Exercícios TE329

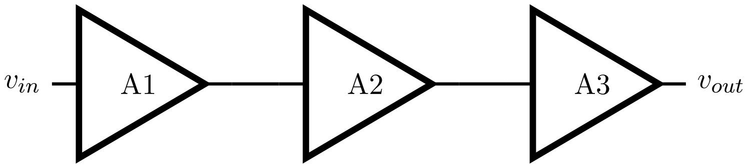
Parte 1

1. Especifique configurações amplificadoras de múltiplos estágios de forma que:
   (a) Seja um bom amplificador de tensão;
   (b) Seja um bom amplificador de corrente;
   (c) Seja um bom amplificador de transcondutância;

2. Para as configurações listadas abaixo, o que pode se dizer sobre R_{in}, R_{out}, A_{v0} e G_m?
   (a) Estágio fonte comum seguido de um estágio fonte comum;
   (b) Estágio Porta comum seguido de um estágio Dreno comum;
   (c) Estágio porta comum seguido de um estágio emissor comum;
   (d) Estágio fonte comum seguido de um estágio dreno comum;

3. Considere os circuitos das figuras abaixo, obtenha os valores de R_{in}, R_{out} e A_{v0} de um amplificador de tensão equivalente:

(a)

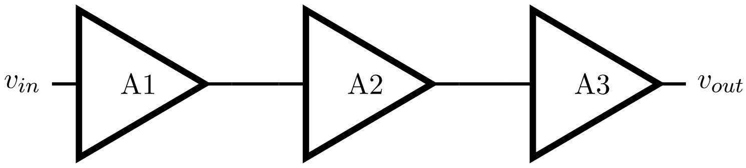


Considere:

	A1	A2	A3
R_{in}	1 kΩ	100 kΩ	10 kΩ
R_{out}	10 kΩ	1 kΩ	100 Ω
A_{v0}	-10 V/V	20 V/V	0.8 V/V

Resposta: $R_{in} = 1$ kΩ, $R_{out} = 100$ Ω, $A_{v0} = -132$ V/V.

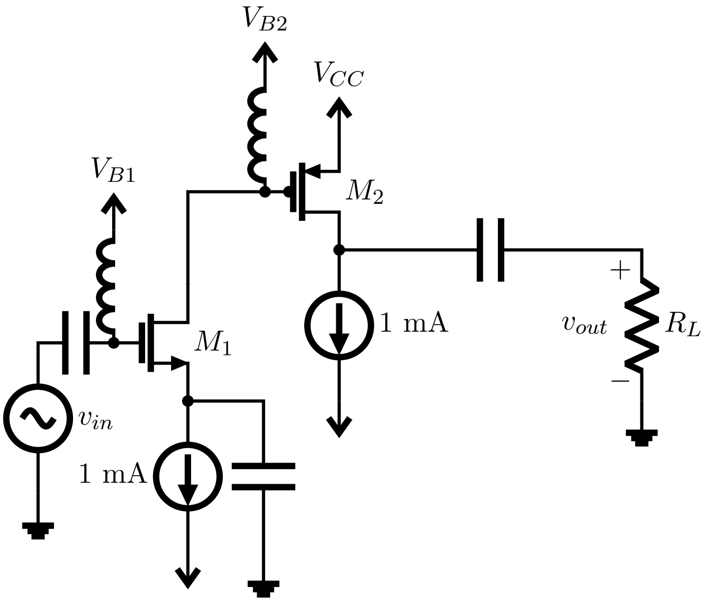
(b)



Considere:

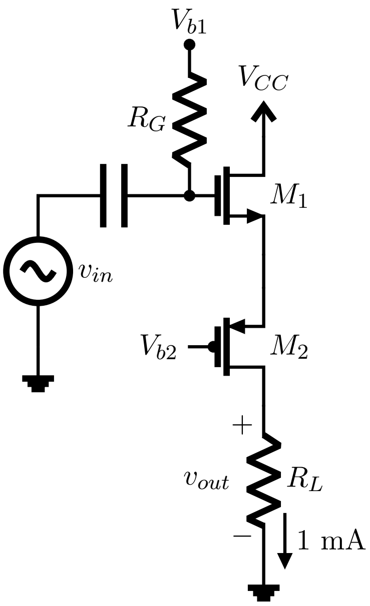
	A1	A2	A3
R_{in}	1 MΩ	10 kΩ	1 kΩ
R_{out}	10 kΩ	100 kΩ	100 kΩ
	$A_{v0} = 10$ V/V	$G_m = 2$ mA/V	$A_{is} = -10$ A/A

Resposta: $R_{in} = 1$ MΩ, $R_{out} = 100$ kΩ, $A_{v0} = -9901$ V/V.

