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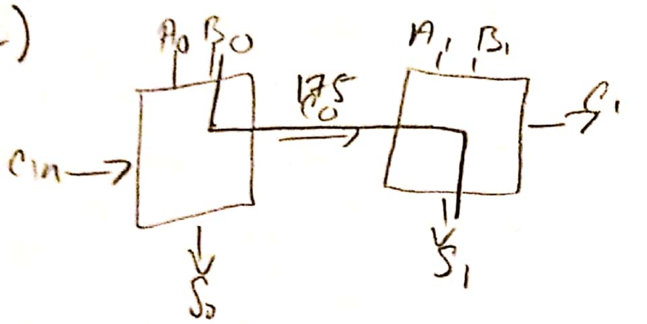
HW#5

Problem 1

1) $S = 95 + 95 = \boxed{190ps}$

$C = 95 + 40 + 40 = \boxed{175ps}$

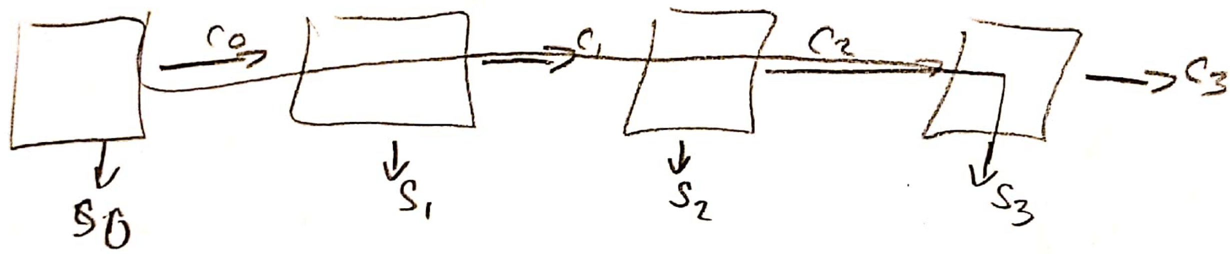
2)



$S_1 = C_0 + S_1 = 175 + 190$
$= \boxed{365ps}$

$C_1 = C_0 + C_1 = 175 + 175$
$= \boxed{350ps}$

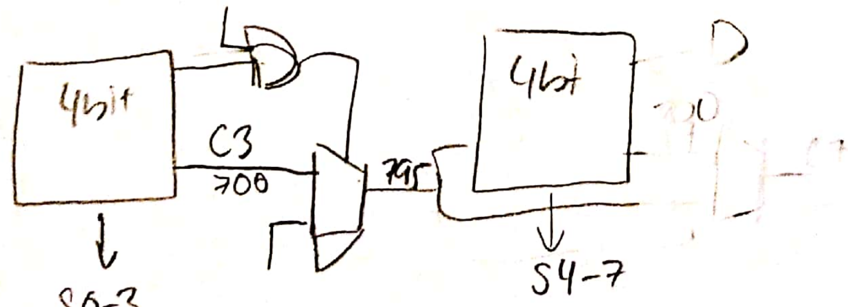
3)



$S_3 = C_0 + C_1 + C_2 + S_3 = 175 + 175 + 175 + 190 = \boxed{715ps}$

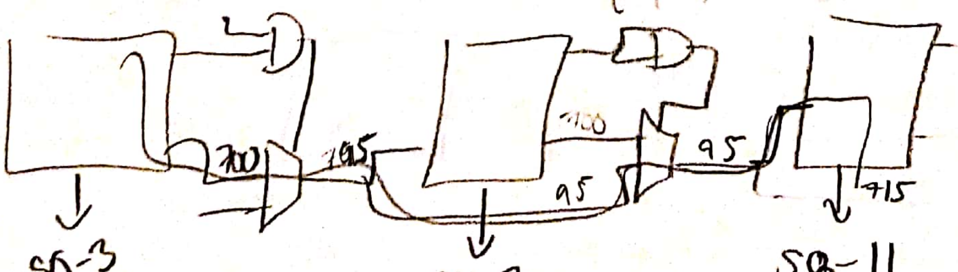
$C_3 = C_0 + C_1 + C_2 + C_3 = 175 + 175 + 175 + 175 = \boxed{700ps}$

4)



$S4\text{-}7 = 700 + 95 + 715 = \boxed{1510ps}$

5)



