Diode

[note the definition of direction of voltage & current]

$V_D = V_A - V_C$

i_D = from A to C

* Diode is basically an electronic valve. It only allows current from A to C..

* So if current tries to flow from A to C [i.e. if $i_D > 0$], the device will act like a short circuit

Hence $V_D = 0$ in this condition. This is the FORWARD BIAS or ON mode.

Side note

For any circuit

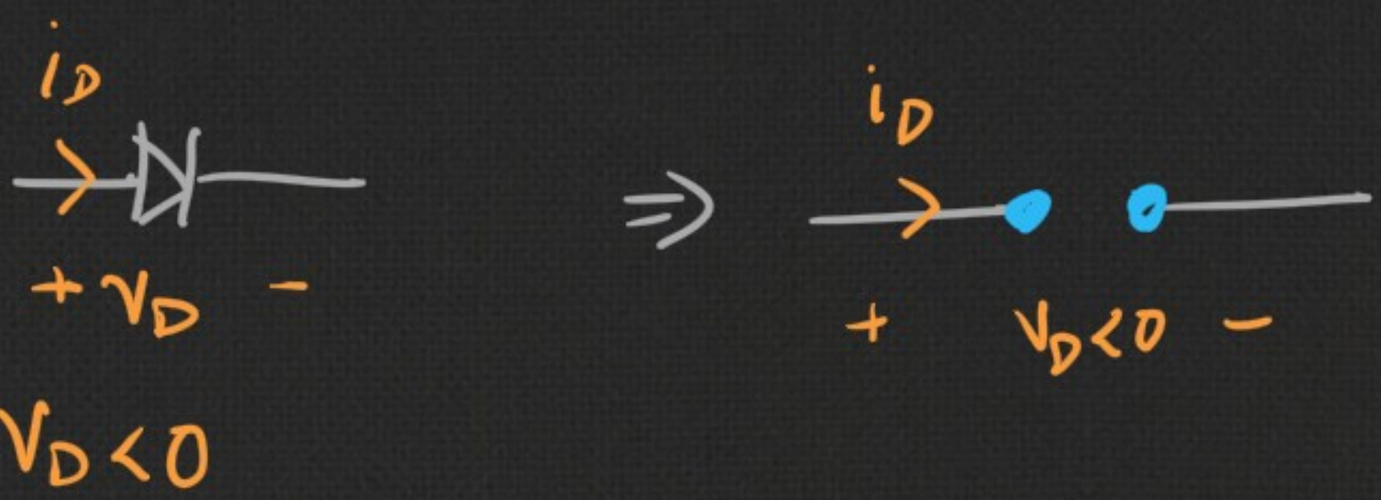
this means $V_1 = V_+ - V_-$

$\Rightarrow \boxed{V_1 = V_a - V_b}$

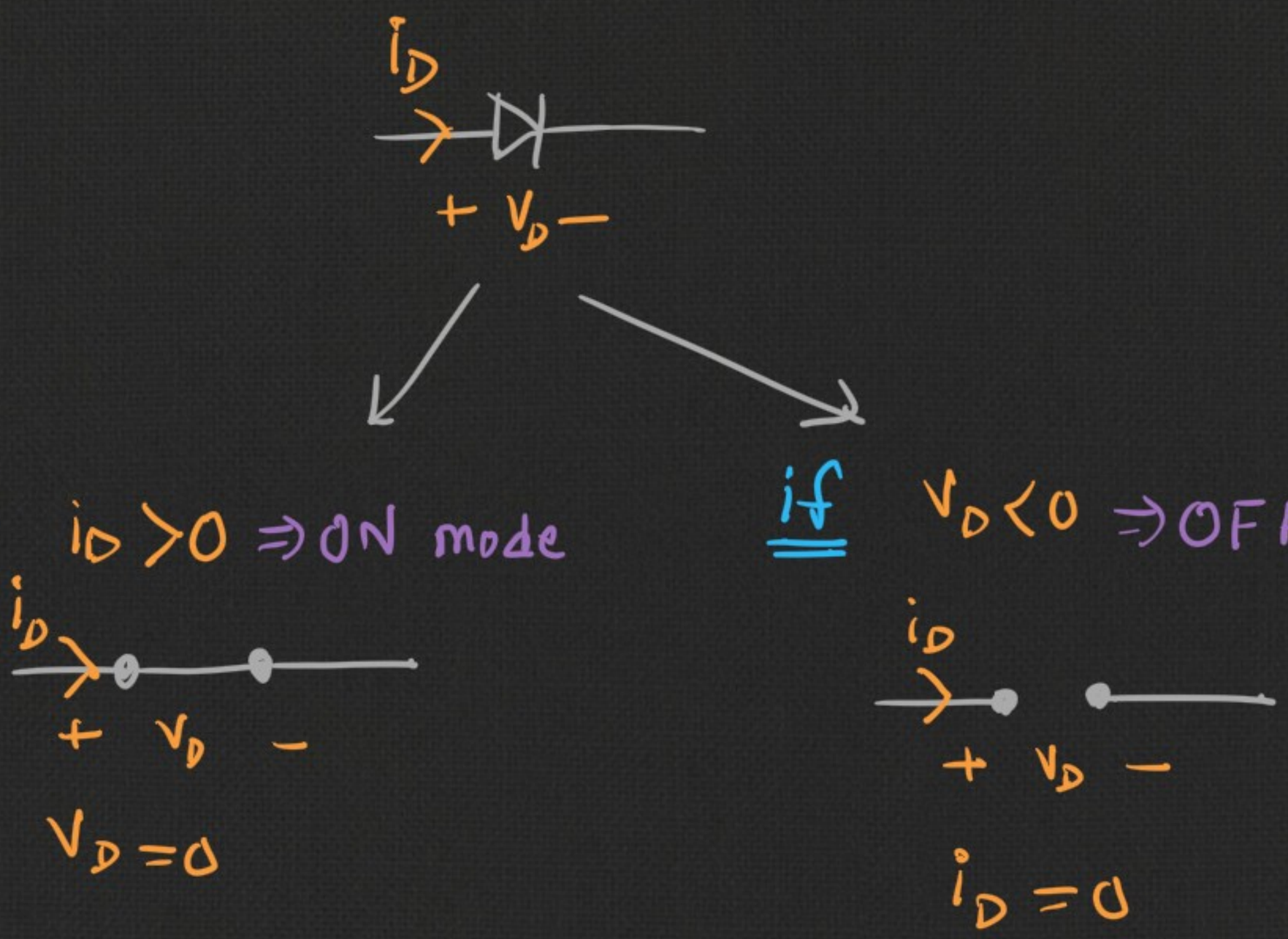
$V_2 = V_+ - V_-$

$\Rightarrow \boxed{V_2 = V_b - V_a}$

