CMOS Transistor Size (3G)

Please send corrections (or suggestions) to youngwlim@hotmail.com.

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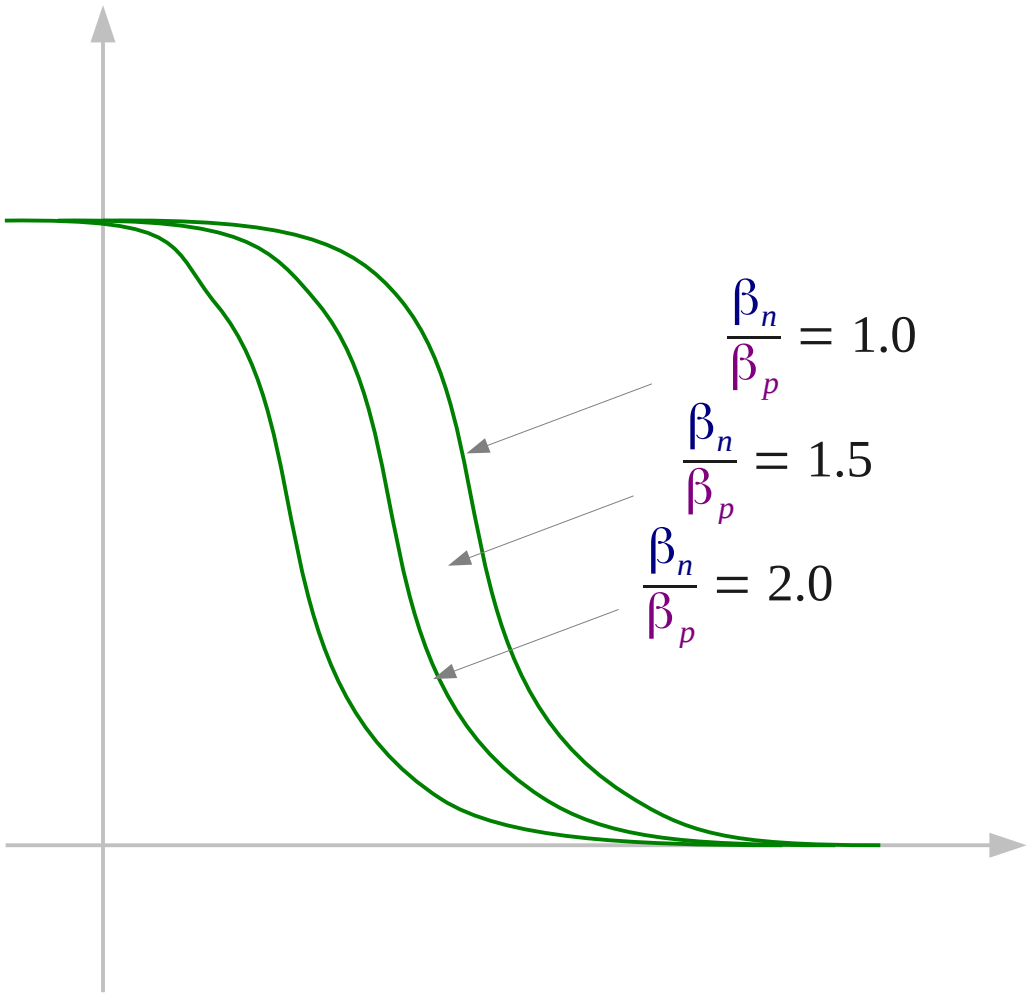
Transconductance Parameter

When $V_{GS} > V_t$ and $V_{DS} < (V_{GS} - V_t)$

$$I_d = k' \frac{W}{L} \left[(v_{gs} - v_t) v_{ds} - \frac{1}{2} v_{ds}^2 \right]$$