$= 700 + 95 + 700$
$+ 95 + 95$
$+ 715$
$= \boxed{1700ps}$

Problem 2

a) A C_0 C_1 C_2 C_3

60 40 40 40 = 180 mux = 60 60

= 180 + 60 + 60 = 300

C_3 C_4 C_5 C_6 S_7 = 210

40 40 40 90

⇒ 300 + 210

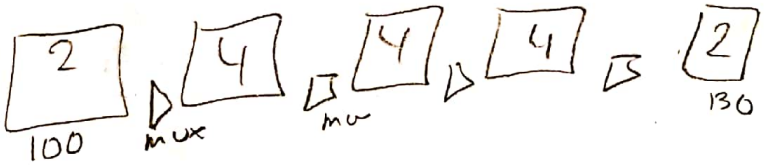
= 510PS

b) A_0 C_0 C_1 = 100 + mux + mux + C_5 + C_6 + S_7

60 40 40 90 = 130

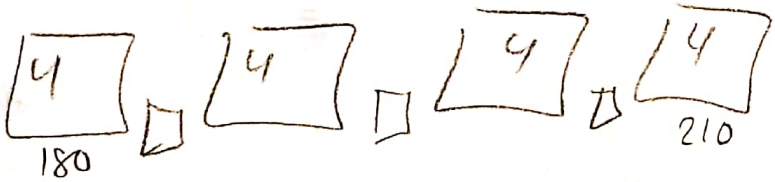
= 100 + 60 + 60 + 130 = 350ps

c)



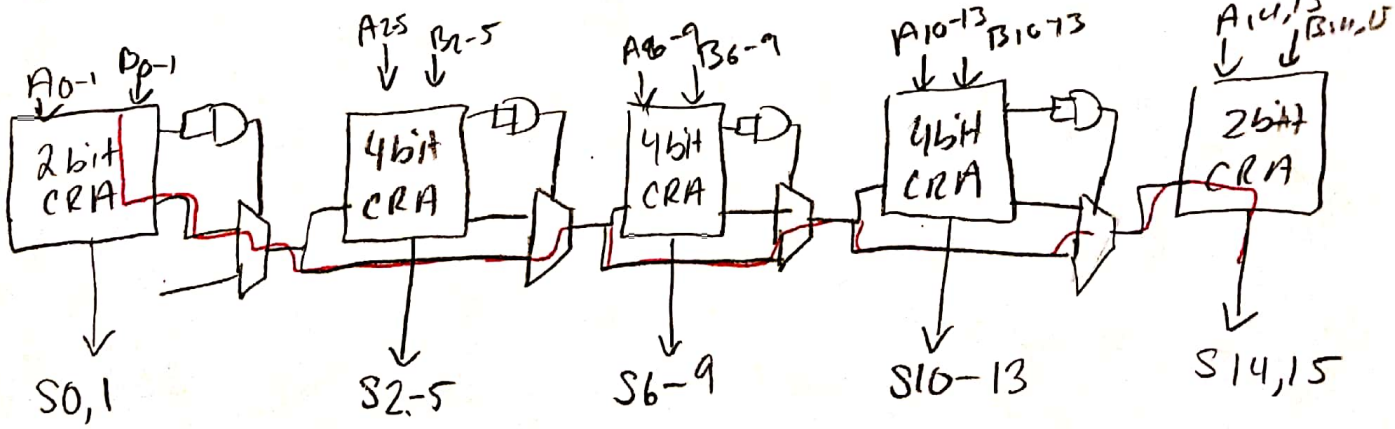
= 100 + 60 + 60 + 60 + 60 + 130

= 470 ps



= 180 + 60 + 60 + 60 + 210 = 570ps

d)



delay = A_0 C_0 C_{13} 100 + 60 + 60 + 60 + 60 + 60 + C_{13} C_{14} S_{15} + 130

C_{13} C_{14} = 130

470ps

Problem 3 (3)

a) $R_1 \to R_3 = 50 + 270 + 50 + 50$

$\Rightarrow \boxed{T \geq 420ps}$

$R_3 \to R_1 = 50 + 270 + 50 = 370$

$R_2 \to R_3 = 50 + 200 + 50 + 50$

$R_3 \to R_2 = 50 + 220 + 50 = 320$

b) $t_{R3} - t_{C1}$ w/ $t_{C2} = t_{C1}$

not worried about set up Violation, worried about hold time

1) $R_1 \to R_3 = 30 + 100 + 20 + 30$

$= 180$

$R_2 \to R_3 = 30 + 90 + 20 + 30$

$= 170$

$R_3 \to R_1 = 30 + 70 + 30$

$R_3 \to R_2 = 30 + 60 + 30$

$= 120$

2) R3 delay $\Rightarrow$ 3 paths

$R_1 \to R_3$

$R_2 \to R_3 = 170$

3) $R_3 \to R_2$ or $R_2 \to R_3$

$R_3 \to R_1 = 30 + 60 + \delta \geq t_{hold}$

$R_2 \to R_3 = 30 + 90 + 20 + \delta \geq 50_{hold}$

$\boxed{\delta \leq 90ps}$

c) $t_{C1} - t_{C3}$ w/ $t_{C2} = t_{C1}$

$R_1 \to R_3$

$T + \delta \geq \underbrace{t_R + t_{IA} + t_D}_{\text{delay}} + \underbrace{t_{SU}}_{\text{margin}}$

$T + 90 \geq 50 + 270 + 50 + 50$

$T \geq 330$

$R_3 \to R_1$ c90

$T - \delta \geq t_R + T_B + t_{SU} = 50 + 270 + 50 \Rightarrow \boxed{T \geq 460ps}$

$R_2 \to R_3$ not affec $T \geq T_R + t_C + T_D + t_{SU} \Rightarrow T \geq 350$