(c) 

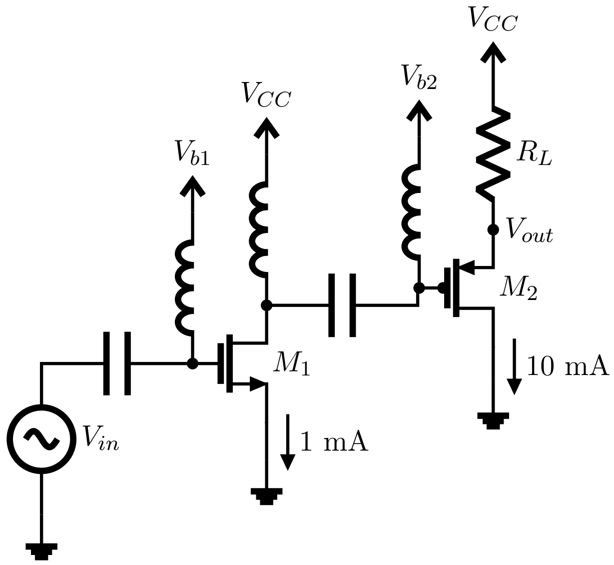
Considere $\mu_n C_{ox} W/L = 2\ \text{mA/V}^2$ e $\lambda = 0.1\ \text{V}^{-1}$

Resposta: $R_{in} = \infty$, $R_{out} = 10\ \text{k}\Omega$, $A_{v0} = 400\ \text{V/V}$.

(d) 

Considere $\mu_n C_{ox} W/L = 2\ \text{mA/V}^2$, $\mu_p C_{ox} W/L = 1.5\ \text{mA/V}^2$, $\lambda = 0.1\ \text{V}^{-1}$ e $R_G = 1\ \text{M}\Omega$.

Resposta: $R_{in} = 1\ \text{M}\Omega$, $R_{out} = 20\ \text{k}\Omega$, $A_{v0} = 40\ \text{V/V}$.

(e) 

Considere $\mu_n C_{ox} W/L = 2$ mA/V², $\mu_p C_{ox} W/L = 1.5$ mA/V² e $\lambda = 0.1$ V^{-1}.

Resposta: $R_{in} = \infty$, $R_{out} = 183$ Ω, $A_{v0} = -20$ V/V.

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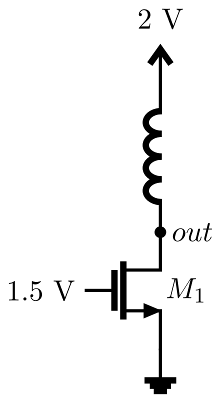
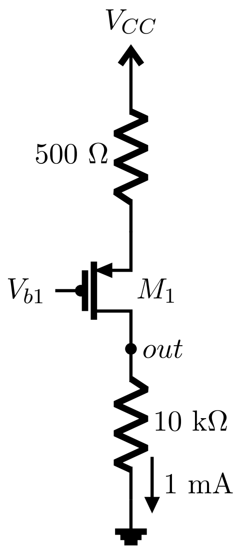
4. Obtenha a resistência equivalente vista do terminal *out* dos circuitos:

(a) 

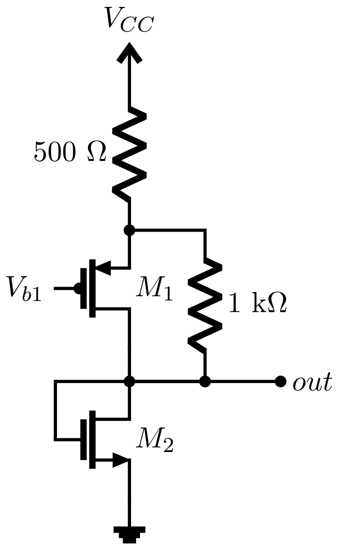
$\lambda = 0.2$ V^{-1}
$V_t = 0.5$ V
$\mu_n C_{ox} W/L = 2$ mA/V²

Resposta: $R_{out} = 3571$ Ω.

(b) 

$\lambda = 0.05$ V^{-1}
$\mu_p C_{ox} W/L = 2$ mA/V²

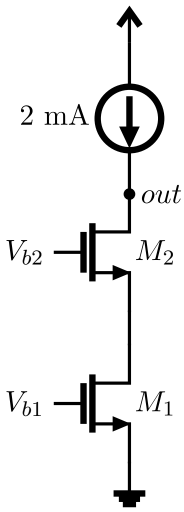
Resposta: $R_{out} = 6.7$ kΩ.



