

ECE S/410 Physical IC Design

MAY 7, 2009 Lec 28

Review for final



EXAM MAY 12

1-3 PM

→ project questions ←

Draw comparator

Why use long L
pull-ups in your

T-B decoder?

DFFs

Schematics

setup & hold times

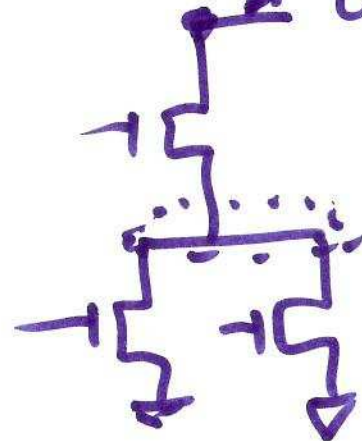
give an example of a dynamic circuit
what does this mean?

Complex CMOS logic

XOR
 → Adder ←

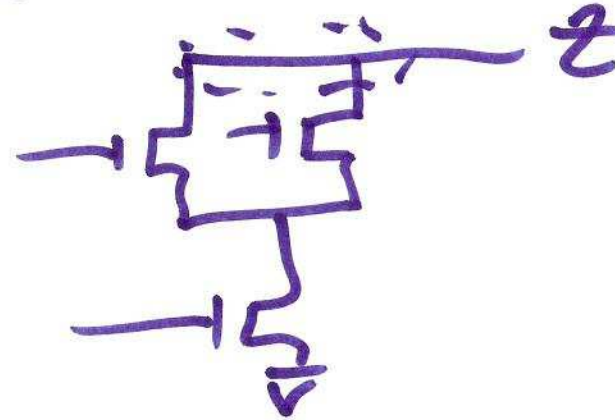
$$A + \bar{B}C$$

order of Transistors



better

NAND, NOR



schematics.

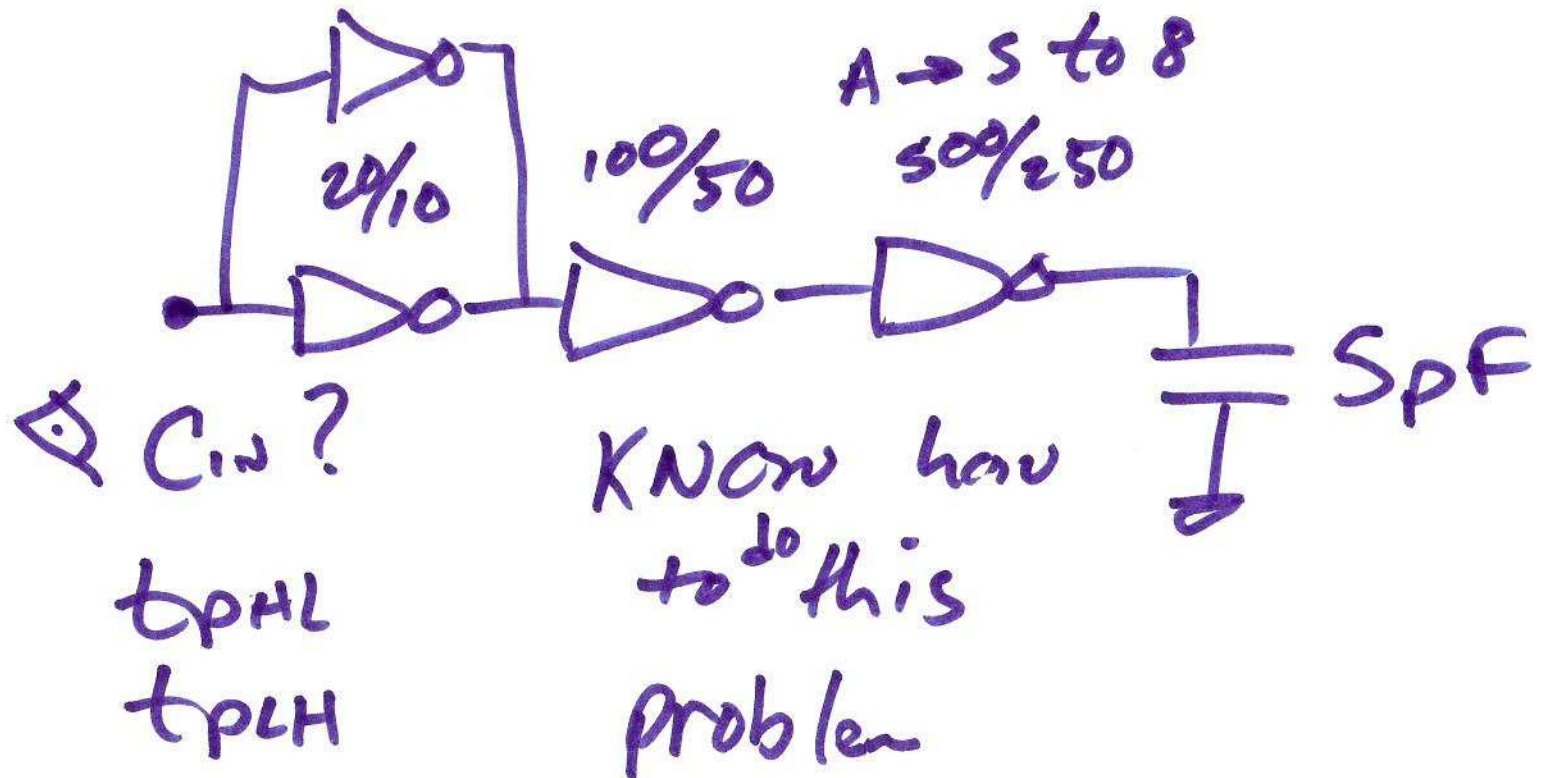
2)