When $V_{GS} > V_t$ and $V_{DS} \geq (V_{GS} - V_t)$

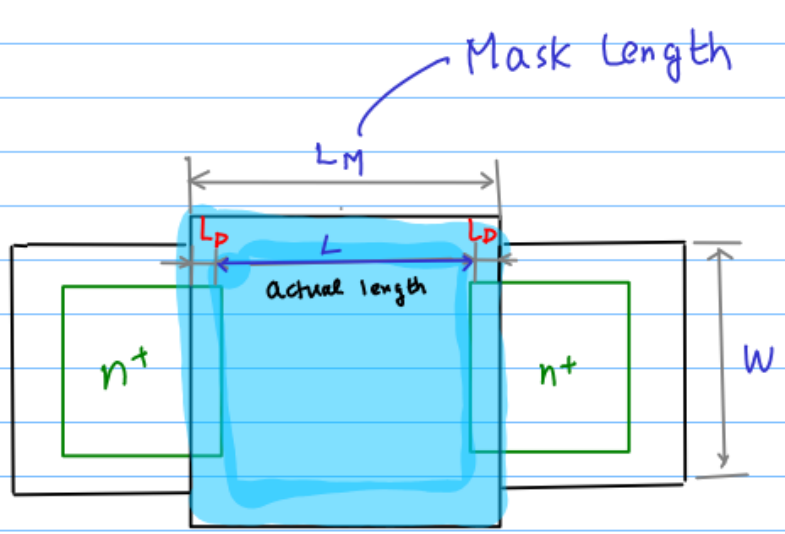
$$I_d = \frac{1}{2} k' \frac{W}{L} (v_{gs} - v_t)^2$$



$$\beta_p = k'_p \left(\frac{W}{L} \right)_p$$

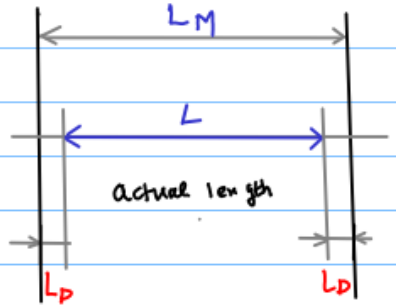
$$\beta_n = k'_n \left(\frac{W}{L} \right)_n$$