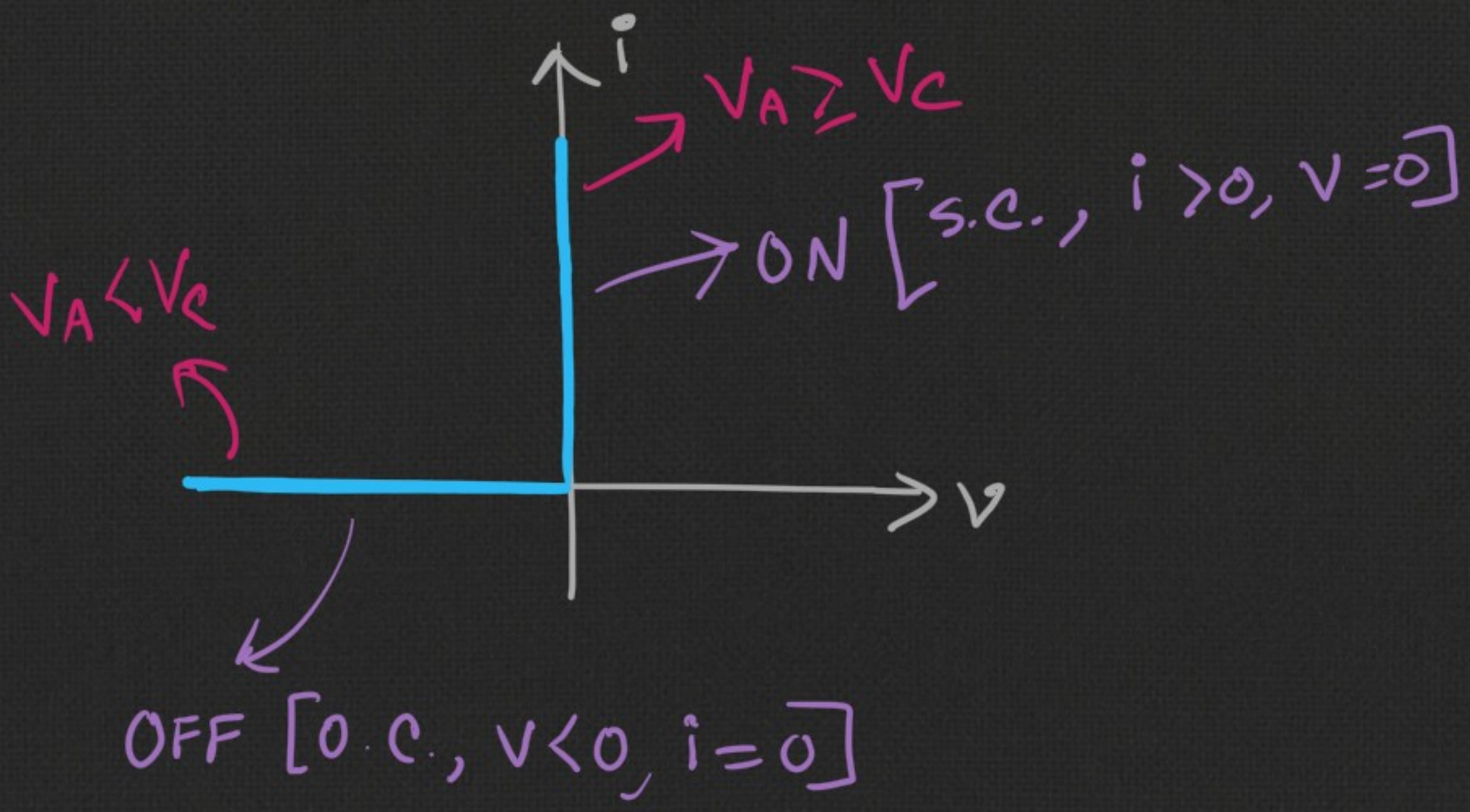
*On the other hand, if $V_D < 0$, the current will <u>try</u> to flow from C to A. But the diode won't allow such current, so it will act like an open circuit.



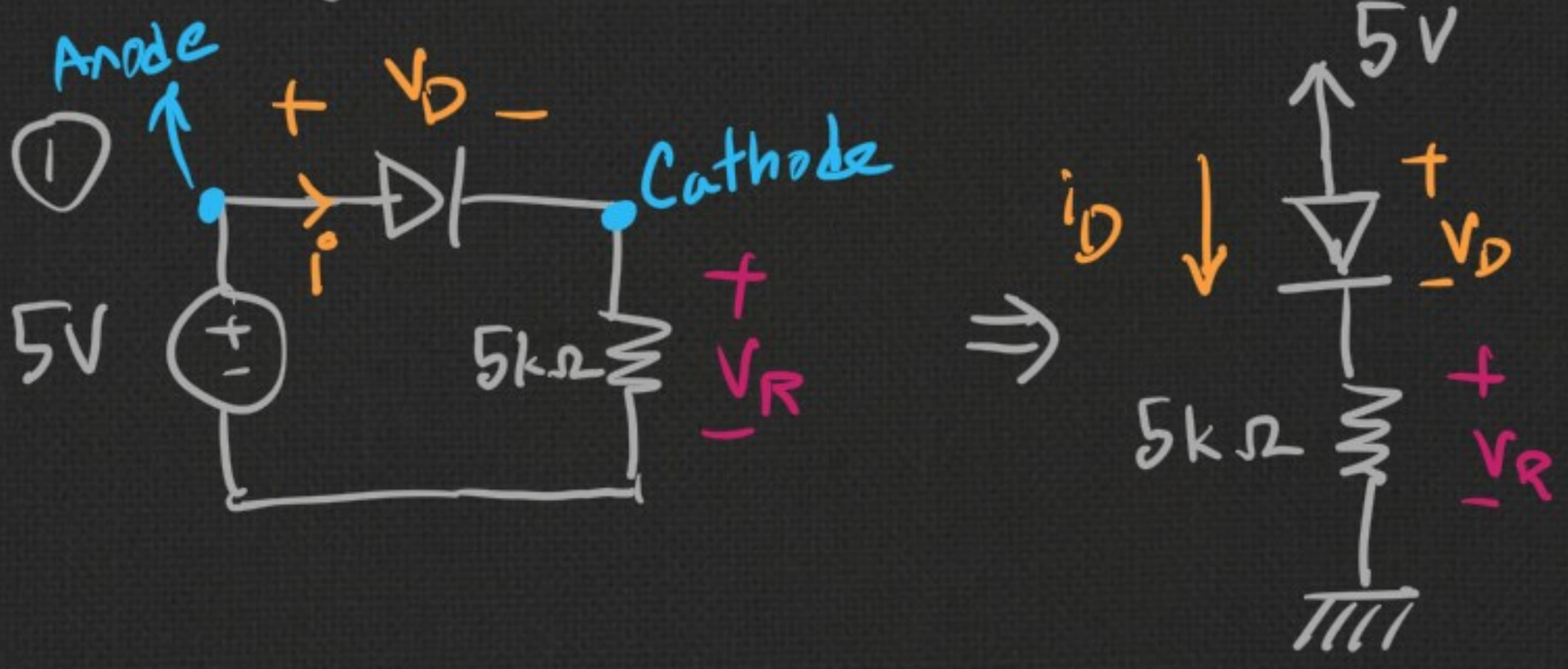
Hence $i_D = 0$ in this condition. This is called the REVERSE BIAS or OFF mode.



