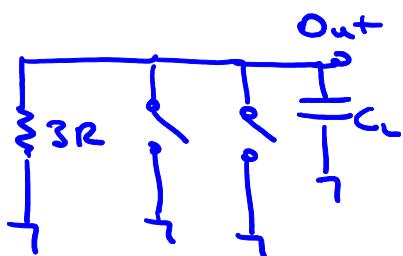


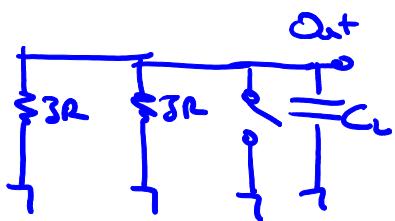
EECS 251 - Homework 7 Solutions

①

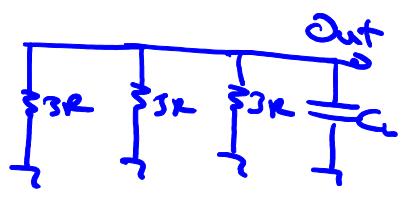
1)



(a)



(b)



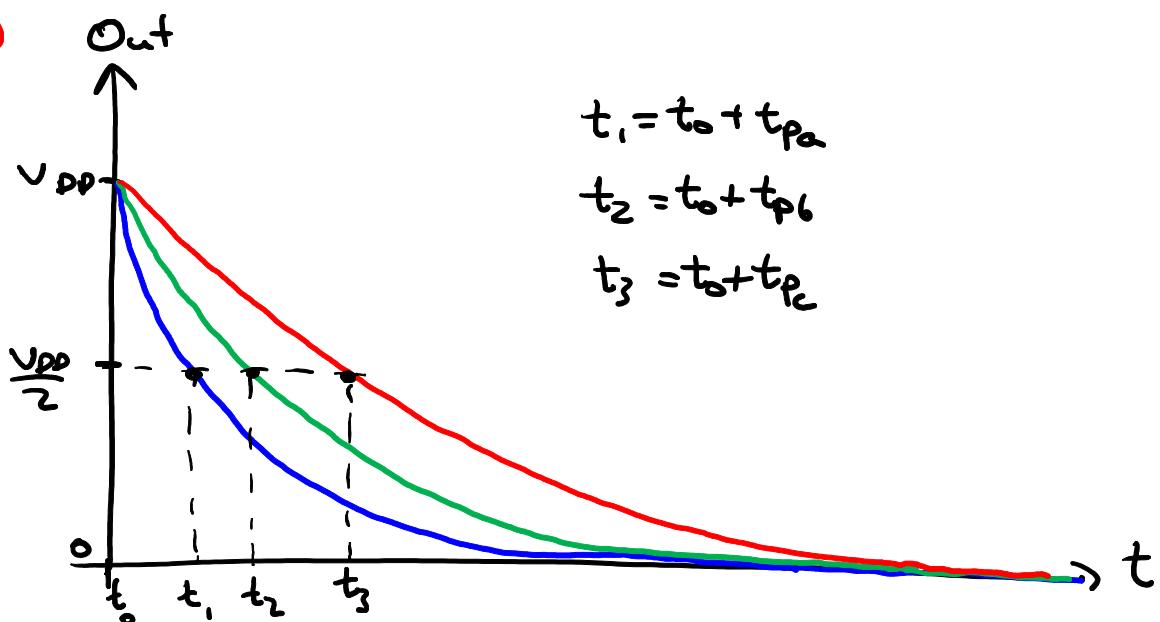
(c)