Channel Length

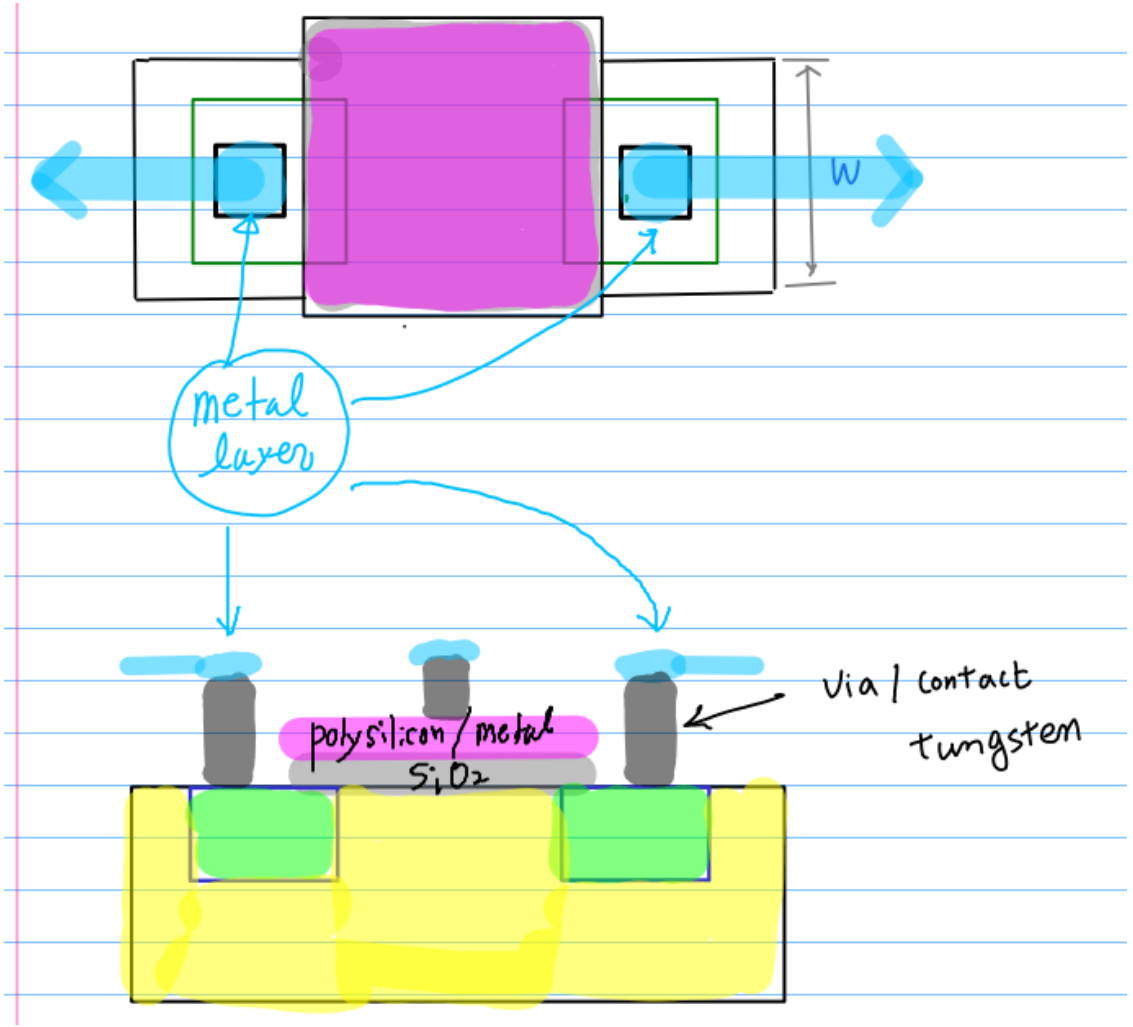


$$L = L_M - 2L_D$$

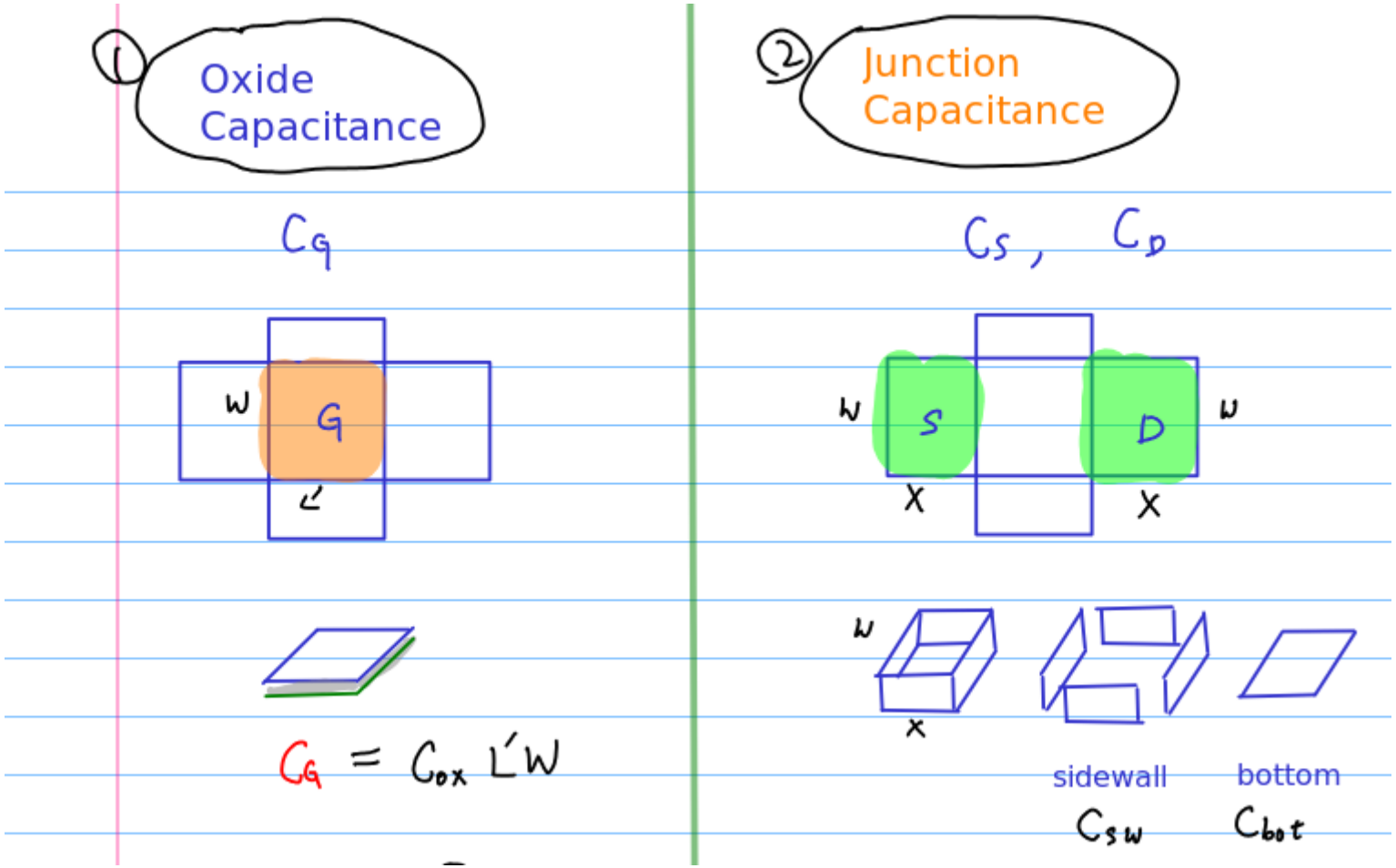
- L_M : Mask Length
- L : Channel Length.
- L_D : Overlapped Length