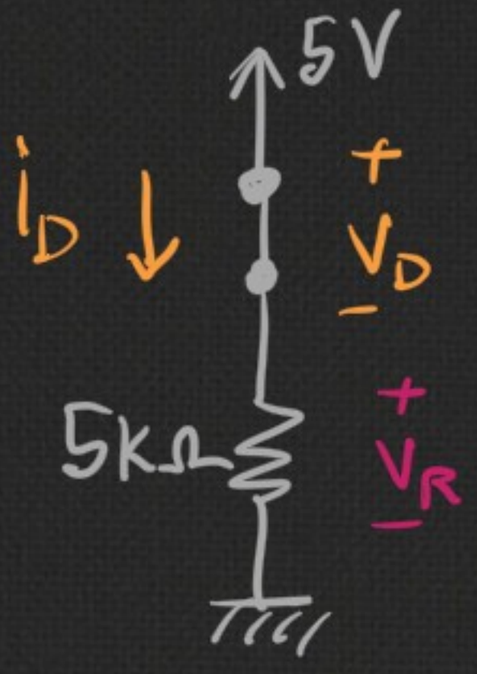
The corresponding IV curve:



Circuit example [DC]



Since 5V > 0V ⇒ current will try to flow from A to C ⇒ $i_D > 0$ ⇒ Diode ON



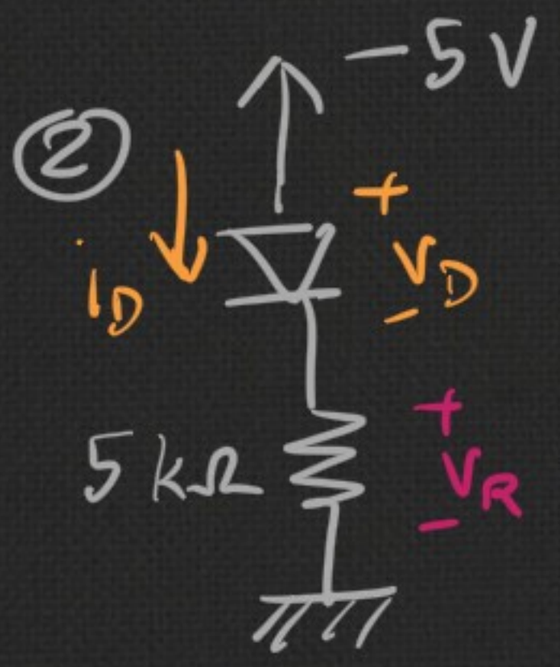
$V_D = 0$ [short circuit]

