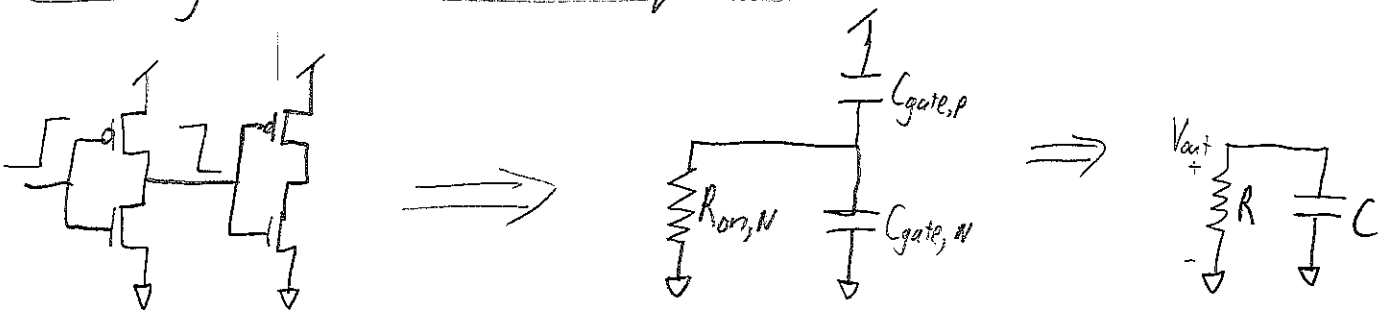
Solving our RC circuit equation:



$$V_{out}(0) = V_{DD}$$

$$V_{out} = -RC\frac{dV_{out}}{dt}$$

$$dt = -RC\frac{1}{V_{out}}dV_{out}$$

$$\int dt = -RC\int\frac{1}{V_{out}}dV_{out}$$

$$t + K_1 = -RC\ln V_{out}$$

$$\frac{-t}{RC} + \frac{-K_1}{RC} = \ln V_{out}$$

$$V_{out} = e^{-t/RC - K/RC}$$

$$= e^{-t/RC}e^{-K/RC}$$

$$= K e^{-t/RC}$$

Use our initial condition:

$$V_{out}(0) = V_{DD} = K e^{-0/RC} = K$$

$$\boxed{K = V_{DD}}$$

So:

$$V_{out}(t) = V_{DD}e^{-t/RC}$$

When does $V_{out} = V_{DD}/2$?

$$V_{DD}/2 = V_{DD}e^{-t/RC}$$

$$\frac{1}{2} = e^{-t/RC}$$

$$2 = e^{t/RC}$$

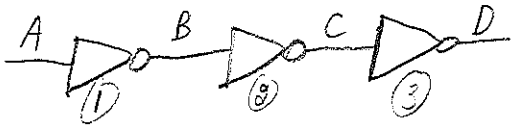
$$\ln 2 = t/RC$$

$$t = RC\ln 2 = 0.69\,RC$$

EE16 Section 5B: Circuit Delay

10/12/15

Warmup:

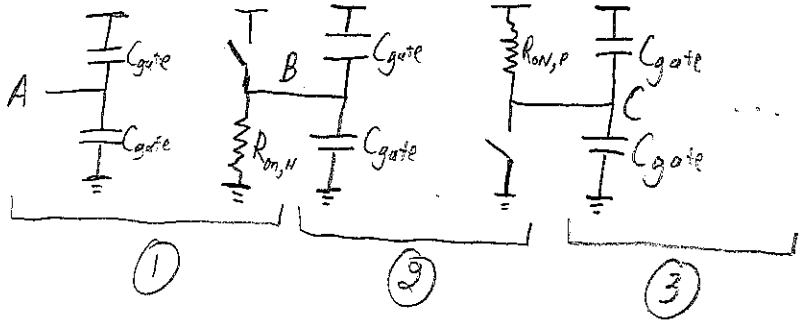


Find the delay from A to C when A transitions from low to high:

$R_{on} = 19.8k\Omega$ for all devices

$C_{gate} = 1fF$ for all devices

Answer:



$t_{A-B} = \ln 2 \; R_{on,N} \cdot 2C_{gate} = 17.7ps$

$t_{B-C} = t_{A-B}$

$t_{A-C} = 35.5ps$

Questions from lecture?