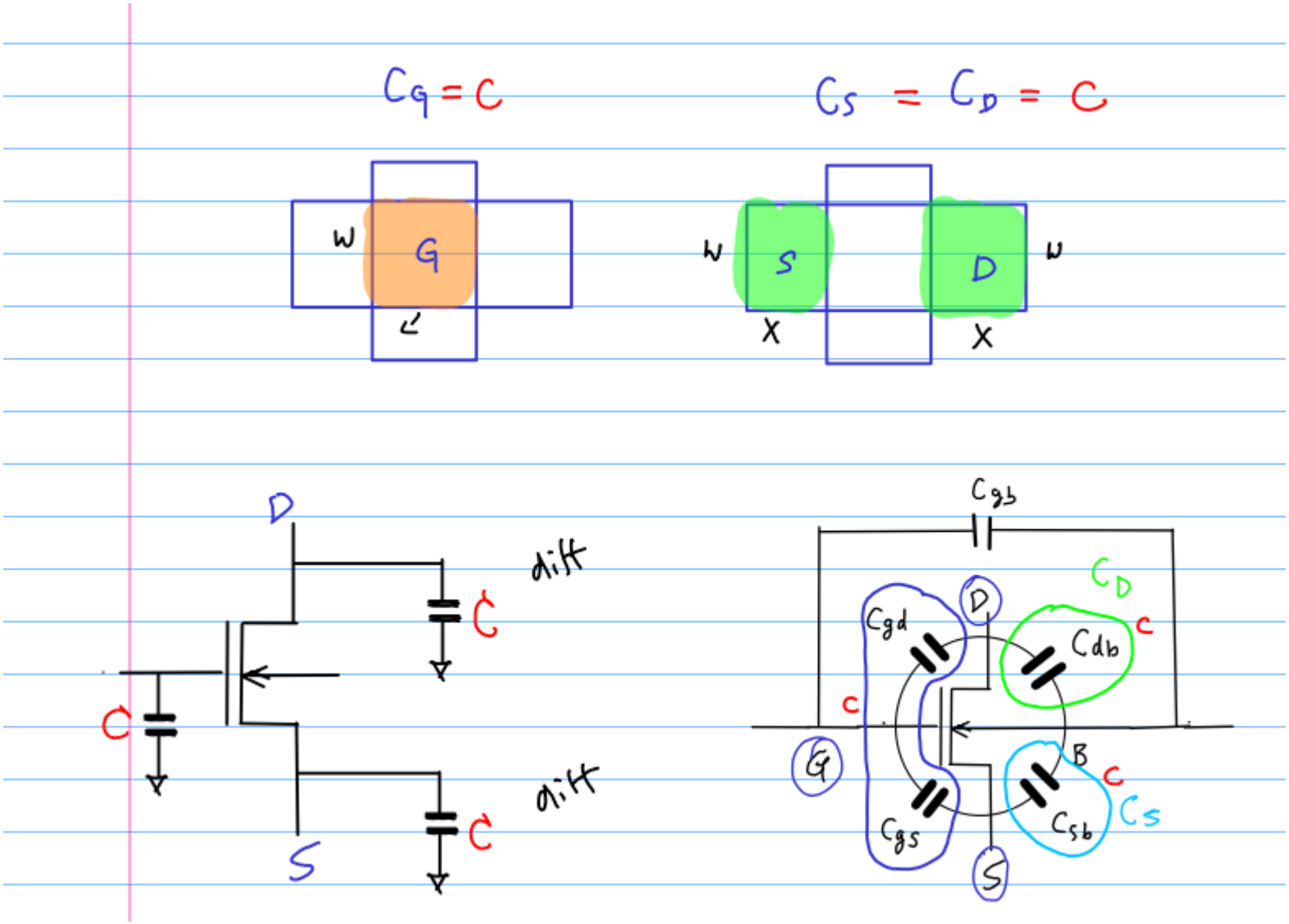
Transistor Dimensions



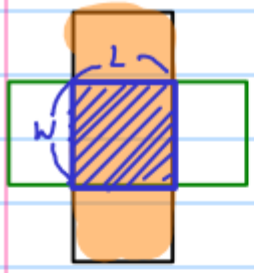
Capacitances of S, D, G



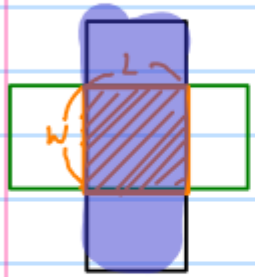
Assume all the same cap (for hand calculation)