$g_{m1} = g_{m2} = 1.5$ mA/V
$r_{o1} = r_{o2} = 5$ kΩ

(c)

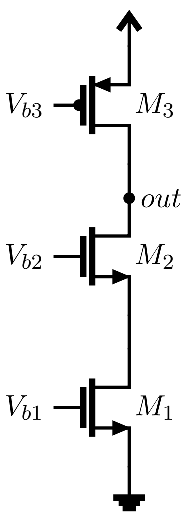
Resposta: $R_{out} = 537\ \Omega$.



$r_{o1} = 2$ kΩ
$r_{o2} = 3$ kΩ
$g_{m1} = 1.5$ mA/V
$g_{m2} = 2$ mA/V

(d)

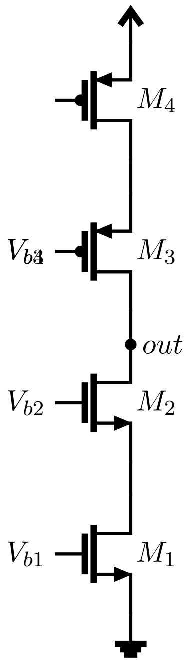
Resposta: $R_{out} = 12$ kΩ.



$r_{o1} = 2$ kΩ
$r_{o2} = 3$ kΩ
$r_{o3} = 4$ kΩ
$g_{m1} = 1.5$ mA/V
$g_{m2} = 2$ mA/V
$g_{m3} = 1.2$ mA/V

(e)

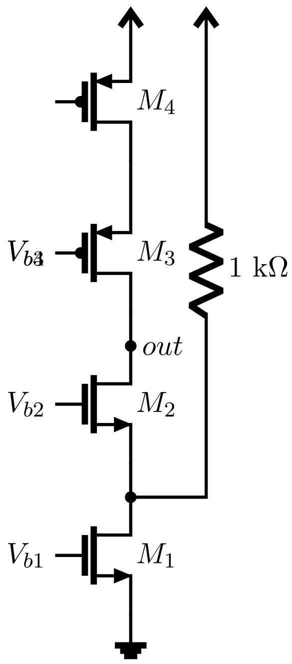
Resposta: $R_{out} = 3\ \text{k}\Omega$.



$r_{o1} = 2\ \text{k}\Omega$
$r_{o2} = 3\ \text{k}\Omega$
$r_{o3} = 4\ \text{k}\Omega$
$r_{o4} = 3.5\ \text{k}\Omega$
$g_{m1} = 1.5\ \text{mA/V}$
$g_{m2} = 2\ \text{mA/V}$
$g_{m3} = 1.2\ \text{mA/V}$
$g_{m4} = 0.9\ \text{mA/V}$

(f)

Resposta: $R_{out} = 7\ \text{k}\Omega$.



$r_{o1} = 2\ \text{k}\Omega$
$r_{o2} = 3\ \text{k}\Omega$
$r_{o3} = 4\ \text{k}\Omega$
$r_{o4} = 3.5\ \text{k}\Omega$
$g_{m1} = 1.5\ \text{mA/V}$
$g_{m2} = 2\ \text{mA/V}$
$g_{m3} = 1.2\ \text{mA/V}$
$g_{m4} = 0.9\ \text{mA/V}$

(g)

Resposta: $R_{out} = 3.2\ \text{k}\Omega$.

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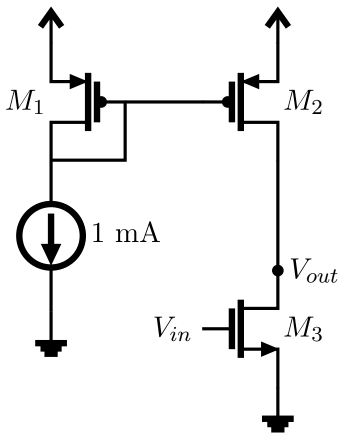
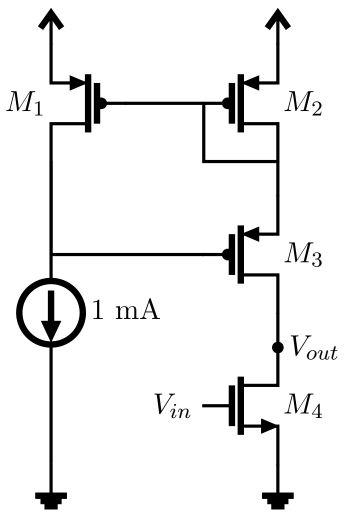
5. Calcule o ganho de tensão em aberto dos circuitos abaixo:



