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# Cut-off

It means no current which is when Vgs is below threshold voltage.

You can see from the equation Ids = β (Vgs - Vt - ) Vds that the Current becomes negative if threshold voltage Vt is larger than Vgs.

When, Vgs is 0.2 V which is smaller than threshold voltage Vt=0.3V:

Vgs - Vt = -0.1V

Hence, No Current.

1. Cut-off equation Ids = 0

# Linear

It means current increases as more voltage is provided. So, if we increase voltage between our drain and source, Vds, we will get more current, Ids.

1. Linear equation Ids = β (Vgs - Vt - ) Vds

# Saturation

It means current does not increase when we increase voltage.

Think about a glass that can contain 500ml water. After you have given 500ml water, it will saturate and drip any more water given into the glass.

When, Vds = VGT = Vgs - Vt,then saturation begins

Example: Given, Vgs = 0.3V, Vt = 0.1V,

Then, we can check that saturation starts when

Vds = VGT

We know, VGT = Vgs - Vt

So, Vds = Vgs - Vt

Vds = 0.3 – 0.1 = 0.2 V

Therefore, at 0.2V our saturation will begin.

1. Saturation equation Ids = (V­GT)2

# Below threshold voltage

Let’s calculate for

1. Vgs = 0 V

This is below threshold voltage and we will have no graph.

2. Vgs = 0.2 V

This is below threshold voltage and we will have no graph.

3. Vgs =0.3 V will just start a very small amount of current, almost equal to zero because saturation begins at Vds = VGT = Vgs - Vt

Vds = 0V – so no visible current will flow.

# Let’s calculate when our saturation starts

Vgs =1 V

Vt = 0.3V

Since it is above threshold voltage, we will get current.

Vds = VGT = Vgs - Vt = 1v -0.3v = 0.7v

Hence, Vds = 0.7V or above will produce saturation region

and below 0.7v will give linear region.

# 

# Calculate Beta

.. β = μ

μ = Mobility which is given 80

tox = Thickness which is given 10.5 amstrong (1 amstrong = cm)

.. β = 80 \* () () = 262.941X = 0.000262941

Leave as constant because in the question it is given as a ratio, not a real number.

Regarding our units, following equation should be in ampere because we are calculating current. We see that, without beta, it is voltage square. So we need to remove these two voltages.

Ids = β (Vgs - Vt - ) Vds

Unit of β is: ( ) \*( ) =

We know, F = (Amp \* Second) by voltage =

So, β is:

.. β = 80 \* () () = 262.941X = 262

Now, we know

# Graph of Ids vs Vds

Given,

|  |  |
| --- | --- |
| Vgs | 0, 0.2, 0.4, 0.6, 0.8, 1.0V |
| Vt | 0.3V |
| Tox | 10.5 Amstrong |

Step 1: Find out Beta

Step 2: Find out saturation region and Linear region

Step 3: Take Vds = any three points below saturation and calculate linear

Step 4: Calculate saturation

Step 5: Plot current and voltage

My graph