$V_R = V_C - 0 = V_C = 5V$

↑ Potential of cathode

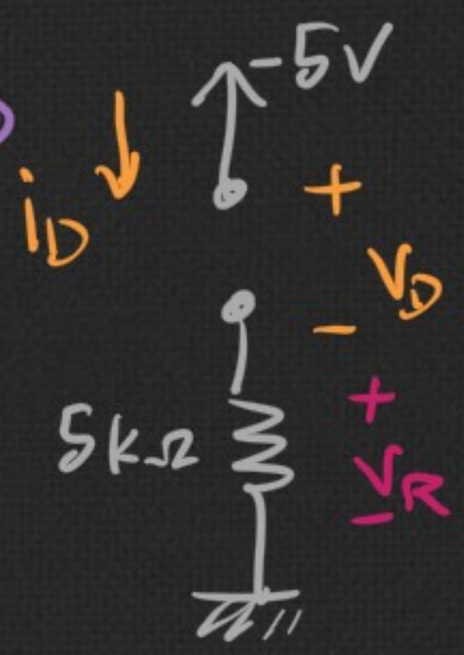
↖ Because cathode is shorted to 5V

$$i_D = \frac{V_R}{R} = \frac{5V}{5k\Omega} = 1mA$$

② 

Since $V_A < V_C \Rightarrow V_D < 0 \Rightarrow$ OFF mode

$V_A = -5V$ (−5V) ; $V_C \sim 0V$ (~0V)



$i_D = 0$ [open circuit]

$V_R = iR$

$= 0 \times 5k$

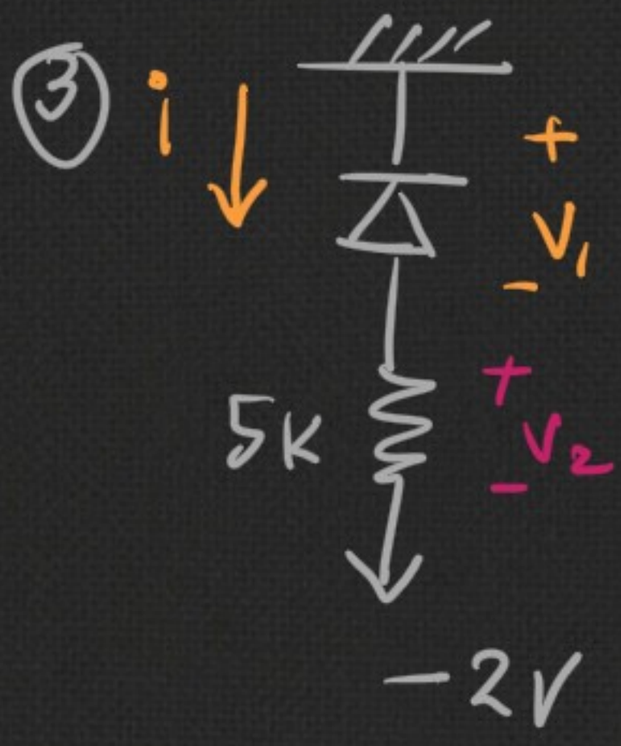
$= 0$

[Remember this!!!
if i through a R is 0, the voltage across two terminals will be equal]

$V_D = V_A - V_C$

$= -5V - 0V = -5V$

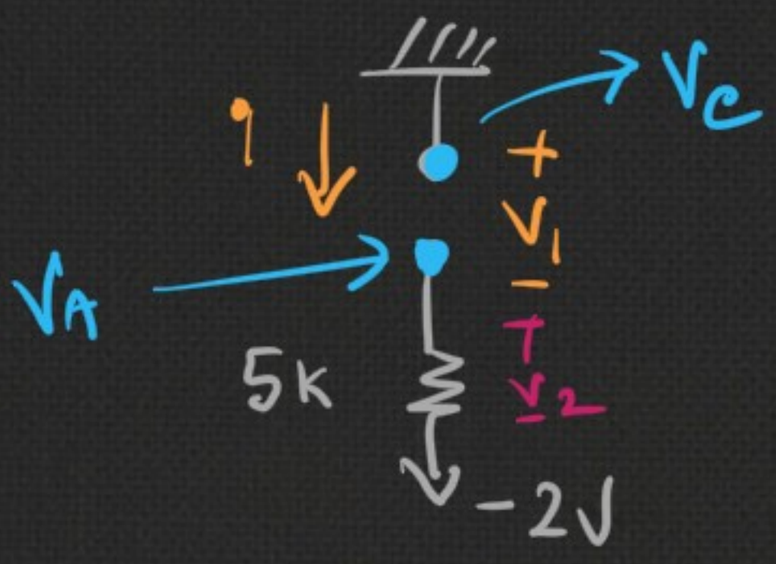
(source) (Resistance)

③ 

$V_A = 0V$ [Connected to GND]