Equal Size



a unit nMOS
effective resistance (R)
with minimum size
min W & min L

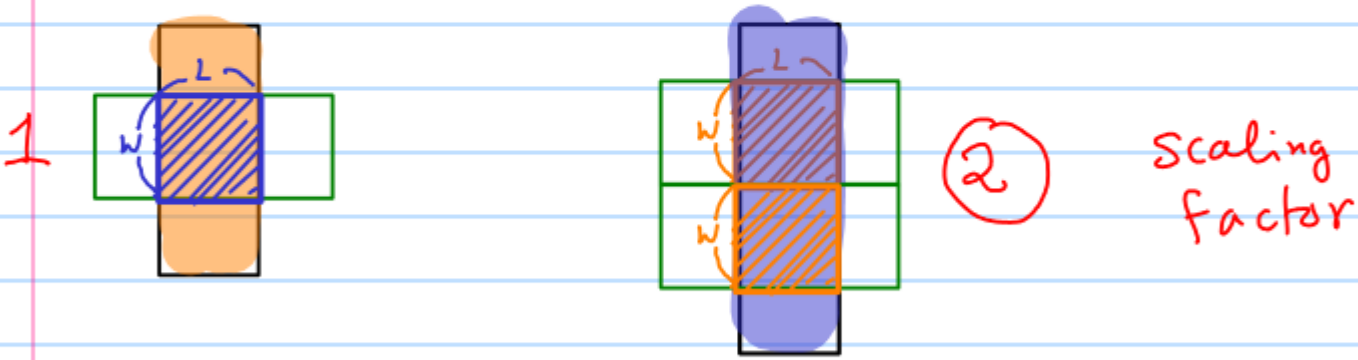


a unit pMOS
effective resistance (2R)
with minimum size
min W & min L

	V_{DD} = 5V	V_{DD} = 3.3V
$R_{n,unit}$	3.9 kΩ	6.8 kΩ
$R_{p,unit}$	14 kΩ	25 kΩ

Equal Resistance

	V_{DD} = 5V	V_{DD} = 3.3V
$R_{n,unit}$	3.9 kΩ	6.8 kΩ
