

學號： \_\_\_\_\_

姓名： \_\_\_\_\_

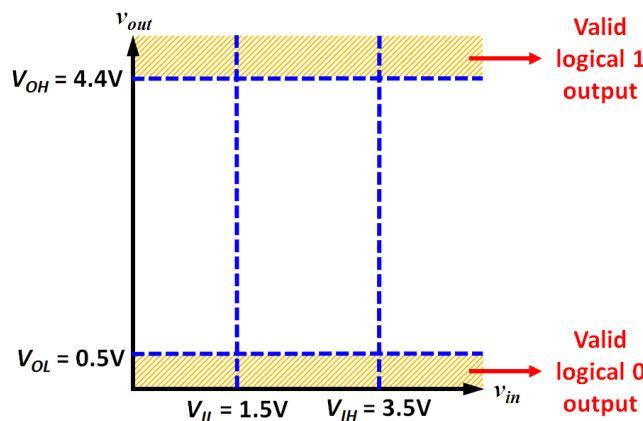
Consider a family of logic gates which operates under the static discipline with the following voltage thresholds:  
 $V_{IL} = 1.5\text{ V}$ ,  $V_{OL} = 0.5\text{ V}$ ,  $V_{IH} = 3.5\text{ V}$ , and  $V_{OH} = 4.4\text{ V}$ .

- (a) What is the highest voltage that can be output by an inverter for a logical 0 output? (14%)
- (b) What is the lowest voltage that can be output by an inverter for a logical 1 output? (14%)
- (c) What is the highest voltage that must be interpreted by a receiver as a logical 0? (14%)
- (d) What is the lowest voltage that must be interpreted by a receiver as a logical 1? (14%)
- (e) What range of voltages will be treated as invalid under this discipline? (14%)
- (f) What are its noise margins ( $NM_0$ ,  $NM_1$ )? (28%)

Solutions:

(a) & (b)

The valid voltage ranges for logical output signal can be found from the following figure under this static discipline.

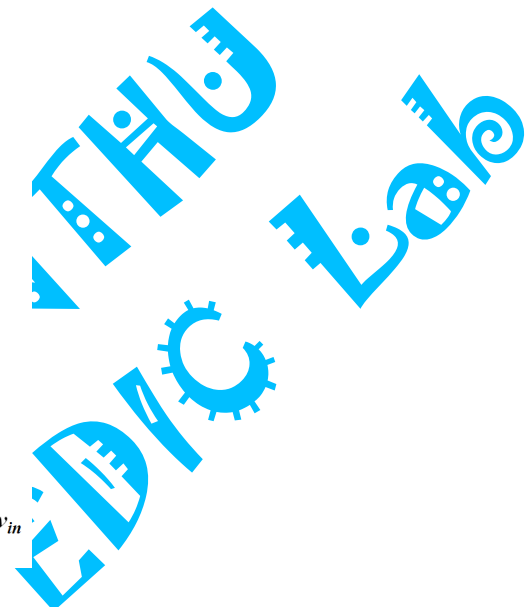
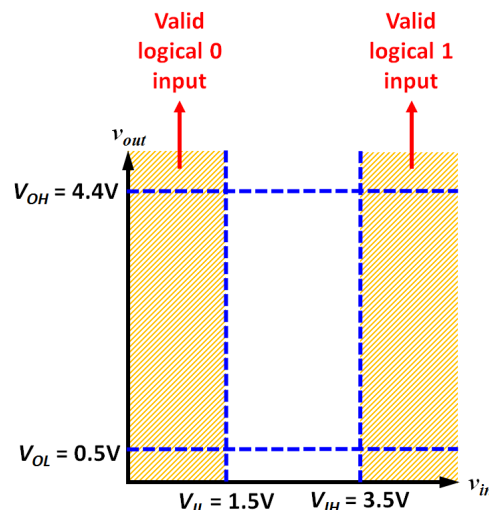


Therefore,

the highest voltage that can be a logical 0 output is  $V_{OL} = 0.5\text{ V}$ , and the lowest voltage that can be a logical 1 output is  $V_{OH} = 4.4\text{ V}$ .

(c) & (d)

The valid voltage ranges for logical input signal can be found from the following figure under this static discipline.



Therefore,

the highest voltage that must be interpreted by a receiver as a logical 0 is  $V_{IL} = 1.5\text{V}$ , and the lowest voltage that must be interpreted by a receiver as a logical 1 is  $V_{IH} = 3.5\text{V}$ .

(e)  
The range of voltages  $1.5\text{V} < v < 3.5\text{V}$  will be treated as invalid under this discipline.

(f)  
 $NM_0 = V_{IL} - V_{OL} = 1\text{V}$   
 $NM_1 = V_{OH} - V_{IH} = 0.9\text{V}$

(a) $V_{OL} = 0.5\text{ V}$ _____, (b) $V_{OH} = 4.4\text{ V}$ _____, (c) $V_{IL} = 1.5\text{ V}$ _____, (d) $V_{IH} = 3.5\text{ V}$ _____,
(e) $1.5\text{V} < v < 3.5\text{V}$ _____, (f) $NM_0 = V_{IL} - V_{OL} = 1\text{V}$ _____, $NM_1 = V_{OH} - V_{IH} = 0.9\text{V}$ _____.