Prelab 4

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S3

A/

$$(C_1 // C_2) + C_3 = C_{eq}$$

$$\frac{(1+10^{-6} + 1\times10^{-6}) \times 10^{-6}}{(1\times10^{-6} + 1\times10^{-6}) + 10^{-6}} = \frac{2}{3} \times 10^{-6} F.$$

B/

$$\tau = R_1 . C_{eq} =$$
$$= 10^{3} . \frac{2}{3} 10^{-6}$$
$$= 0,67 \cdot 10^{-3} s$$

c) .

1) charging.

we apply KVL to the circuit:

$$V_{in} = V_c + V_b = V_c + R_1 i$$

$$V_{in} = V_c + R_1 C_{eq} \frac{d v_c}{dt}$$

$$\frac{V_{in}}{RC} = \frac{d v_c}{dt} + \frac{V_c}{\tau} \Rightarrow V_c(t) = A e^{-t/\tau} + V_{in}$$

At $t = 0$; $V_c(t) = 0V \Rightarrow V_{in} = -A$.

$$\Rightarrow V_c(t) = -V_{in} e^{-t/\tau} + V_{in} = V_{in}(1 - e^{-t/\tau}) .$$

$$i(t) = \frac{V_{in}}{R}(1 - e^{-t/\tau}) .$$

2) discharging.

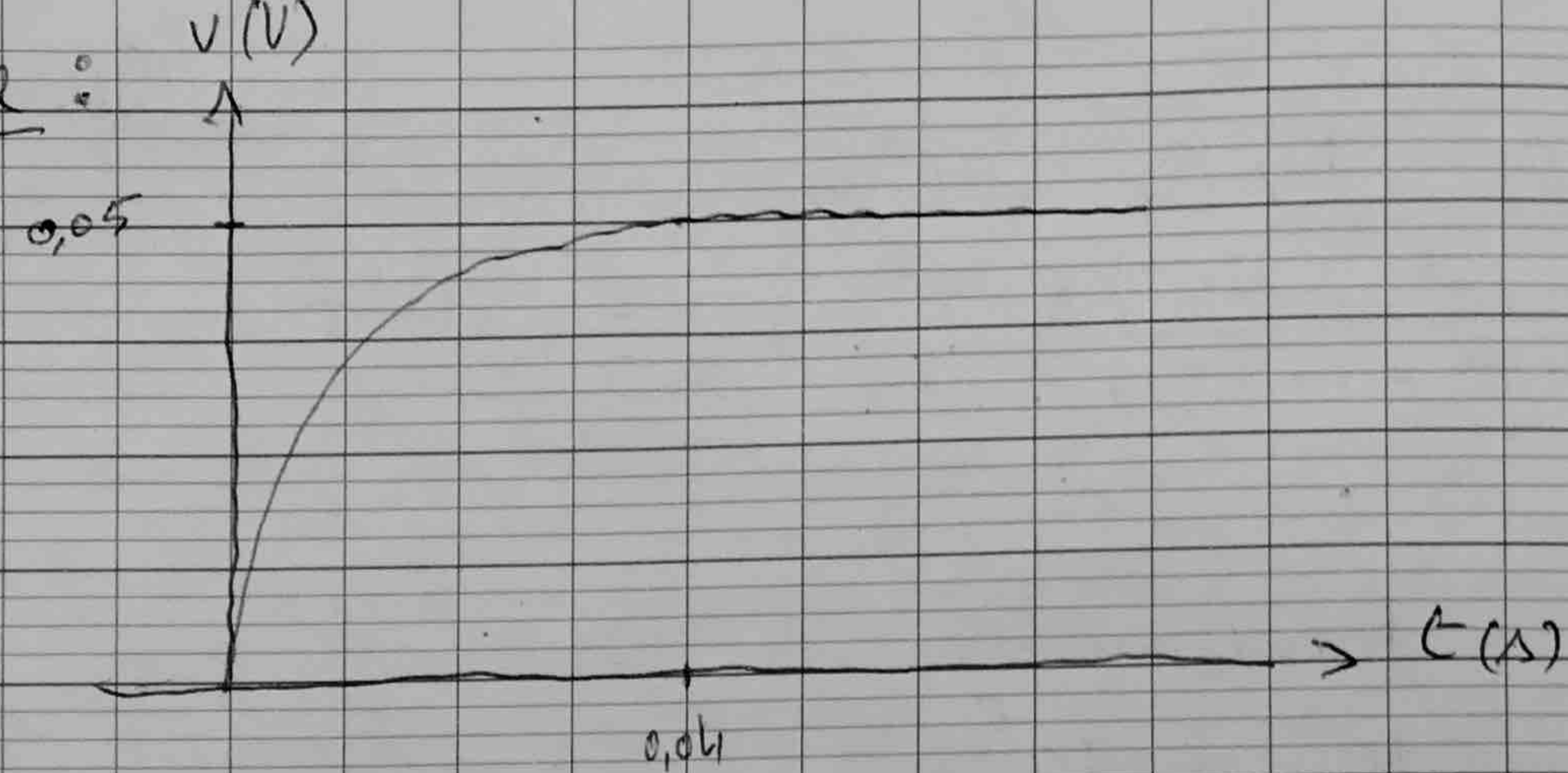
we apply KVL . $V_c + V_b = 0$

$$\Rightarrow V_c + RC \frac{dV_c}{dt} = 0$$ the solution is $V_c = A e^{-t/\tau}$