Buffer design size inverters

$$A = 2.71 = e \quad \text{ideal}$$

$$N = \ln \frac{C_L}{C_{in}}$$

20/10

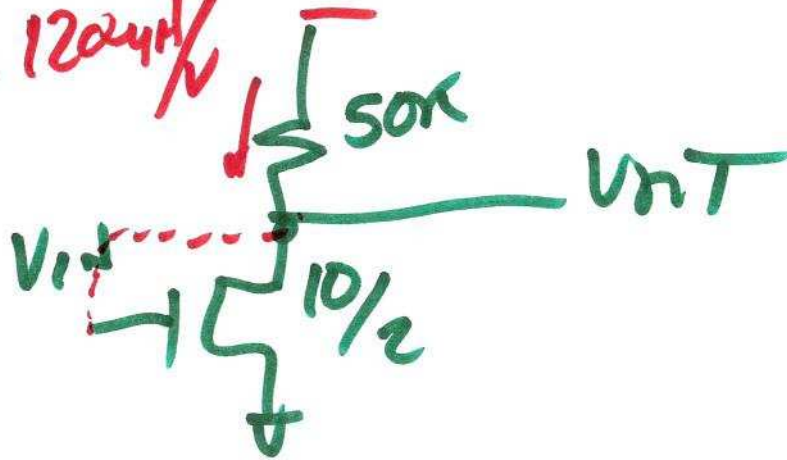


3)

Switching POINT

$V_{THN} = 0.8V$

$K_{PN} = 120 \mu A/V^2$



old ex Ans

$V_{OH} = ? V_{DD}$

$V_{OL} = ?$

$V_{SP} = ?$

$I = ?$

$I @ V_{OUT} = V_{SP}$

for V_{SP}

$$\frac{V_{DD} - V_{SP}}{50K} = \frac{\beta_N}{2} (V_{SP} - V_{THN})^2$$

for V_{OL}
 $V_{IN} = V_{DD}$
 $V_{OUT} = V_{OL}$

$$\frac{V_{DD} - V_{OL}}{50K} = \beta_N \left((V_{DD} - V_{THN}) V_{OL} - \frac{V_{OL}^2}{2} \right)$$

5)

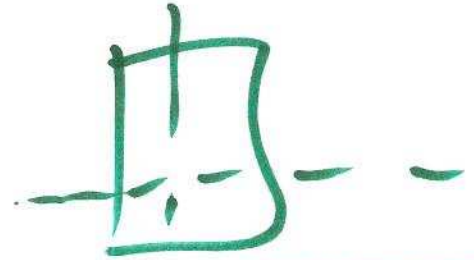
good problem to know :)

Layout of an inverter

well node

nmos & pmos node, etc.

X-SECT

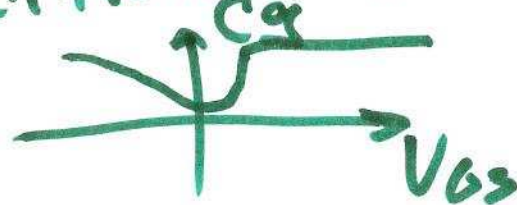
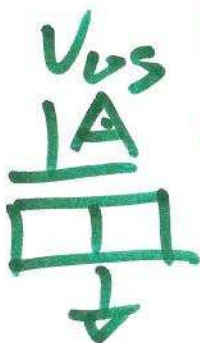


MOSFET operation

N_{ED} , N_{RS} , P_D , P_S , A_D , A_S

for both nmos & pmos

Deriving the equations
capacitances C_V



$$\frac{qAV}{N_A \dots N_D}$$

P-SUB

6)

