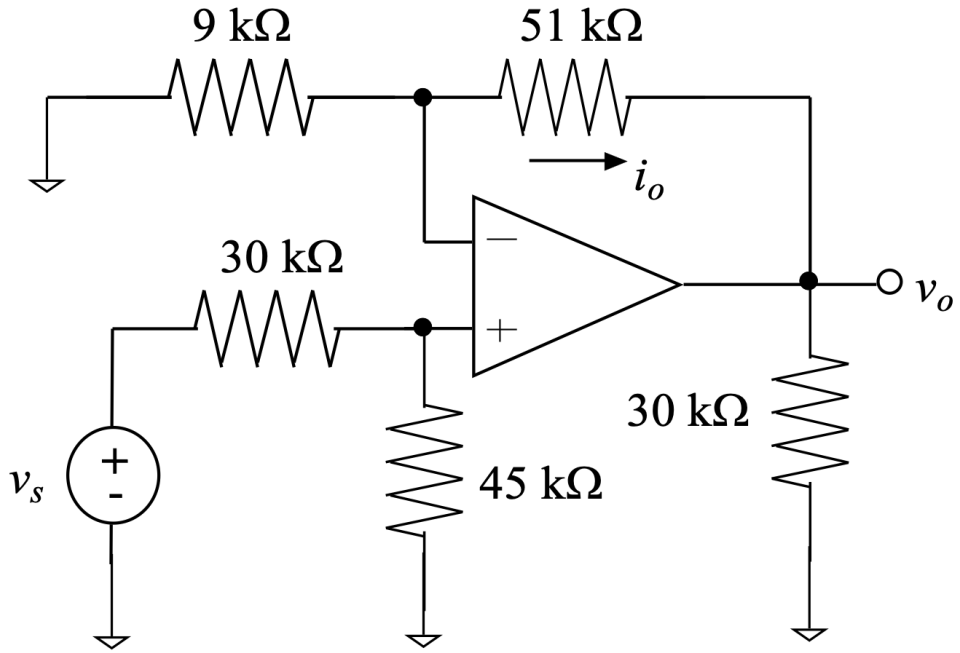


Practice problem: find v and i

$v = 5\ V, i = -0.1\ mA$



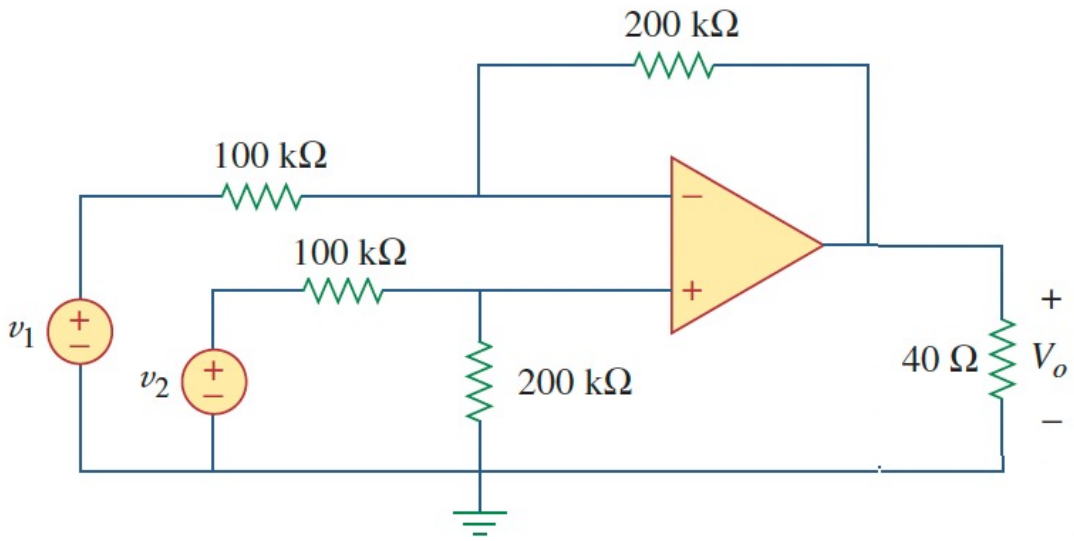
Practice problem: find v_o and i_o if $v_s = 2\ V$



$v_o = 8\ V, i = -0.133\ mA$

Practice problem: find V_o

$V_o = 2(V_2 - V_1)$



Practice problem: find v_o

$-4\ V$