$V_C \sim -2V$

So $V_D < 0 \Rightarrow$ OFF mode



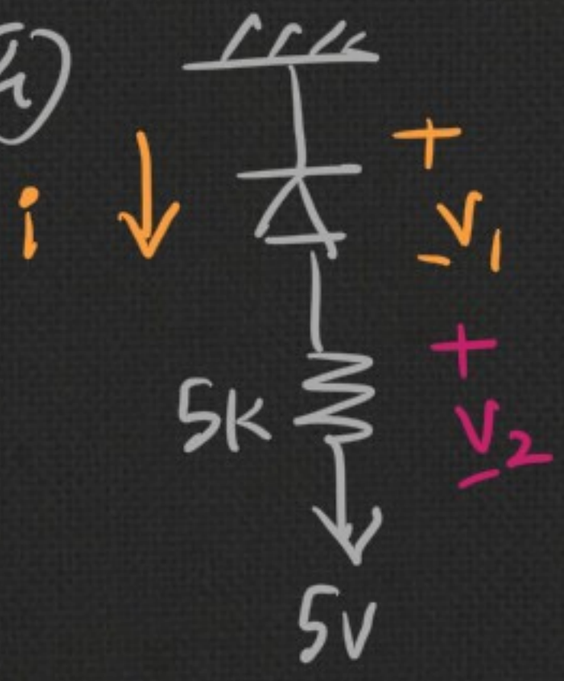
$i = 0$ [open ckt]

$V_2 = i \times R = 0 \times 5k = 0 \Rightarrow V_A = -2V$

Because the R is "shorted"

$V_1 = V_C - V_A = 0 - (-2) = 2V$

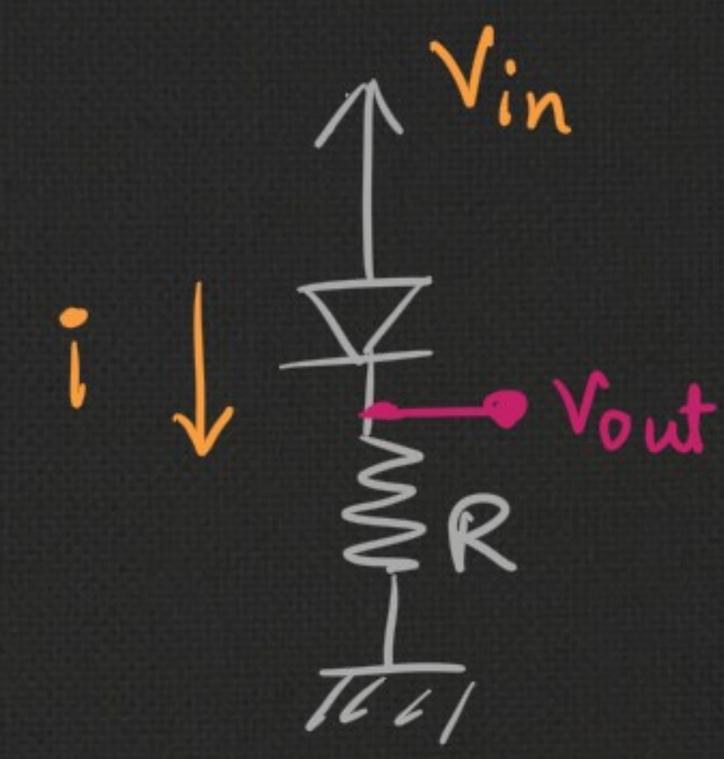
④

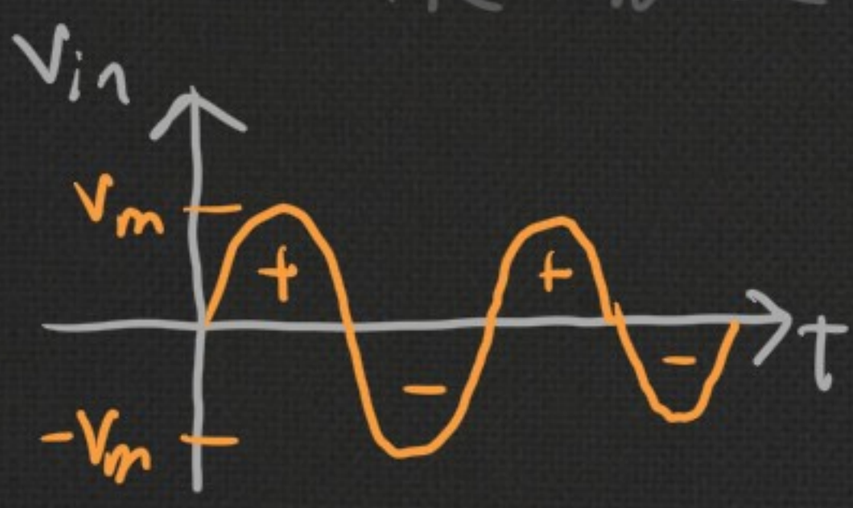


Find i, V_1, V_2. [Try yourself]