Overlap capacitances

SATURATION

bottom
AND
sidewall

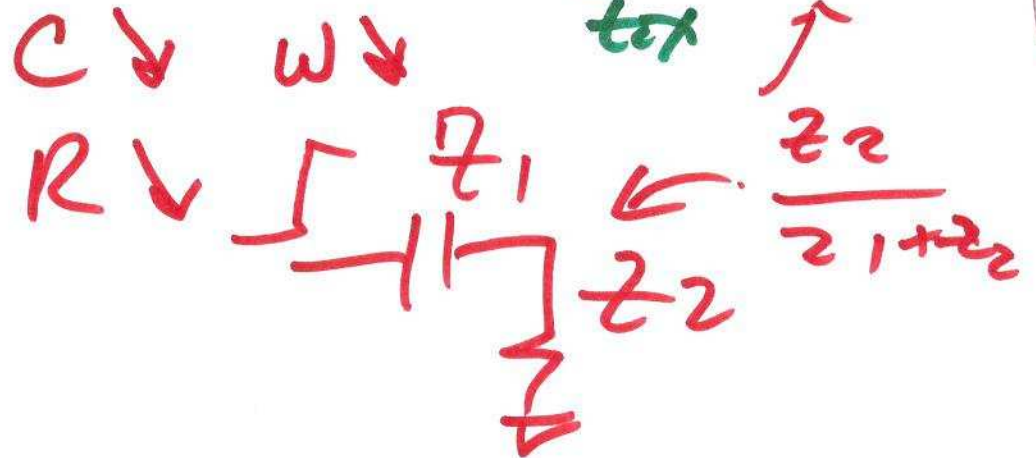
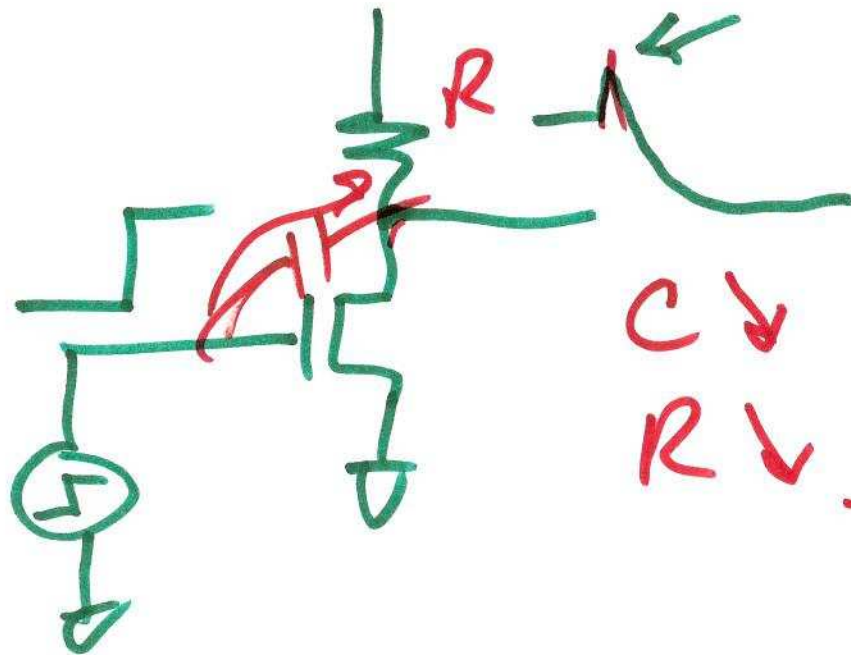
$$C_{gs} = \frac{2}{3} C_{ox}$$