$\mu_n Cox = 0.2$ mA/V2
$\mu_p Cox = 0.15$ mA/V2
$L = 0.1\ \mu$m
$W_1 = 0.5\ \mu$m
$W_2 = 1.5\ \mu$m
$W_3 = 1\ \mu$m
$\lambda_p = 0.12\ \mathrm{V}^{-1}$
$\lambda_n = 0.09\ \mathrm{V}^{-1}$

(a)

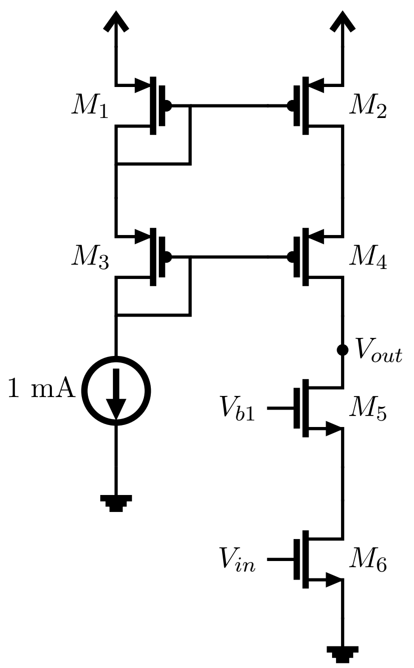
Resposta: $A_{v0} = -5.5$ V/V.



$\mu_n Cox = 0.2$ mA/V2
$\mu_p Cox = 0.15$ mA/V2
$L = 0.1\ \mu$m
$W_1 = 0.5\ \mu$m
$W_2 = 1.5\ \mu$m
$W_3 = 1.5\ \mu$m
$W_4 = 1\ \mu$m
$\lambda_p = 0.12\ \mathrm{V}^{-1}$
$\lambda_n = 0.09\ \mathrm{V}^{-1}$

(b)

Resposta: $A_{v0} = -12.3$ V/V.

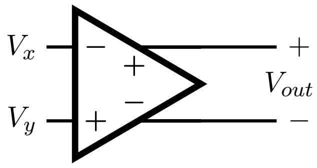


$\mu_n Cox = 0.2$ mA/V2
$\mu_p Cox = 0.15$ mA/V2
$L = 0.1\ \mu$m
$W_1 = 0.5\ \mu$m
$W_2 = 1.5\ \mu$m
$W_3 = 1.5\ \mu$m
$W_4 = 1.5\ \mu$m
$W_5 = 1\ \mu$m
$W_6 = 1\ \mu$m
$\lambda_p = 0.12\ \mathrm{V}^{-1}$
$\lambda_n = 0.09\ \mathrm{V}^{-1}$

(c)

Resposta: $A_{v0} = -61.5$ V/V.

6. Considere o circuito da figura abaixo e responda

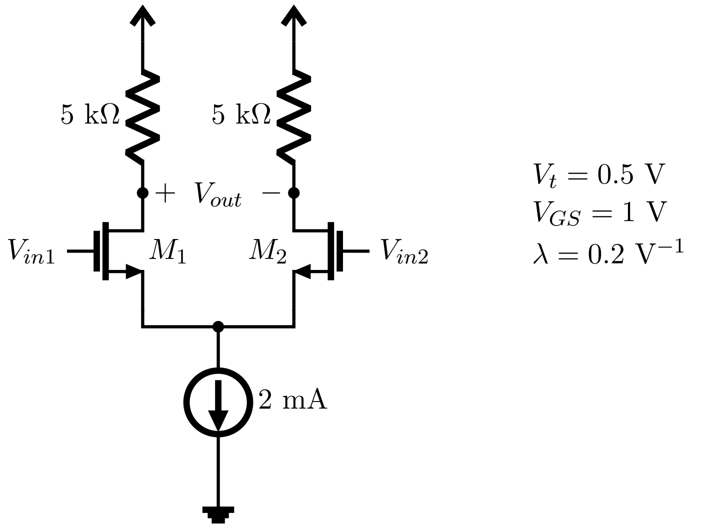


(a) Seja $V_x = \sin(\omega t)$, $V_y = -\sin(\omega t)$, $A_{v0} = 10$ V/V. Qual será o sinal de saída?