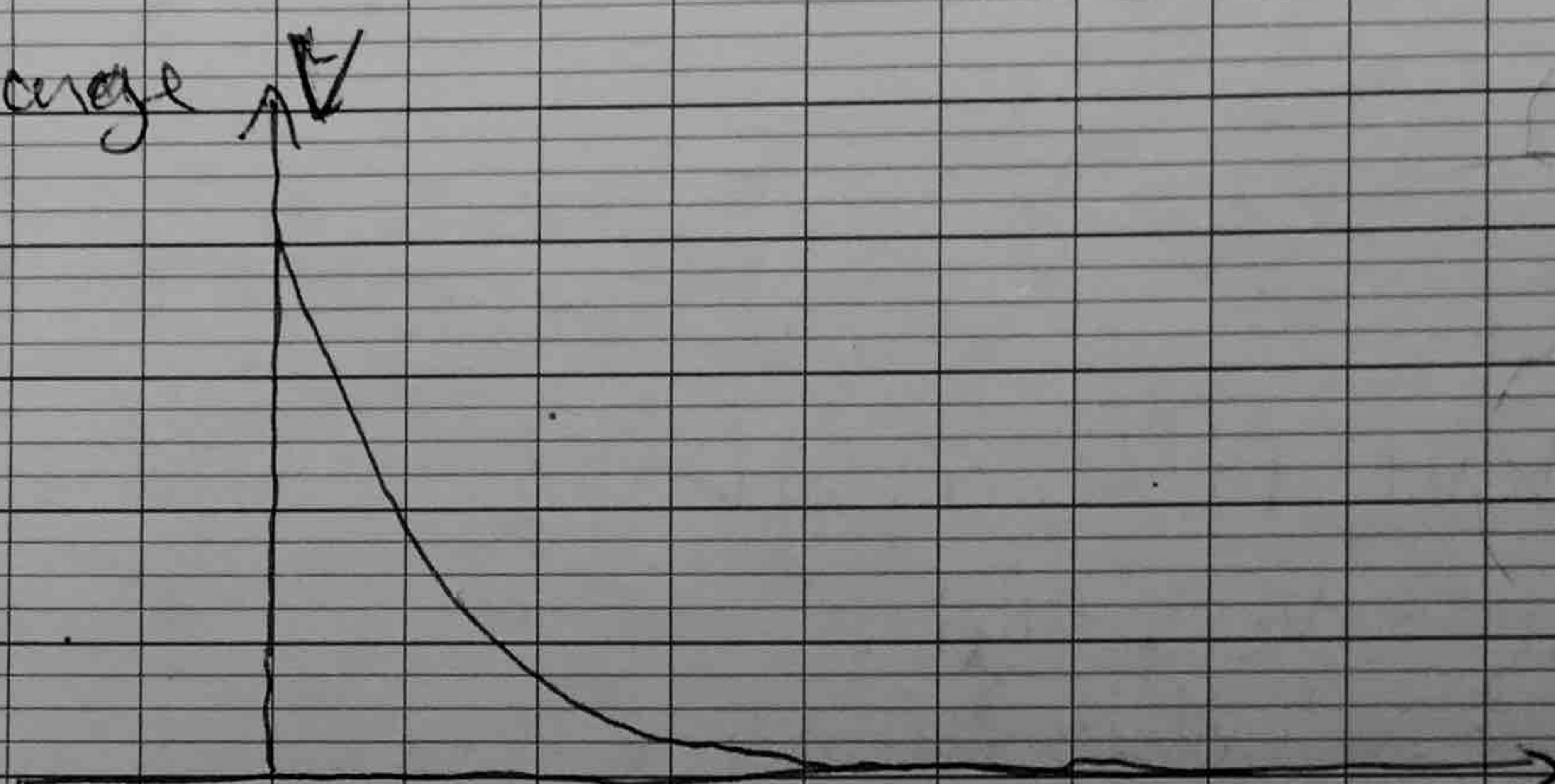
at $t = 0$; $V_c = V_{in}$

$$\Rightarrow V_c = V_{in} e^{-t/\tau} \; ; \; i(t) = \frac{C dV_c}{dt} \Rightarrow i(t) = \frac{-V_{in}}{R} e^{-t/\tau}$$

charge :



Discharge



charge :

t	t/τ	$v(t)/v_c$	$i(t)/i_c$
0,335	0,5	39,3%	60,7%
0,495	0,7	50%	50%
0,67	1	63,21%	36,8%
1,34	2	86,46%	13,54%
2,01	3	95,02%	4,9%
2,68	4	98,16%	1,84%
3,35	5	99,3%	0,7%

discharge

t	t/τ	$v(t)/v_c$	$i(t)/i_c$
0,0335	0,5	60,7	39,3 %
0,499	0,7	50	50 %
0,67	1	36,7	63,21 %
1,34	2	13,5	86,46 %
2,01	3	4,9	95,02 %
2,68	4	1,8	98,16 %
3,35	5	0,67	99,3 %

E/

Applying ohm's law :

$$V_o = Ri = RC \frac{dV_{in}}{dt}$$

At $t = 0{,}003$ ms. V_{in} goes to zero

$V_{in} \longrightarrow 0V. \Rightarrow V_{in} \simeq 0V$

$$\Rightarrow \frac{dV_{in}}{dt} \longrightarrow -\infty$$