$$C_{gd} = \text{overlap}$$

$$= C_{G00} \cdot W$$

$$= C_{ox} \cdot L_D \cdot W$$

$$= \frac{E_{ox}}{t_{ox}} \cdot L_D \cdot W$$

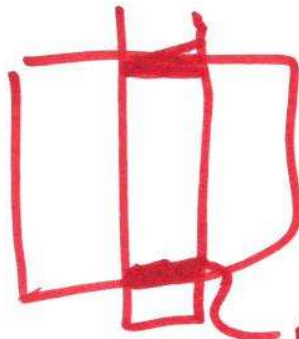


→

130
90
65
45

Ch. 6

subthreshold slope



p-well $\log I_D$ vs. V_{GS}
implan

Scaling

65nm

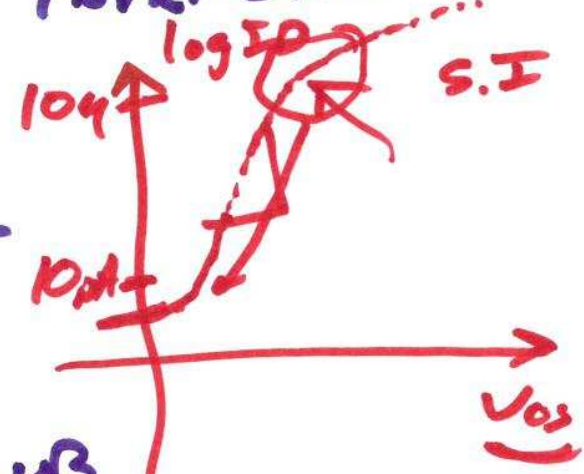
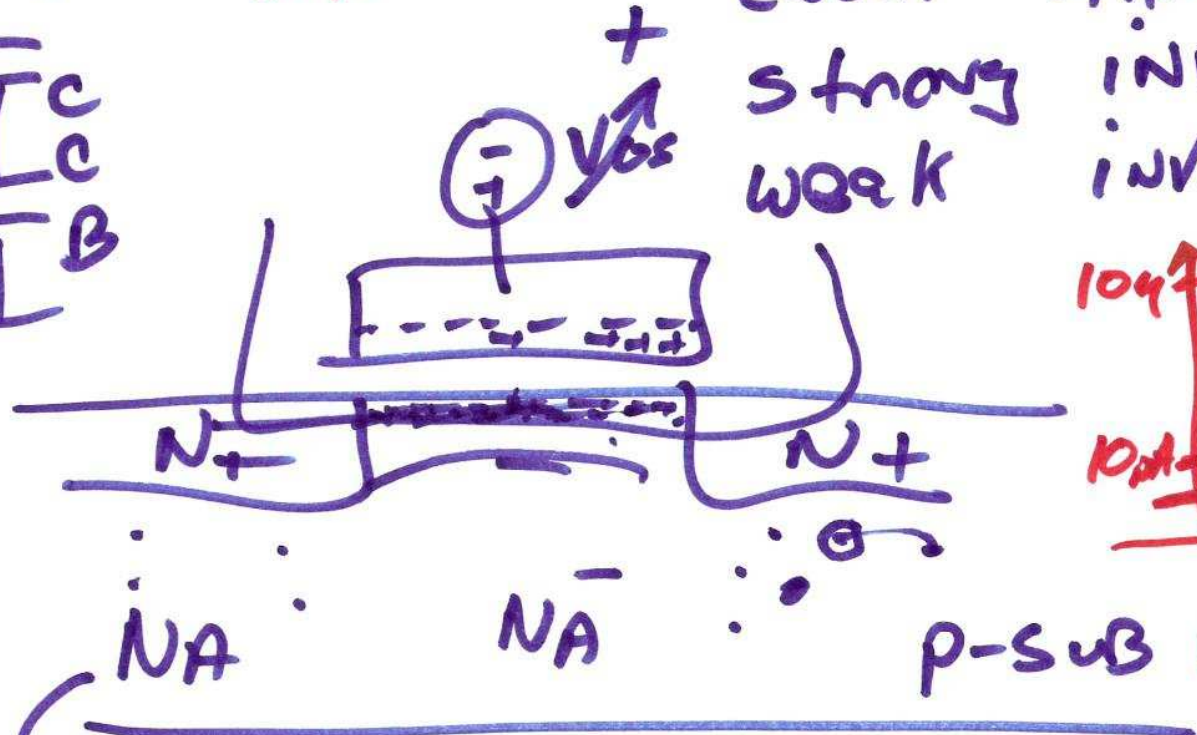
45nm