(b) Se $V_x = 2 + \sin(\omega t + \pi)$, $V_y = 2 + \sin(\omega t)$, $A_{v0} = 2$ V/V, Qual será o sinal de saída?

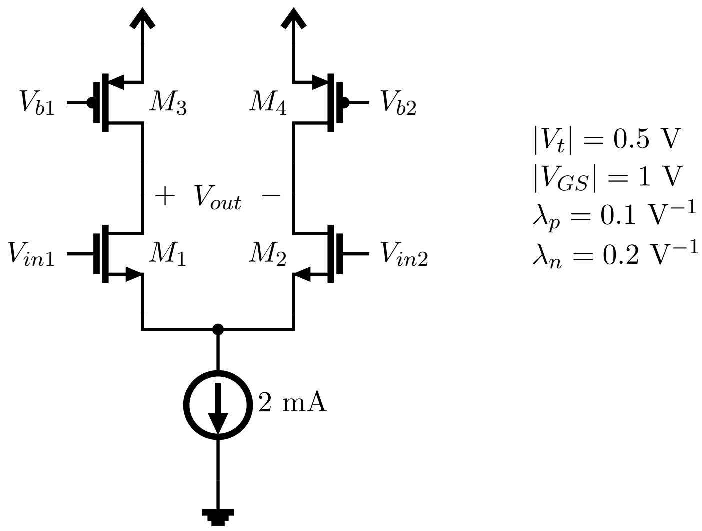
(c) Ao inserir $V_y = 0.05\sin(\omega t) + 2$ e $V_y = -0.05\sin(\omega t) + 2$, observa-se $V_{out} = 10\sin(\omega t) + 0.01$. Qual é o ganho diferencial e CMRR. CMRR = 20000

7. Para os circuitos das figuras abaixo obtenha A_{v0}, R_{in} e R_{out}.



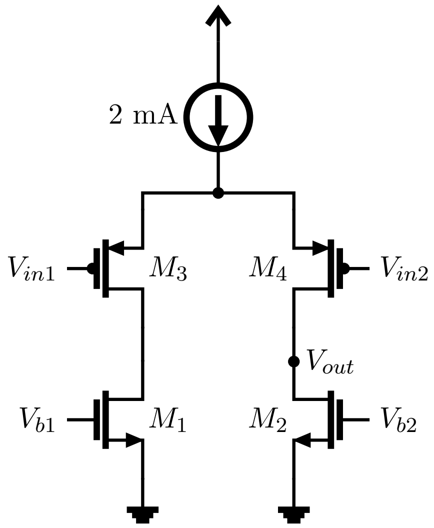
(a)

Resposta: $R_{in} = \infty$, $R_{out} = 5$ kΩ, $A_{v0} = -10$ V/V.



(b)

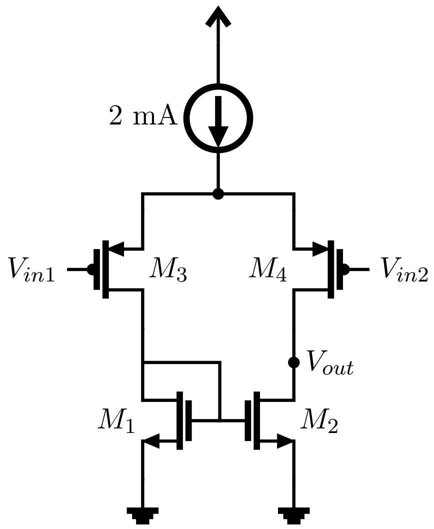
Resposta: $R_{in} = \infty$, $R_{out} = 6.7$ kΩ, $A_{v0} = -13.3$ V/V.



$\mu_p C_{ox} W/L = 1.5$ mA/V²
$\mu_n C_{ox} W/L = 2$ mA/V²
$\lambda_p = 0.1$ V^{-1}
$\lambda_n = 0.2$ V^{-1}

(c)

Resposta: $R_{in} = \infty$, $R_{out} = 3.3$ kΩ, $A_{v0} = -2.9$ V/V.



$\mu_p C_{ox} W/L = 1.5$ mA/V²
$\mu_n C_{ox} W/L = 2$ mA/V²
$\lambda_p = 0.1$ V^{-1}
$\lambda_n = 0.2$ V^{-1}

(d)

Resposta: $R_{in} = \infty$, $R_{out} = 3.3$ kΩ, $A_{v0} = 5.8$ V/V.
