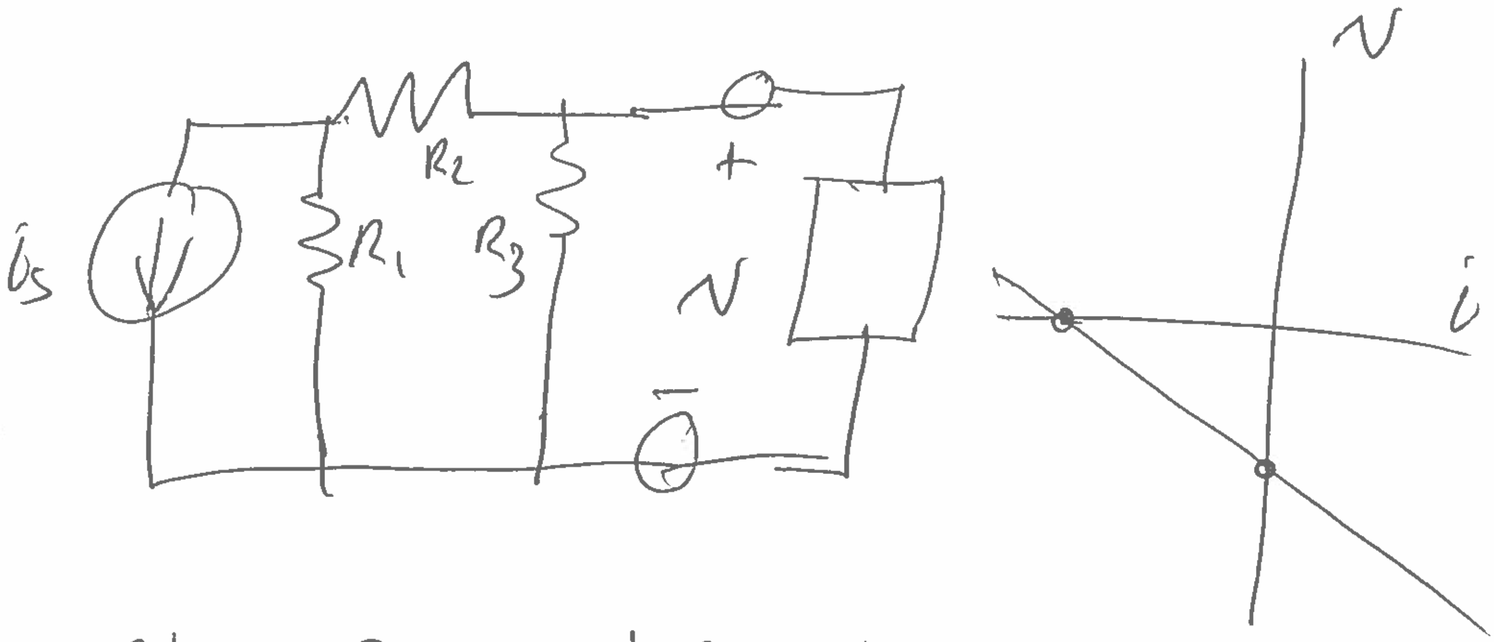
SDP-2



Choose R_1, R_2 and R_3 That create Graph

Hints: ① Find V_{oc} and R_T

② equation of line can be written

as $v = -R_T i + V_{oc}$

③ Set $R_3 = 2 \times$ slope

$R_1 + R_2 = 2 \times$ slope

Use 2 Point form of line

$$(y - y_1) = \frac{(y_2 - y_1)}{(x_2 - x_1)}(x - x_1)$$

Given Data Points

(−6 mA, 0 V) and (0 mA, −3 V)

x_1 y_1 x_2 y_2

$$(y-0) = \frac{\overset{-3-0}{\cancel{(0-(-3))}}}{\underset{0-(-6)}{\cancel{(-6-0)}}}\left(x-(-6)\right)$$