$S = ?$

strong inversion

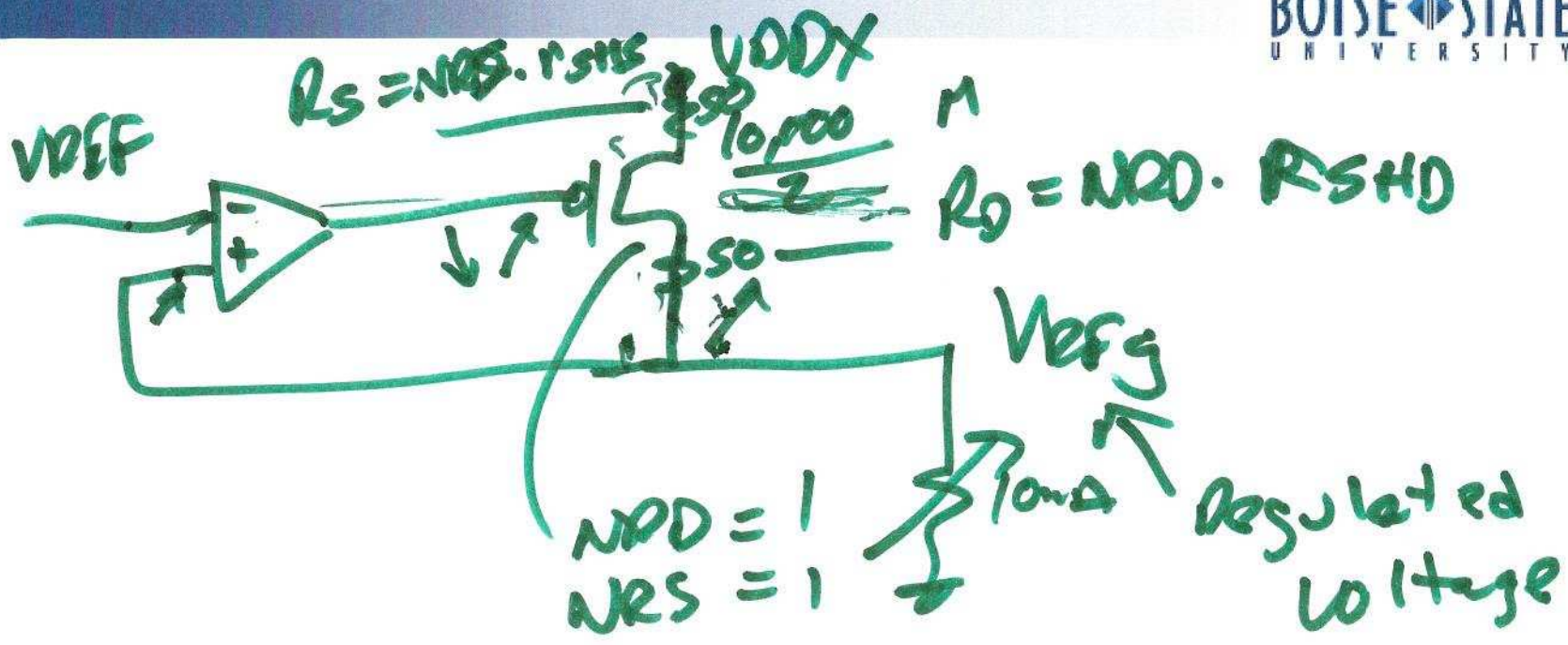
weak inversion

$S = ?$



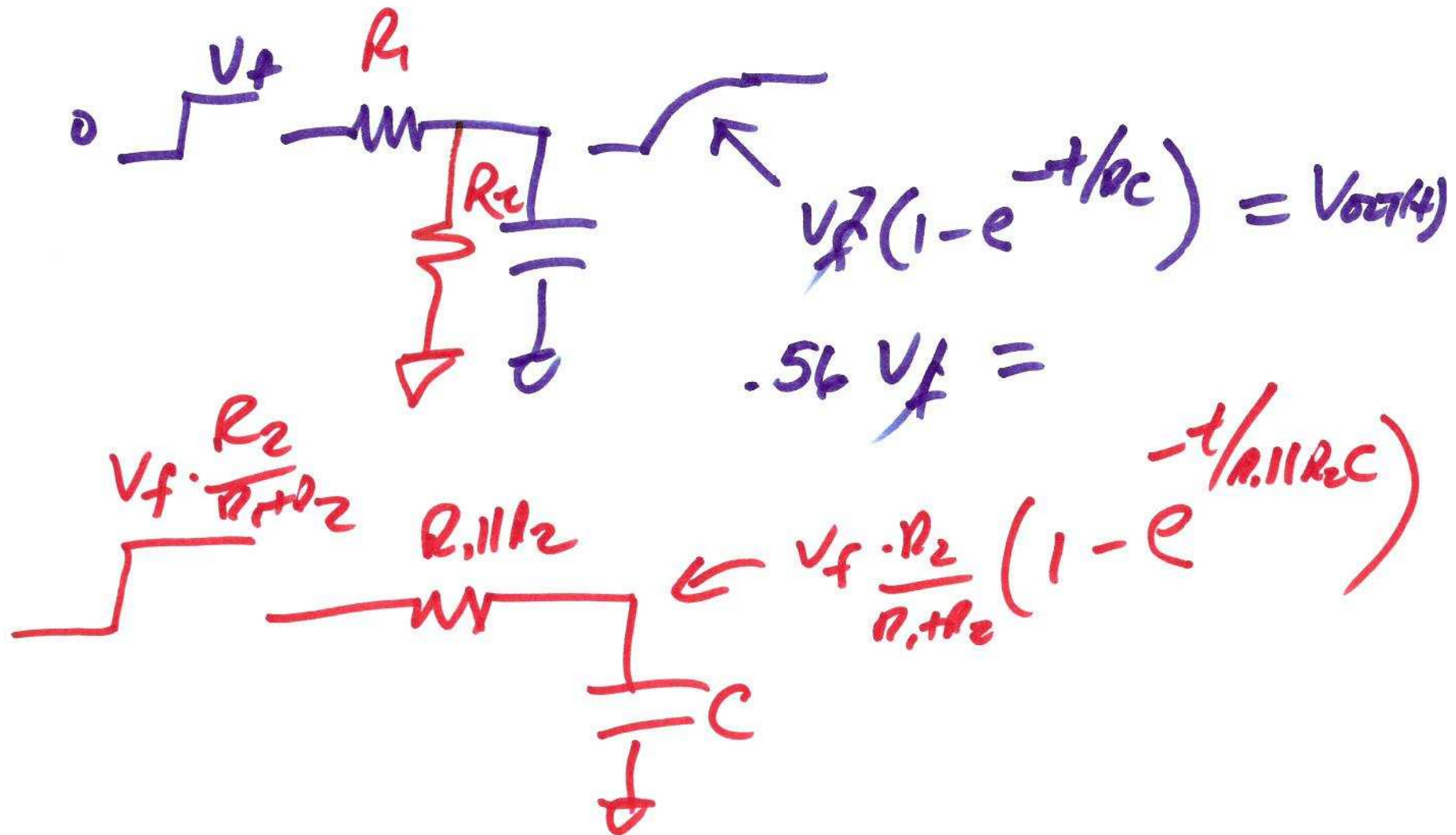
