In order to satisfy the static discipline, a circuit must produce outputs that are better than the acceptable inputs.

This ensures that if you concatenate multiple gates together, for example one buffer followed by another buffer, then the input to each gate will be valid even if a small amount of noise was introduced by the previous gate.

So taking a closer look at that, what that means is that if I have a valid input at my first buffer, and I am guaranteeing that the output that I produce is slightly better than my original input, then even if a little bit of noise was introduced, the input to the second buffer is still going to be considered a valid input.

More concretely, to satisfy the static discipline, a valid low output must be less than a valid low input.

The way that we specify this is that is that Vol il.

Also, a valid high output must be greater than a valid high input.

So Voh must be greater than Vih.

If we put this all together, we have Vol il and Vih oh and of course we want our low inputs to be less than or equal to our high inputs, so Vil ih.

Another way to think about this is to look at the orange and green arrows which show the ranges of valid inputs which are wider than the ranges of valid outputs.

The other thing that is shown here are the noise margins which correspond to the area of valid inputs but invalid outputs.

As we said earlier, a valid input must always produce a valid output.

A valid input has Vin il if its low or Vin > Vih if its high.

A valid output has Vout ol if its low and Vout > Voh if its high.

In this problem, we want to determine whether specifications 1, 2, and 3 (which provide 0.3 volt noise margins) satisfy the static discipline given the voltage transfer curve shown here.

For each specification, we need to check the following two constraints: 1) Is Vol il ih oh - satisfying this constraint guarantees that the outputs produced are better in quality than the inputs.

The second constraint is: Does a valid input produce a valid output?

Since this curve shows an inverting function, this translates to: a) Does a valid input (where Vin il) always produce a valid high output (where Vout > Voh)?

And b) Does a valid high input (where Vin > Vih) always produce a valid low output (where Vout ol)?

If all of these constraints are satisfied, then that specification obeys the static discipline.

If not, it doesn't.

For all three specifications, we see that indeed Vol il ih oh, so the first constraint is satisfied for all three specifications.

Now let's check the second constraint.

For specification #1: If Vin il which is equal to 0.4, then Vout = 5 which is greater than Voh which is 4.9, so a valid low input produces a valid high output.

If Vin > Vih which equals 4.6 then Vout equals 0 which is less than Vol which is 0.1, so a valid high input produces a valid low output.

Since all of the constraints are satisfied, specification #1 satisfies the static discipline.

For specification #2: If Vin out >= 4 which is not greater than> Voh which is 4.4.

So this specification does not satisfy the static discipline.

For specification #3: If Vin out >= 4 which in this case is greater than Voh which is 3.9.

So the first part of the constraint checks out.

Now we need to check what happens when we have a valid high input.

In this case, if Vin > 3.6 then Vout ol or 1.1, so this part of the constraint checks out as well.

Since all the constraints are satisfied, that means that specification #3 also satisfies the static discipline.