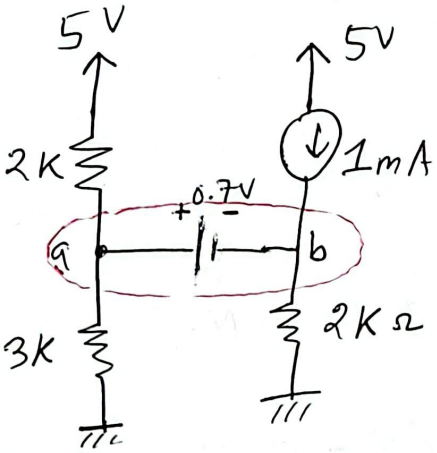
Set - A Quiz - 2

b D_1, D_2 cannot be ON at same time as otherwise V_{ab} would receive 0.7V and -0.7V drop at same time → impossible case!

if D_1 = ON, D_2 → off :



at super node:

$$\frac{V_a - 5}{2} + \frac{V_a}{3} + \frac{V_b}{2} - 1 = 0$$

$$\Rightarrow 3V_a - 15 + 2V_a + 3V_b - 6 = 0 \quad \text{— (1)}$$

and, $-V_a + 0.7 + V_b = 0$ — (2)

solving → $V_a = 2.8875\,V$

$V_b = 2.1875\,V$

Hence, I_{ab} = apply KCL at node $a = \frac{5 - V_a}{2K} + \frac{0 - V_a}{3K}$

$= 0.09375\,mA$

As we assumed D_1 to be on and $0.09375\,mA > 0$

hence, our assumption is true and correct for D_1.

As for D_2 → $V_{ba} = V_b - V_a = -0.7V \not> 0.7V$

hence D_2 is off as assumed.

(a) if both diodes disconnected:

$$V_a = 5 \times \frac{3}{3+2} = 3V$$

$$V_b = 2k \times 1m = 2V$$

(b) If two diodes are in opposite direction in series then overall network is off

Hence $\boxed{I_{ab} = 0\,A}$

Question No. 2

(a) for D1 and D2 → both can't be ON.

if D1 ON, D2 off : $V_{01} = (2 - 0.3) = 1.7\,V$ ↓

$V_{01} = 1.7$ doesn't turn on D2 as

$(2.2 - 1.7) = 0.5\,V < V_{D2}$

Hence assumption ok → $V_{01} = 1.7\,V$

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for D_3, D_4 : both can't be ON.

if D_3 ON, D_4 off → $V_{02} = (2.4 - 0.5) = 1.9\,V$

as for D_4 → $(2.5 - 1.9) = 0.6\,V < V_{D4}$

hence, assumption ok → D_4 stays off. $V_{02} = 1.9\,V$

(b) $V_{DD} = 5V$ here. $V_{O1} = 1.7V$, $V_{O2} = 1.9V$

analyze before any current flow occurs in D_5, D_6 →

D_5, D_6 can't stay ON at same time as V_o would receive 2 different node voltages.

if D_5 ON, D_6 off :

$$V_o = V_{D5} + V_{O1} = 1 + 1.7 = 2.7V$$

for D_6 → $(V_o - V_{O2}) = (2.7 - 1.9) = 0.8V < 1V$

hence, D_6 stays off as assumed.

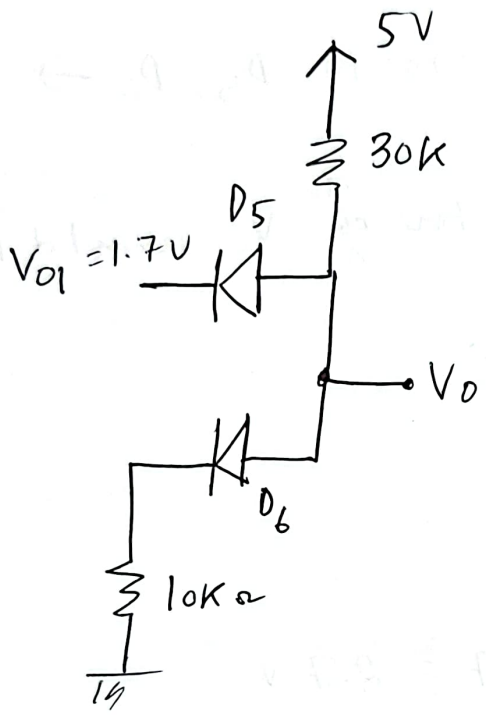
Hence, $\boxed{V_o = 2.7V}$

(c) if $V_3 = -2V$, $V_4 = -3V$:

~~if V_3 ON, D_4 off D_3 V_{O2} $(-2 - 0.7) = -2.7V$~~

No diode can get ON because D_3, D_4 both are in reverse biased state.

from ① → $V_{01} = 1.7V$,



if D_5 ON, D_6 off → $V_o = 1.7 + 1 = 2.7V$

↓

turns on D_6 as well.

Hence, D_5 can't be on.

if D_5 = off, D_6 = ON!

$$I_{D6} = \frac{5 - V_{D6}}{10K + 30K} = 0.1\ mA$$

hence, $V_o = KVL = (0.1m \times 10K) + V_{D6} = 2V$

$V_o = 2V$ → does not turn D_5 ON as $(2 - 1.7) < V_{D5}$

Hence this assumption → correct.

$$V_o = 2N.$$