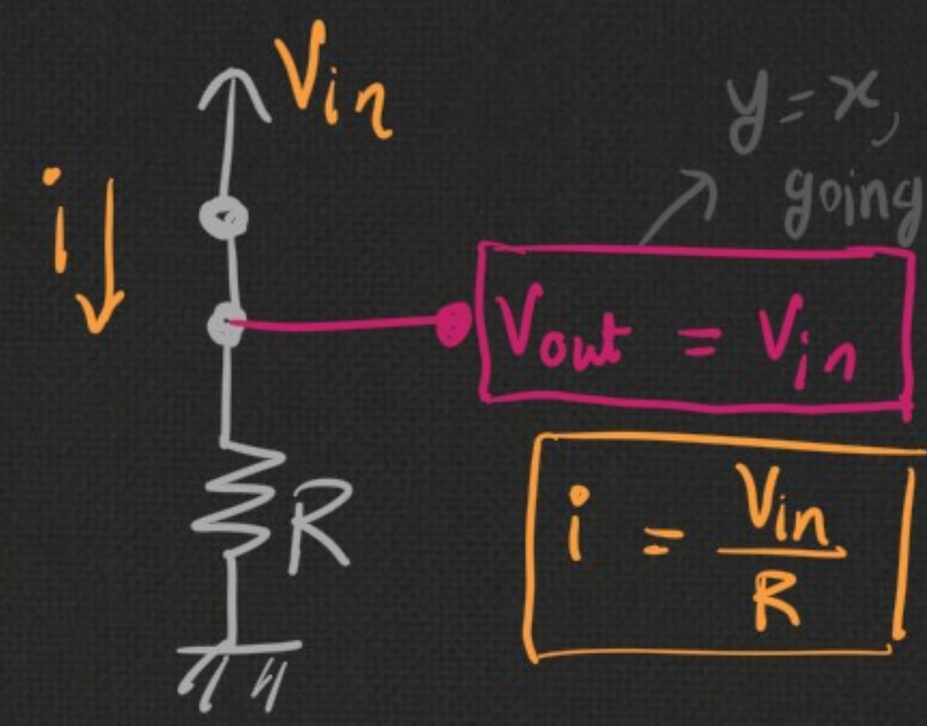
Simple Application : Half-wave rectifiers

First step to convert from AC to DC.



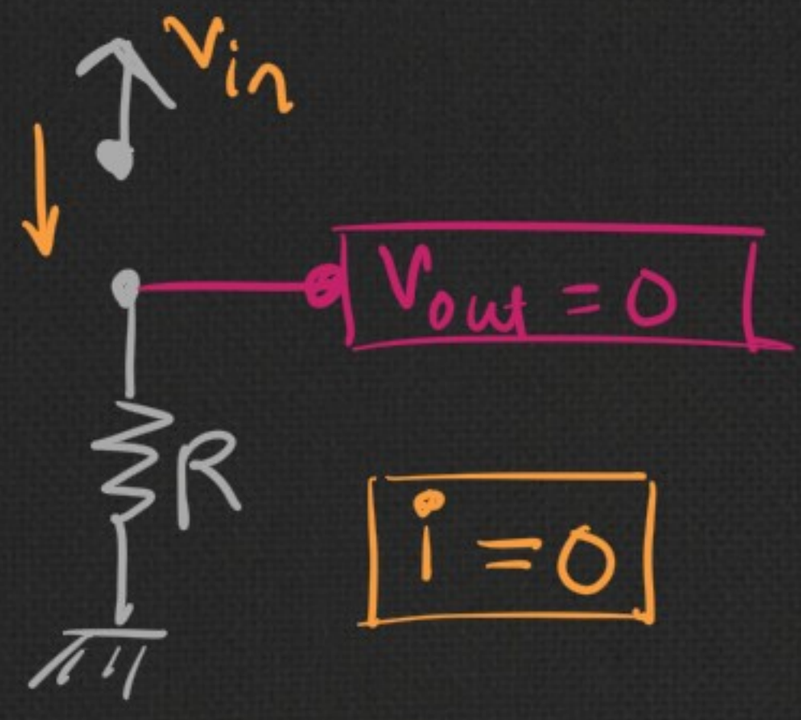


$V_{in} > 0$ [+ve half cycle]