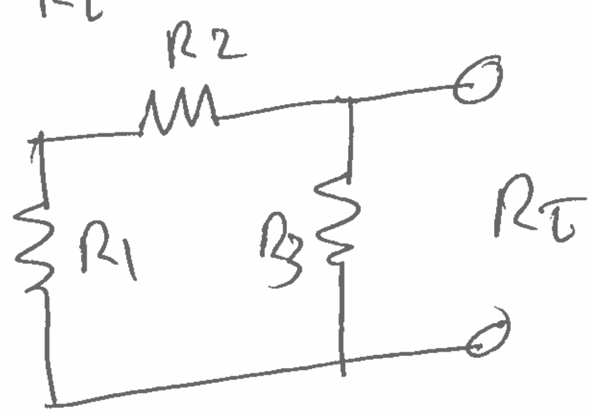
$$\boxed{y = -\frac{1}{2}\underset{V/mA = k\Omega}{x} - 3_V}$$

$$v = -R_T\, i + V_{oc}$$

$V_{oc} = -3V$ $R_T = -\left(-\frac{1}{2}\,k\Omega\right)$

$R_T = 500\Omega$

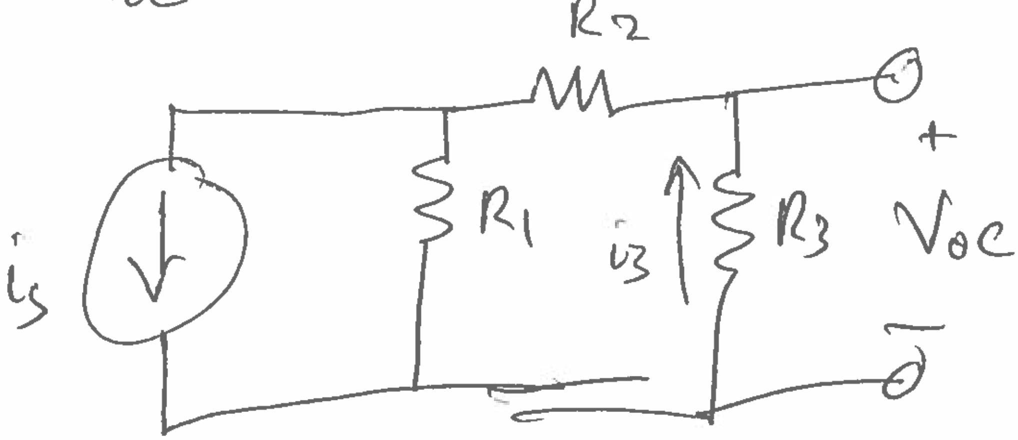
Find R_T



$$\frac{1}{R_T} = \frac{1}{R_1+R_2} + \frac{1}{R_3} = \frac{R_3 + R_1 + R_2}{(R_1+R_2)\,R_3}$$

$$R_T = \boxed{\frac{(R_1+R_2)R_3}{R_1+R_2+R_3} = 500\Omega}$$

Find v_{oc}



$$v_{oc} = -i_3 R_3$$

$$i_3 = i_s \left(\frac{\frac{1}{R_2+R_3}}{\frac{1}{R_2+R_3} + \frac{1}{R_1}} \right) = i_s \left(\frac{R_1}{R_1+R_2+R_3} \right)$$

$$V_{oc} = -i_s \left(\frac{R_1}{R_1+R_2+R_3}\right) R_3$$

$$-i_3 \frac{R_1 R_3}{R_1+R_2+R_3} = -3V$$

and $$\frac{(R_1+R_2)R_3}{R_1+R_2+R_3} = 500\Omega$$

3rd Hint $\Rightarrow$ $R_3 = 2(500\Omega) = 1000\Omega$

and $R_1+R_2 = 2(500\Omega) = 1000\Omega$

Choose $R_3 = 1000\Omega$ $R_1 = R_2 = 500\Omega$

Check

$$R_t = \frac{(500\Omega+500\Omega)\,1000\Omega}{(500\Omega+500\Omega+1000\Omega)} = \frac{(1000\Omega)^2}{2000\Omega}$$

$$= \frac{1000\Omega}{2} = 500\Omega \checkmark$$

$V_{oc} = -3V$

$$V_{oc} = -3V = -\frac{i_s R_1 R_3}{R_1 + R_2 + R_3}$$

$$i_s = 3V \frac{(R_1 + R_2 + R_3)}{R_1 R_3} = 3V \left(\frac{500\Omega + 500\Omega + 1000\Omega}{(500\Omega)(1000\Omega)} \right)$$