$$t_{p_a} = \ln(2) \cdot 3R \cdot C_L = 3 \cdot \ln(2) \cdot R C_L$$

$$t_{p_b} = \ln(2) \cdot \frac{3R}{2} \cdot C_L = 1.5 \cdot \ln(2) \cdot R C_L$$

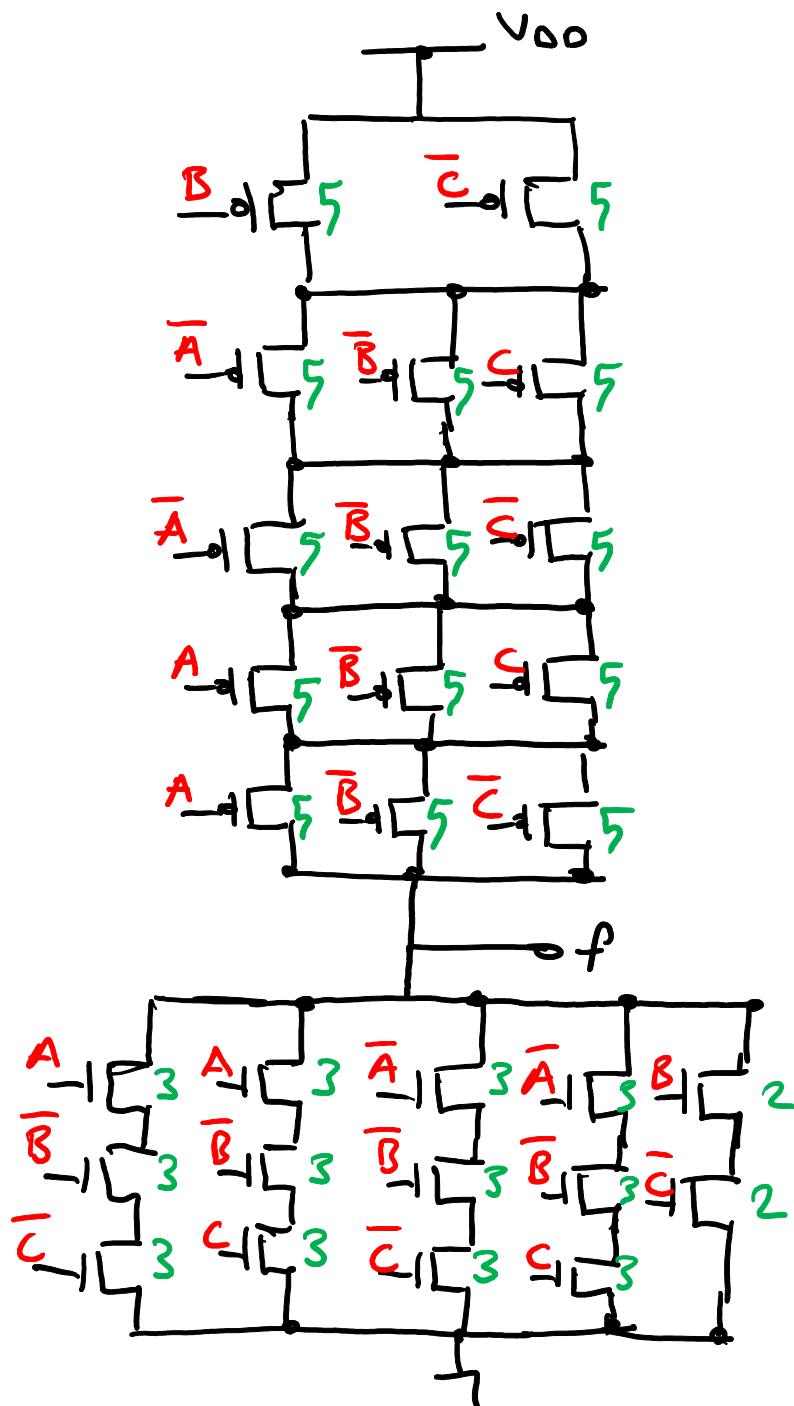
$$t_{p_c} = \ln(2) \cdot \frac{3R}{3} \cdot C_L = \ln(2) \cdot R C_L$$

2)



(2)

1)

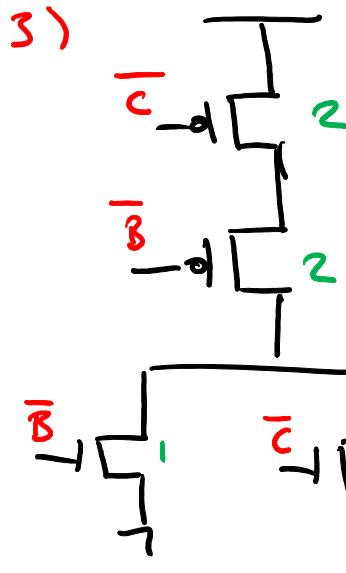


2)