Atoms/cm³

8)

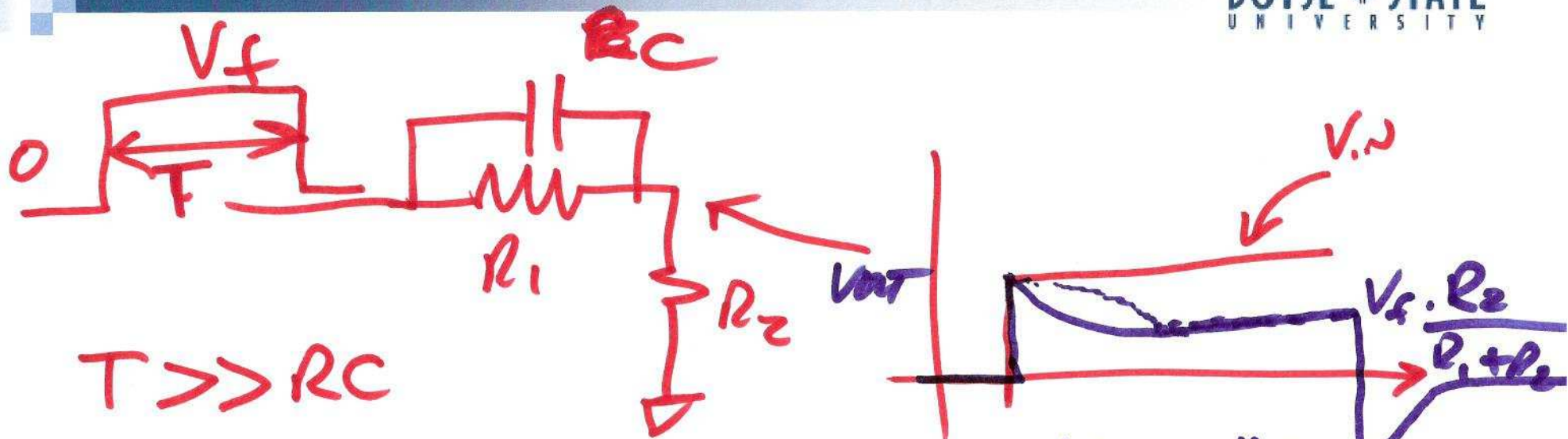


LAYOUT of devices
 study all quizzes, tests
 H.W.

