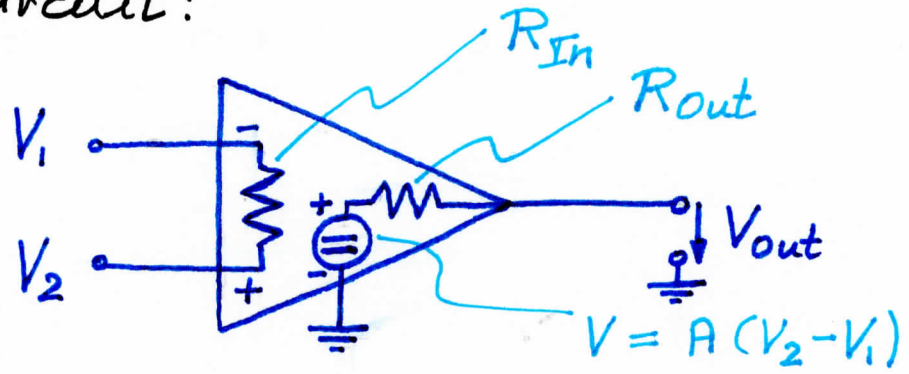
Ideal versus real operational amplifiers

		Ideal op amp	Real op amp
Input impedance	R_{In}	∞	$< \infty$ (finite)
Amplification	A	∞	$< \infty$ (finite)
Output impedance	R_{out}	0	> 0 (finite)

Equivalent circuit:



Example:

$R_{In} = 100\ M\Omega$ (not ∞)

$R_{out} = 100\ \Omega$ (not 0)

$A = 10^7$ (not ∞)

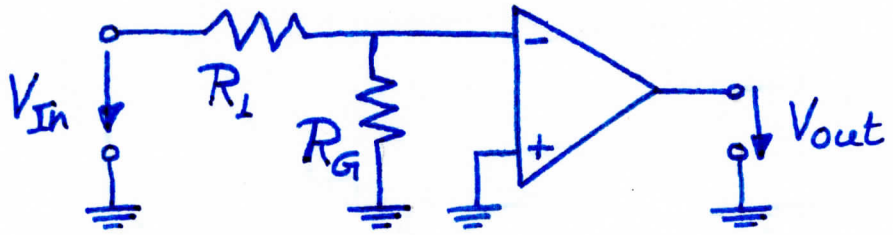
Consequences for input circuit

⇒ Design input circuit so that

$$R \ll R_{In}$$

↳ Resistors "seen by" input terminals of op amp.

Example:



⇒ Design circuit such that

$$(R_1 \parallel R_G) \ll R_{In}$$

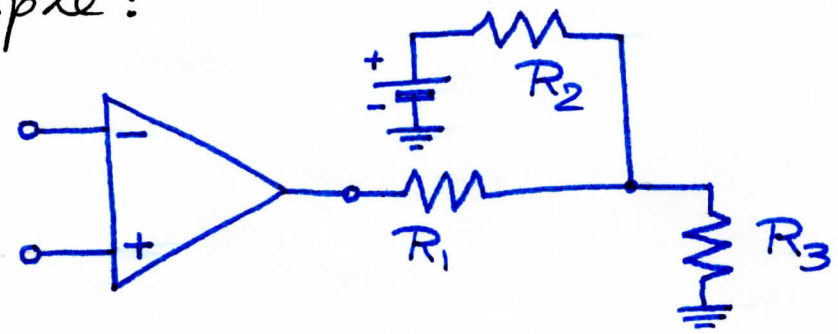
Consequences for output circuit

⇒ Design output circuit to satisfy

$$R_{Load} \gg R_{out}$$

↳ Load as seen by output terminal of op amp.

Example:



⇒ Design circuit such that

$$\underbrace{R_1 + (R_2 \parallel R_3)}_{R_{Load}} \gg R_{out}$$

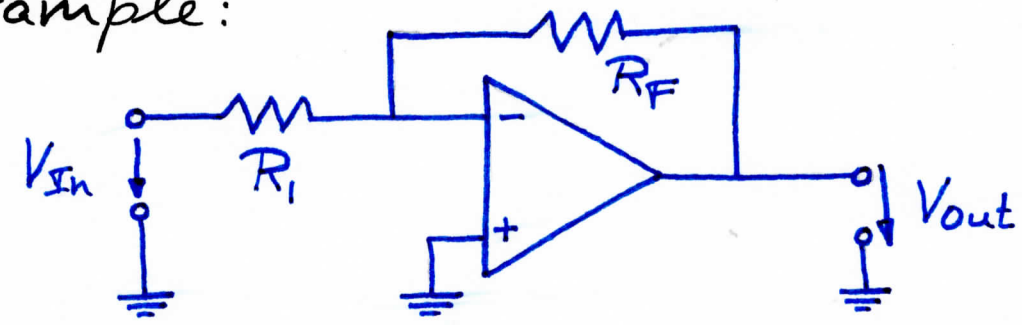
Consequences for feedback circuit

⇒ Design feedback circuit to satisfy

$$A_{\text{with feedback}} \ll A_{OL}$$

↳ open loop (without feedback) e.g. 10^7

Example:



⇒ Design circuit such that

$$A_{\text{with feedback}} = -\underbrace{\frac{R_F}{R_1}}_{\text{e.g. } 10^2} \ll \underbrace{A_{OL}}_{\text{e.g. } 10^7}$$