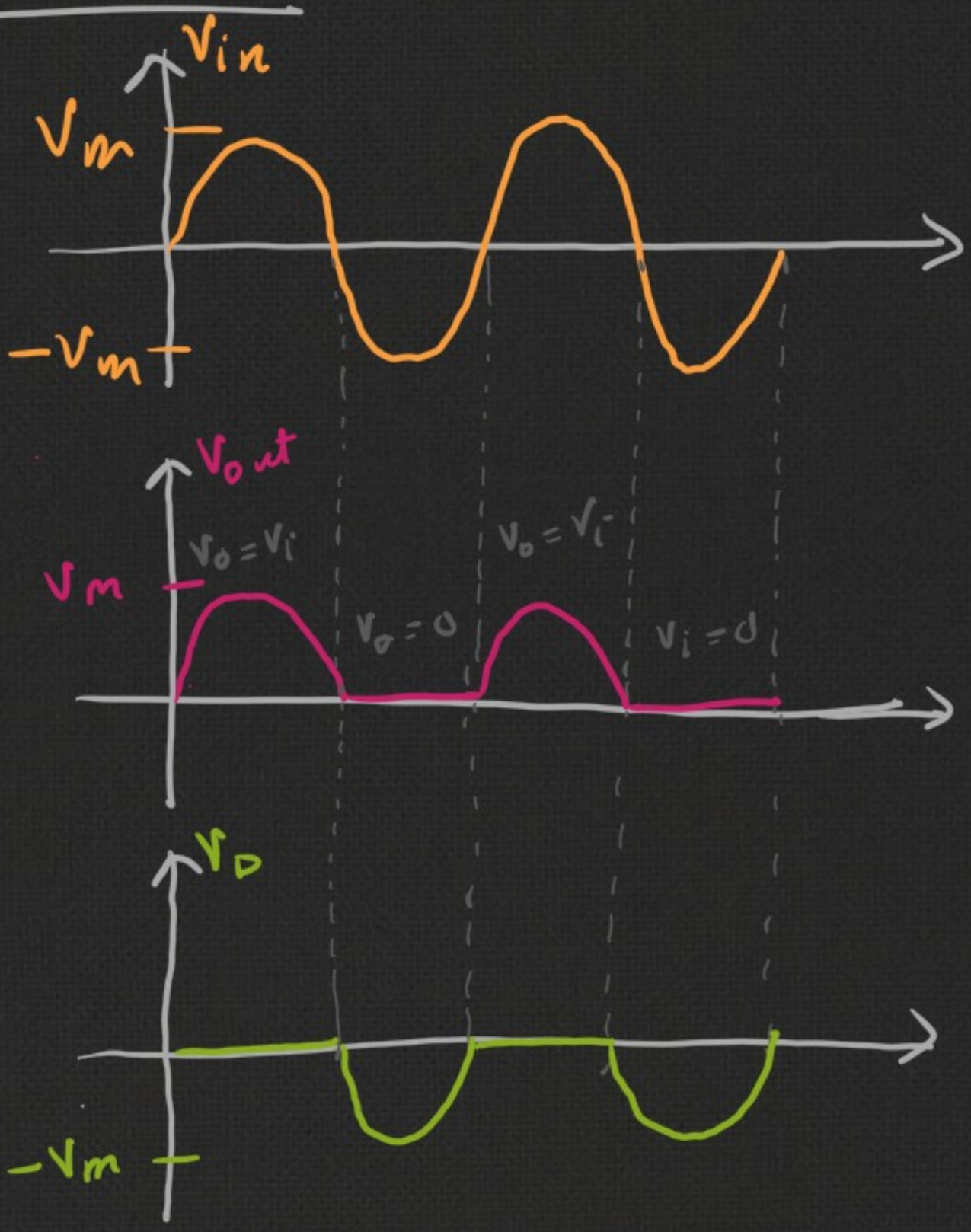
Diode is conducting

$V_{in} < 0$ [-ve half cycle]



Diode is not Conducting

waveforms



$$V_{in} = V_{out} + V_D$$

$$\Rightarrow V_D = V_{in} - V_D$$

Transfer Characteristics

⇒ x axis → input

⇒ y axis → output