CG2027 Assignment 1

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1. a) rise time t_r is the time taken for the output voltage to change from 10% to 90%

t_r = 383.86ps − 359.95ps

= 23.91ps

fall time t_f is the time taken for the output voltage to change from 90% to 10%

t_f = 132.36ps − 113.35ps

= 19.01ps

b) high-to-low propagation delay t_{pHL} is the timing difference between the 50% point of input voltage change from low to high and the 50% point of the corresponding output voltage change from high to low

t_{pHL} = 120.88ps − 108.62ps

= 12.26ps

c) low-to-high propogation delay t_{pLH} is the timing difference between the 50% point of input voltage change from high to low and the 50% point of the corresponding output voltage change from low to high

t_{pLH} = 368.35ps − 355.05ps

= 13.30ps

d) Duty cycle is the ratio of time a signal is HIGH to the time a signal is LOW

50% duty cycle means signal is HIGH 50% of the time

taking 50% voltage as the valid transition from LOW to HIGH

t_{ON} = 355.05ps − 108.62ps

= 246.43ps

period of signal = 246.43ps × 2

= 492.86ps

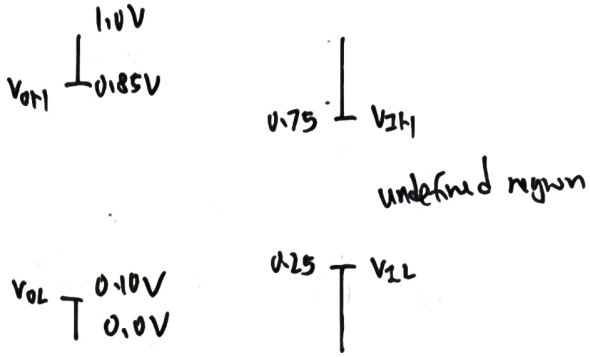
$$\text{frequency} = \frac{1}{492.86\text{ps}} = 2.028\,973\,745 \times 10^{9}\,\text{Hz}$$

$$\approx 2.029\,\text{GHz}$$

2. a) Noise margins are the differences between input and output voltage thresholds which tells us how much noise can be added to a valid 0 or 1 output signal and still have the result interpreted correctly at the inputs which it is connected

$$NM_H = V_{OH} - V_{IH}$$
$$= 0.85V - 0.75V$$
$$= \underline{0.10V}$$

$$NM_L = V_{IL} - V_{OL}$$
$$= 0.25V - 0.10V$$
$$= \underline{0.15V}$$



b) When input high and input low of Buf2 becomes the same (eg 0.5V) the noise margins NM_H and NM_L will increase which increases noise immunity. However, the undefined region also disappears when we set the input high to equal the input low. A potential problem with having no undefined region is that inputs near this threshold where $V_{IL} = V_{IH}$ could fluctuate between valid high and valid low which results in unstable and unpredictable output.