		BC		
		00	01	11
		10		
A	0	0	0	1
	1	0	0	1

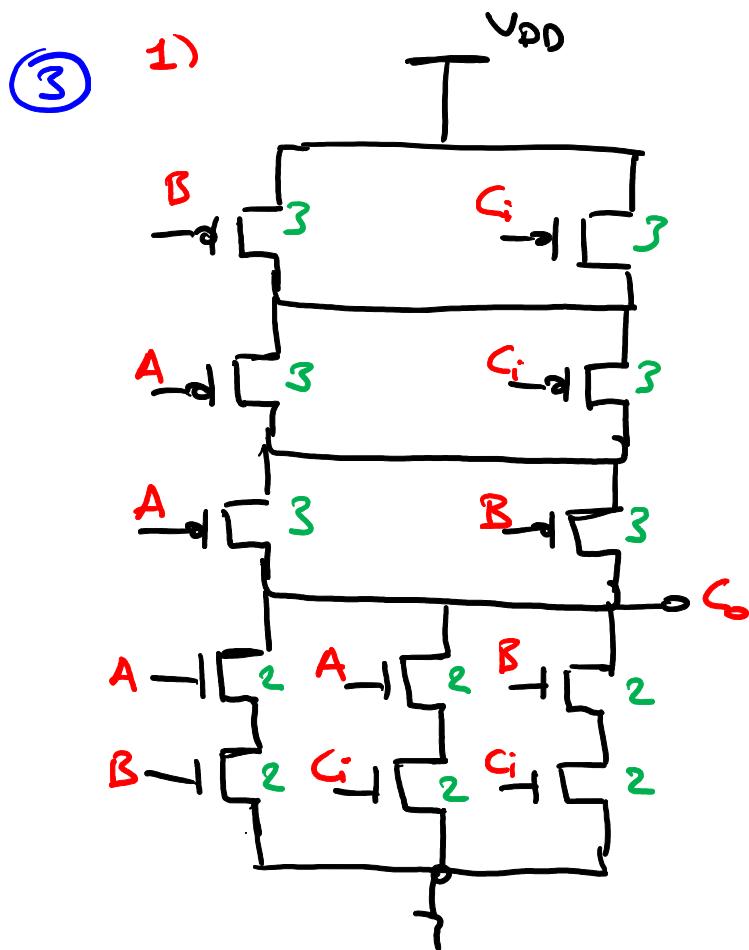
$\Rightarrow f = B \cdot C$

$f = \overline{\overline{B} + \overline{C}}$



4)

PMOS	NMOS
↑	↑
$A_{total_1} = 70 + 40 = 110$	$A_{total_2} = 4 + 2 = 6$



- 2) Yes, it is equivalent. It uses less transistors and utilizes smaller transistors, reducing the input capacitances.
- 3) It is a static CMOS gate. It does not have complementary PU/PD networks, but the two networks operate as if they are complementary. This property (that only some logical functions have) is called "self-duality".

(4) For Plos weaker than Nnos ($c_{2,1}$)

$$\text{TLE} = \frac{4}{3} \times \frac{5}{3} \times \frac{5}{3} \times \frac{7}{3}$$

$$B = 4$$

$$F = 200$$

$$PE = 6914 \Rightarrow EF = \sqrt[7]{PE} \approx 3.54$$

$$f = \frac{c_L}{EF} = 56.5$$

$$e = \frac{f}{EF} \cdot LE_e = 37.2$$

$$d = \frac{e}{EF} \cdot LE_d = 17.52$$

$$c = \frac{d}{EF} = 4.95$$

$$b = B_f \cdot \frac{c}{EF} - LE_b = 9.33$$

$$a = \frac{b}{EF} \cdot LE_a = 3.52$$

The fact that a is not exactly 3.52 is due to rounding errors.

For pmos equal to NMOS

$$\text{TTL} = \frac{3}{2} \cdot \frac{3}{2} \cdot 2 \cdot 2 = 9$$

$$B = 4$$

$$F = 200$$

$$PE = 7200 \Rightarrow EF = \sqrt[7]{PE} \approx 3.56$$

$$f = \frac{C_L}{EF} = 56$$

$$e = \frac{f}{EF} \cdot LE_e = 31.46$$

$$d = \frac{e}{EF} \cdot LE_d = 17.67$$

$$c = \frac{d}{EF} = 4.96$$

$$b = B_b \cdot \frac{c}{EF} \cdot LE_b = 8.36$$

$$a = \frac{b}{EF} \cdot LE_a = 3.52$$

The fact that a is not exactly 3.52 is due to rounding errors.