$$= 3V \frac{(2000\Omega)}{500\Omega(1000\Omega)} = \frac{2(3V)}{500\Omega} = \frac{6V}{500\Omega}$$

$$i_s = 0.012A \Rightarrow 12.0 \, mA$$

One Solution

$i_s = 12mA$

$R_1 = 500\Omega$

$R_2 = 500\Omega$

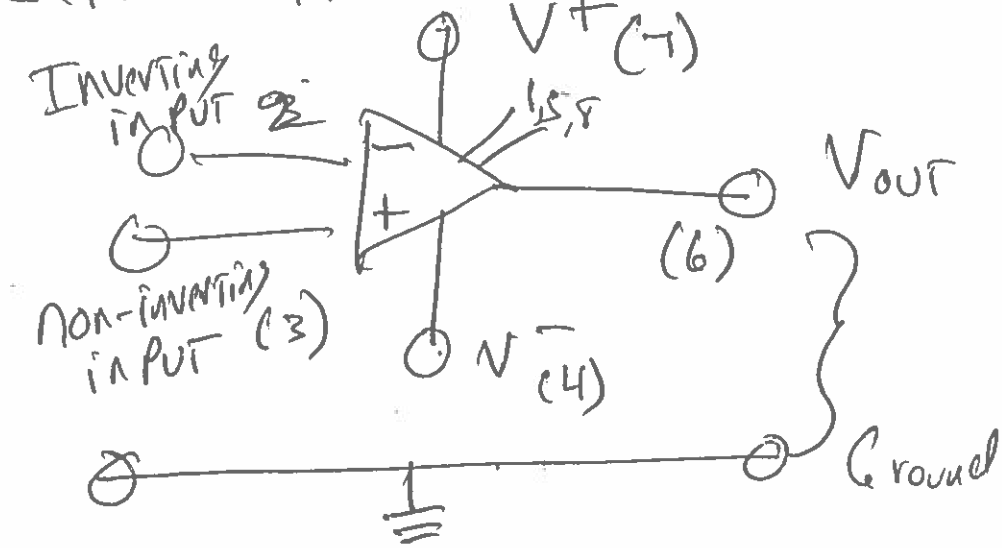
$R_3 = 1000\Omega$

Another $i_s = 12mA$

$R_1 = 1000\Omega$ $R_2 = 1000\Omega$ $R_3 = 667\Omega$

Operational Amplifiers

Replaced transistors in modern circuits



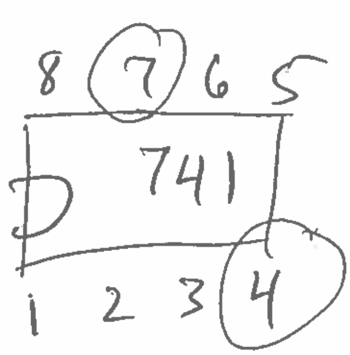
V^+ — positive power to op-amp

V^- — negative power to op-amp

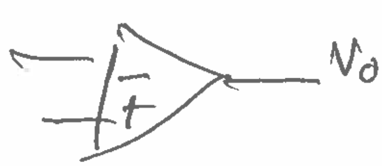
Traditional V^+, V^- is symmetric $\pm 12V$

$\pm 15V$

$\pm 10V$



more traditionally circuits show



ideal VS non-ideal OP-AMP Behavior

4 Rules of OP-AMPs push ideal OP-AMP Behavior

4 Rules

1) Circuit of OP-Amp with closed negative feed back loop will Adjust output of OP-AMP To make $V_- = V_+$

inverting input (non-inverting) input

2) V_- and V_+ draw no current
input impedence To V_-, V_+ is ∞.

impedence is The Total opposition To flow of current in a D.C. $Z = R$ Z is impedence

3. The ~~[illegible]~~ OUTPUT impedence is zero.
(The output does provide or Absorb current)

4. The Gain or Voltage Amplification can be ∞.

Voltage follower
(Buffer)