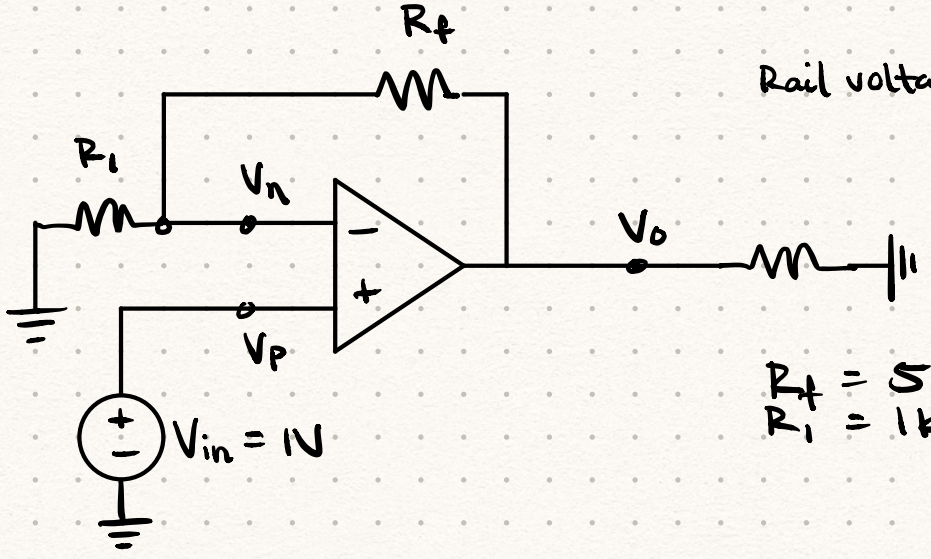
5.5

OP-AMP

Non-inverting amplifier



Rail voltages ± 12V

$R_f = 5k\Omega$
$R_1 = 1k\Omega$

Find: V_o

Solution: $V_p = 1V = V_n = V_{in}$ ← neg. feedback

NVA @ V_n:

$$\frac{V_{in} - 0}{R_1} + \frac{V_{in} - V_o}{R_f} = 0$$

$$V_{in}\left(\frac{1}{R_1} + \frac{1}{R_f}\right) = \frac{V_o}{R_f}$$

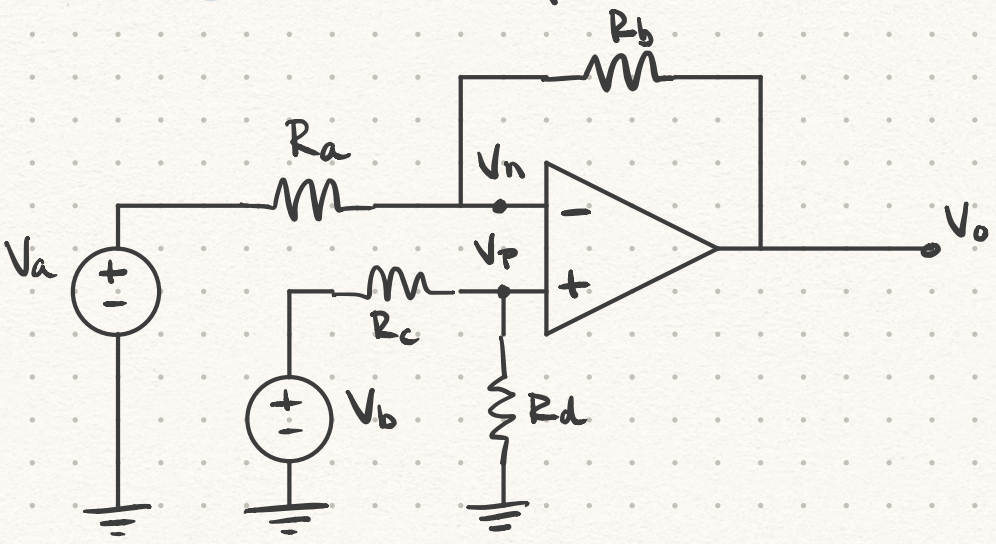
gain → $\frac{V_o}{V_{in}} = \boxed{A = \frac{R_f}{R_1} + 1}$

→ $V_o = 1V \cdot \left(\frac{5k\Omega}{1k\Omega} + 1\right)$

$\boxed{V_o = 6V}$

5.6

Difference amplifier circuit



$V_a = 5V$
$V_b = 4V$

$R_a = 10k\Omega$
$R_b = 50k\Omega$
$R_c = 4k\Omega$
$R_d = 20k\Omega$

Find: V_o in terms of circuit vars, then value

Solution:

$$V_p = V_b\left(\frac{R_d}{R_c+R_d}\right) \quad \leftarrow V \text{ divider}$$

NVA: $\frac{V_n - V_a}{R_a} + \frac{V_n - V_{out}}{R_b} = 0$

$$\rightarrow V_o = R_b\left(\frac{V_n}{R_a} + \frac{V_n}{R_b} - \frac{V_a}{R_a}\right)$$

$$= V_n\left(\frac{R_b}{R_a}+1\right) - V_a\left(\frac{R_b}{R_a}\right), \quad V_n = V_p$$

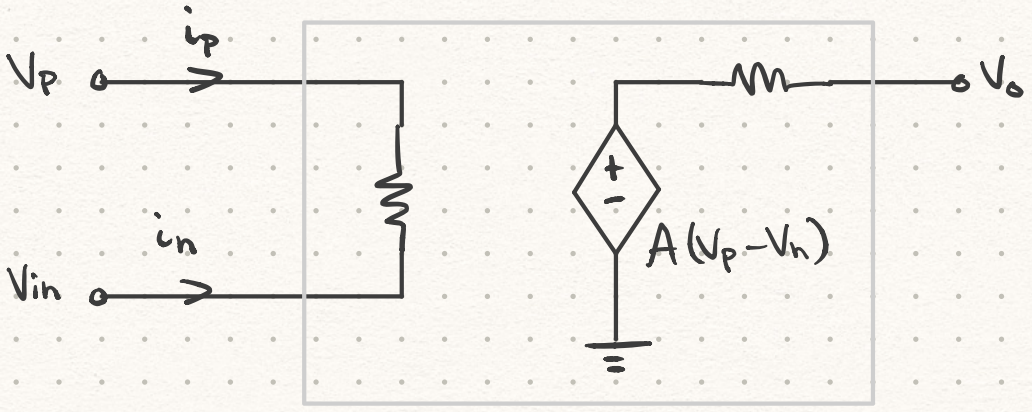
$$= V_b\left(\frac{R_d}{R_c+R_d}\right)\left(\frac{R_b}{R_a}+1\right) - V_a\left(\frac{R_b}{R_a}\right)$$

$$V_o = -5V$$

NOTE: if $\frac{R_b}{R_a} = \frac{R_d}{R_c}$, let $= A_x$

$$\rightarrow \boxed{V_o = A_x(V_b - V_a)}$$

5.7



How good is ideal model vs. this one?