TRANSIENT RESPONSES EQUATIONS

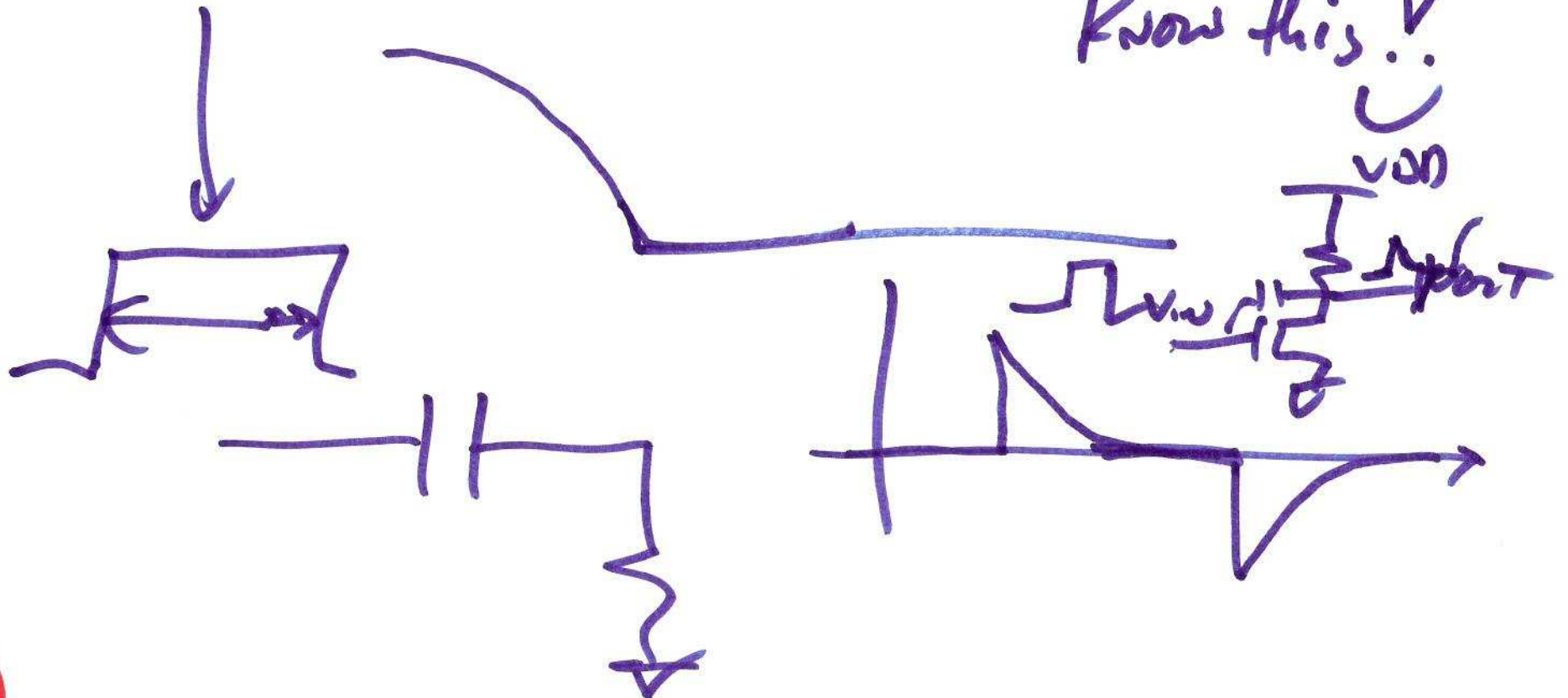


11)

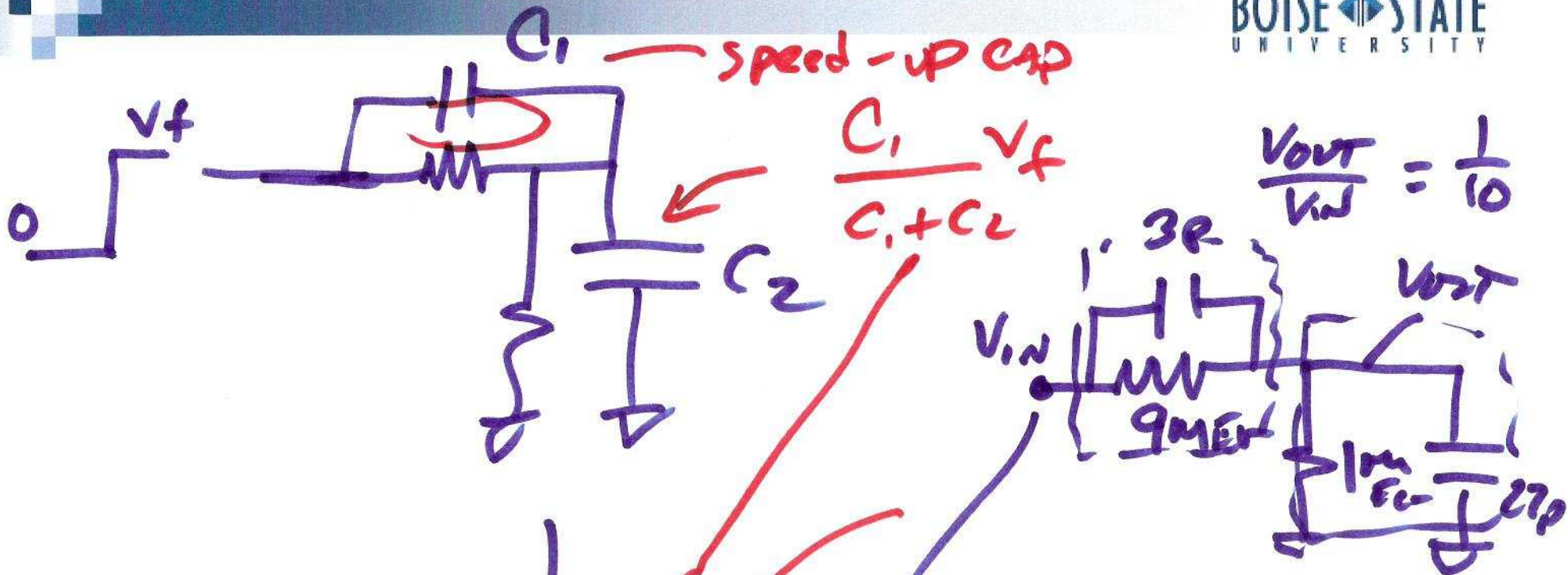


$T \gg RC$

Know this...