$R_{p,unit}$	14 kΩ	25 kΩ



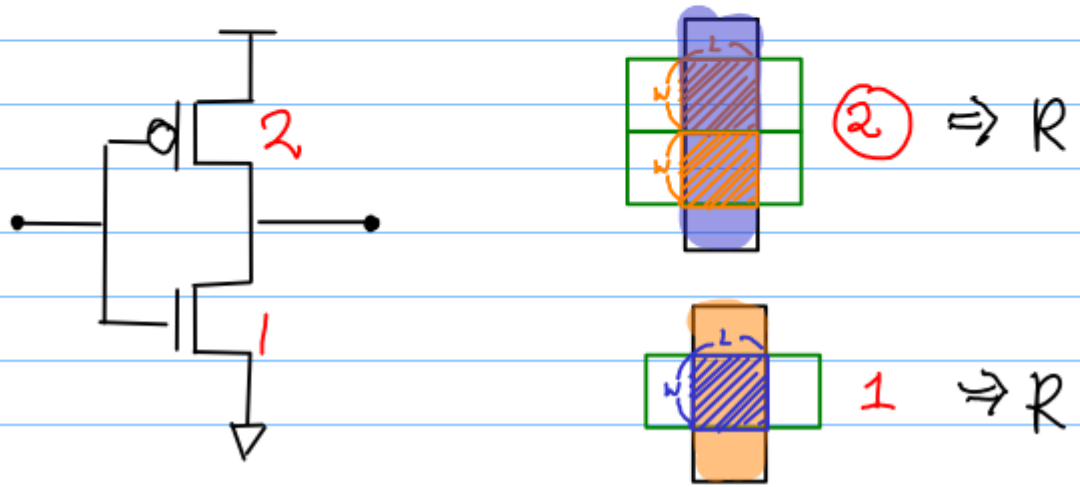
$R_n \simeq R_p$

A Unit Inverter

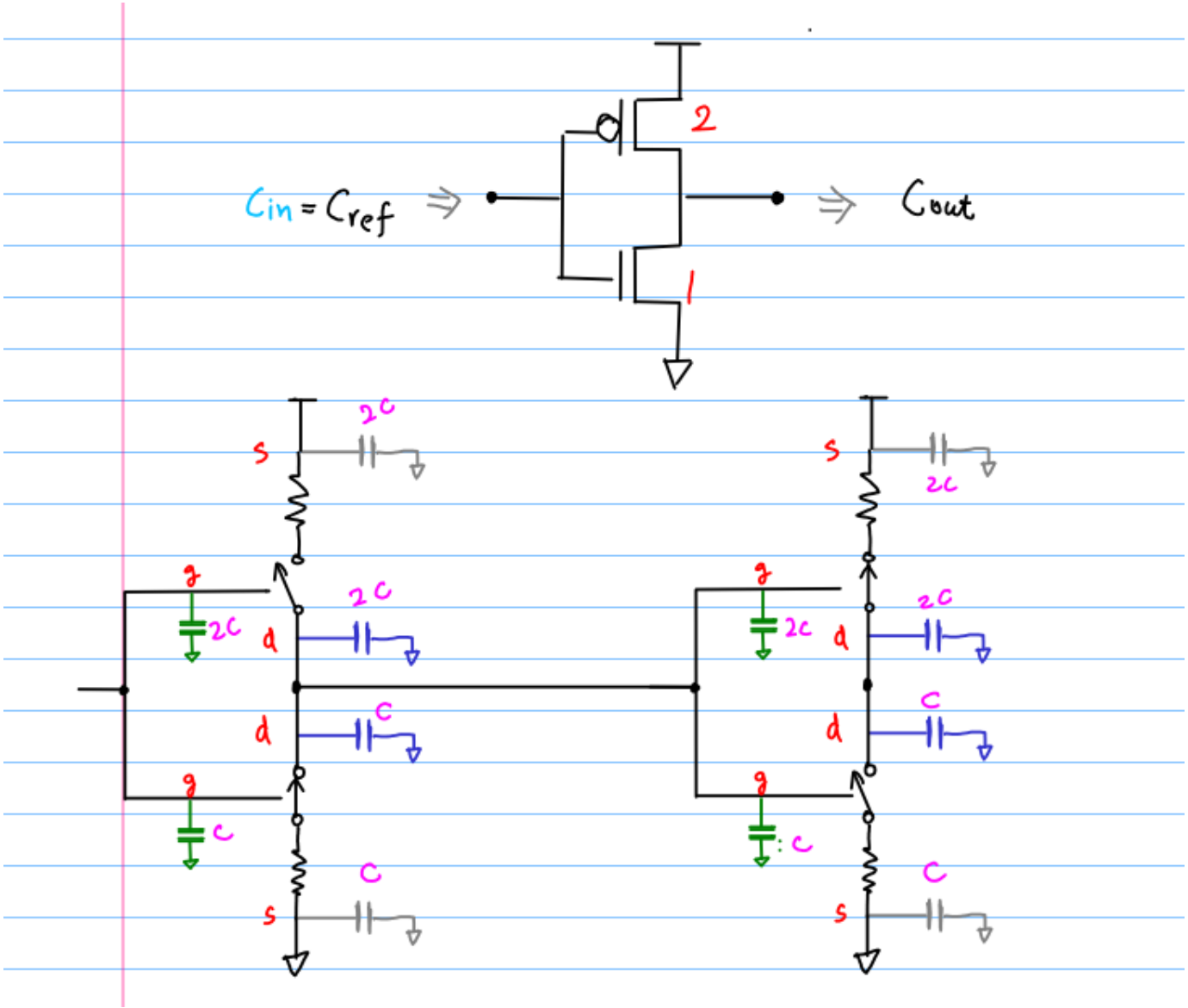
X1 reference gate

a Symmetric inverter

$\beta_n = \beta_p$ $R_n = R_p$



Cascade Inverter Modeling



Characteristic Curve

References

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