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Due: January 19 (midnight) HW 1

Instructions: Complete the problems below **in your own handwriting**. Show any work. Circle your answers where necessary. If the work or answer is not readable, you will not receive credit.

1 Fill in the Blank [30 points]

Fill in the blank with the most correct answer.

a) Statistical Timing Analysis checks if setup and hold times are satisfied.

b) Placement determines the location of standard cells.

c) Routing creates the wires that connect standard cells.

d) Floorplanning determines the location of standard cell rows and macro blocks.

e) Dopants can be added most quickly by ion implementation.

f) A shape on the mcon layer creates a connection between LI and the metal layer.

g) PMOS transistors are created in an n-type well.

h) After some processing steps, a wafer is made more flat using chemical mechanical planarization.

i) Dielectric materials electrically insulates interconnect layers.

j) When exposed to UV light, photoresist develops with the pattern of the mask.

k) The source and drain of an NMOS transistor is n-type type silicon.

l) The four terminals of a transistor are the gate, source, drain and body.

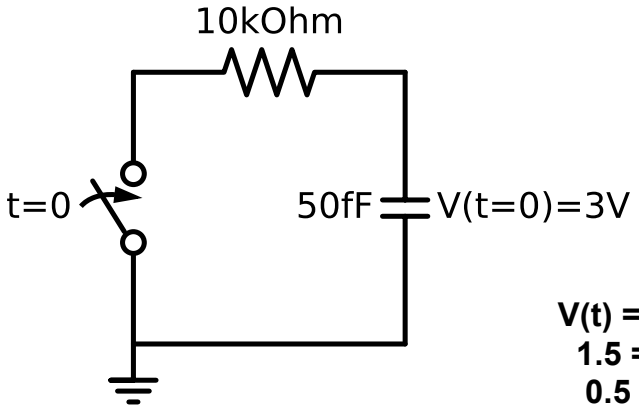
m) Metal interconnect is commonly made with copper (a material).

n) Modern MOS transistor gates are made with polysilicon (a material).

o) Etching can be isotropic or anisotropic.

2 Review: Time Constants [8 points]

What is the time **in nanoseconds** to discharge this capacitor to 50% of the initial value? **Show your work!**

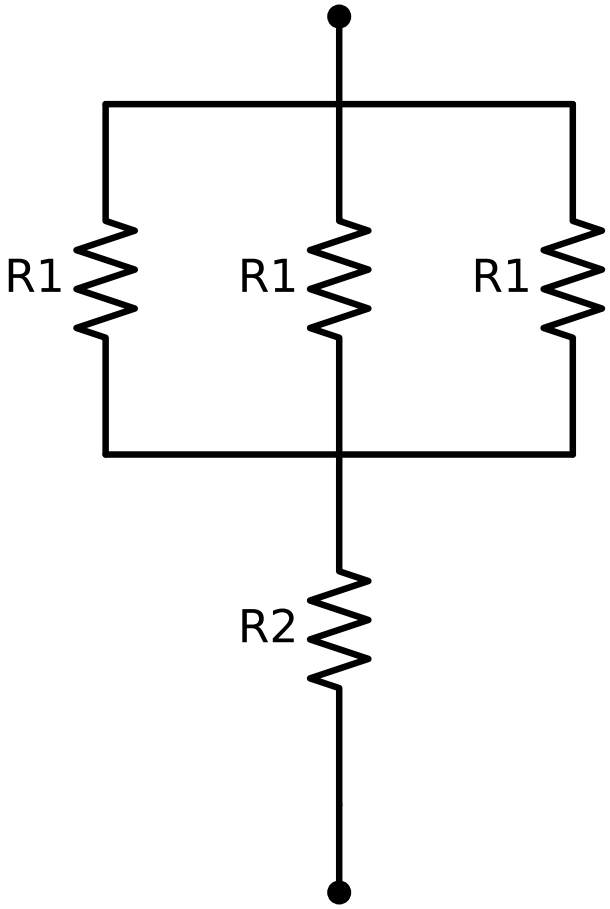


V(t) = V_0*e^(-t/rc)
1.5 = 3*e^(-t/rc)
0.5 = e^(-t/rc)
ln(0.5)=-t/(10^4*50*10^-15)
t = -ln(0.5)*(5*10^-9)

t = 0.3466 ns

3 Review: Series/Parallel Resistors [5 points]

Assuming R1=10kΩ and R2=20kΩ, what is the equivalent resistance **in kΩ** of the circuit below? **Show your work!**



1/((1/10)*3))+20 =
10/3+20 =

23.33kOhm

4 Processing Steps [7 points]

For each mask layer, specify the correct processing step or step(s) in the CMOS fabrication process: implantation, diffusion, oxidation, etch, deposition.

a) nwell: Implantation, diffusion

b) psdm: Implantation, diffusion

c) m1: Deposition, etching

d) licon: Deposition, etching

e) poly: Deposition, etching

f) diff: Diffusion

g) mcon: Implantation, diffusion