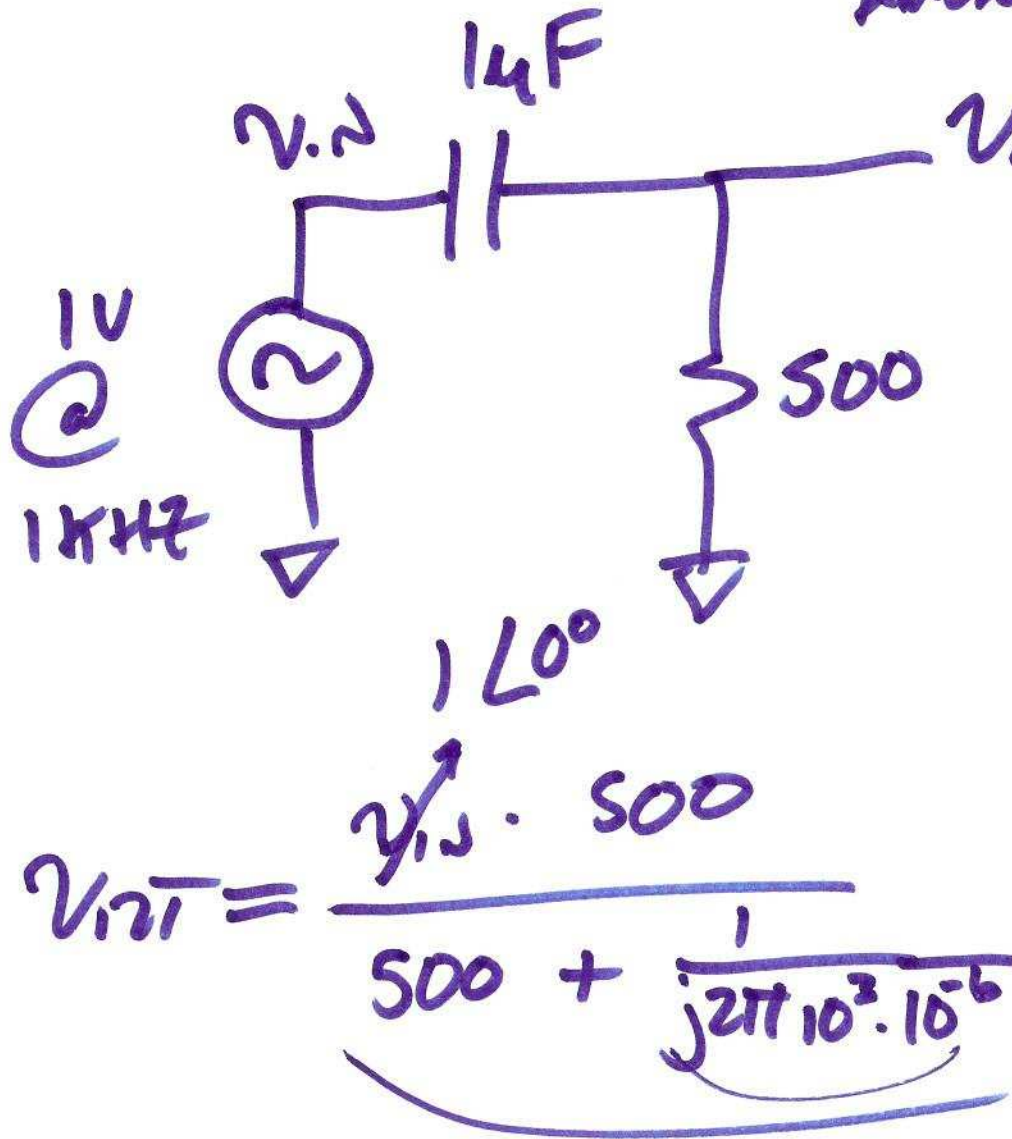
12)



Bode response
AC Analysis

$$C_{in} = \frac{3p \cdot 27p}{3p + 27p} \approx 3p$$

know this ☺



Sketch v_i & v_{out} on the scope plot in the time domain.

$$V_{out} = \frac{V_{in} \cdot 500}{500 + \frac{1}{j2\pi 10^3 \cdot 10^{-6}}}$$

14)