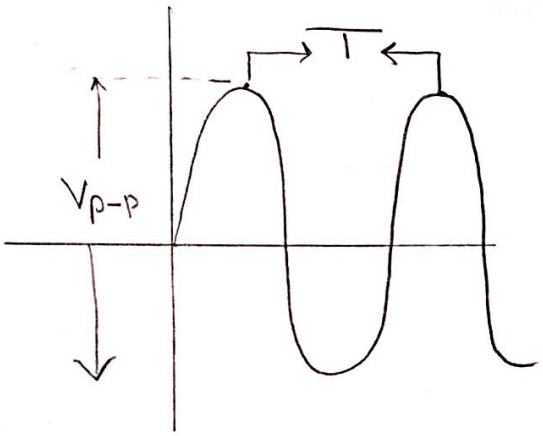
The Cathode-Ray Oscilloscope (CRO)

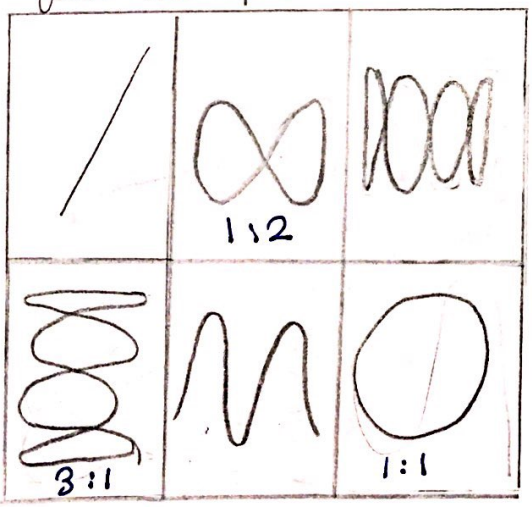
used for :
1- measuring the peak to peak voltage V_{p-p}
2- measuring the frequency of a sinusoidal signal supplied by a signal generator
3- To display lissajous figures



$f = \frac{1}{T}$ (frequency)

$V_p = \frac{V_{p-p}}{2}$

lissajous figures
for example



- farmes of waves
  - Sine wave
  - Square wave
  - Triangle wave
  - Saw tooth

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⟹

- CRO can display graphs of potential differe... Vs. time
- it can be used to measure AC and DC voltages
- Can misure amplitude & frequency of a given AC signal As well as the phase (Φ) betwee two AC Signals

Structure

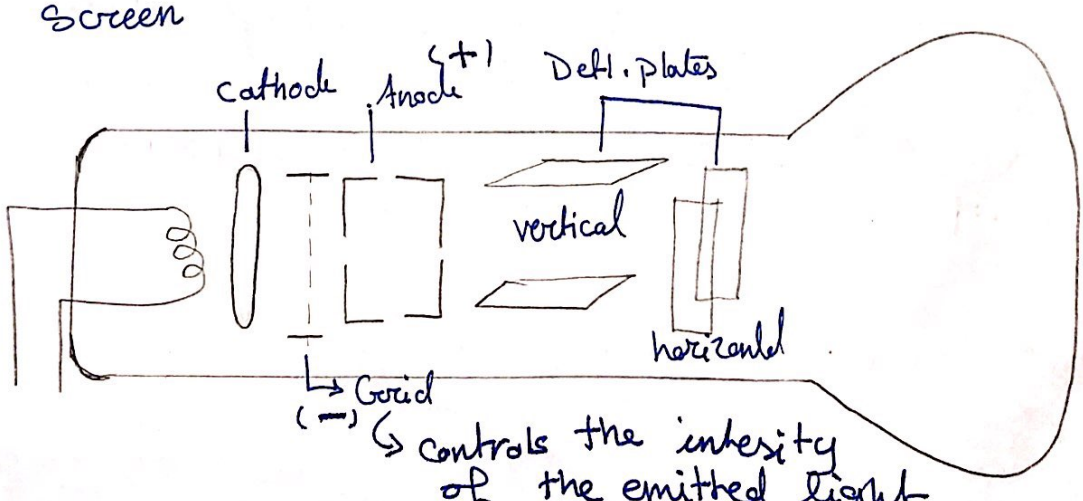
cathode Ray Tube (CRT)

1- evacuated glass tube
2- Cathode and Anode
3- Deflection plates
4- Grid (charged -)
5- Vertical and horizontal deflection plates

The process :-

① filaments heates the cathode ⟹ ② electrons are emitted by the cathode ⟹ ③ electrons are accelerated due the high positive potential at the accelerating anode

⟹ ④ electrons move toward the florescent screen ⟹ ⑤ electrons hit the screen ⟹ ⑥ The material covering the screen emits light



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RC Circuit using Oscilloscope

- measuring τ and $t_{1/2}$ using a signal generator and and a CRO

- Connecting a signal generator and R and C on series
- (provides a square wave voltage to the circuit)

$$t_{\frac{1}{2}} = RC \ln 2$$

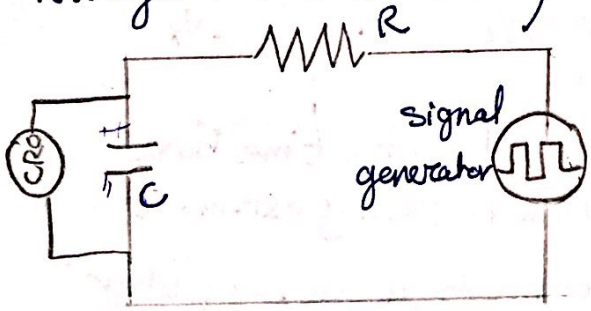
$$t_{\frac{1}{2}} = \tau \ln 2$$

$$V(t) = \frac{Q_0}{C}(1 - e^{\frac{t}{RC}}) \quad \text{(charging)}$$

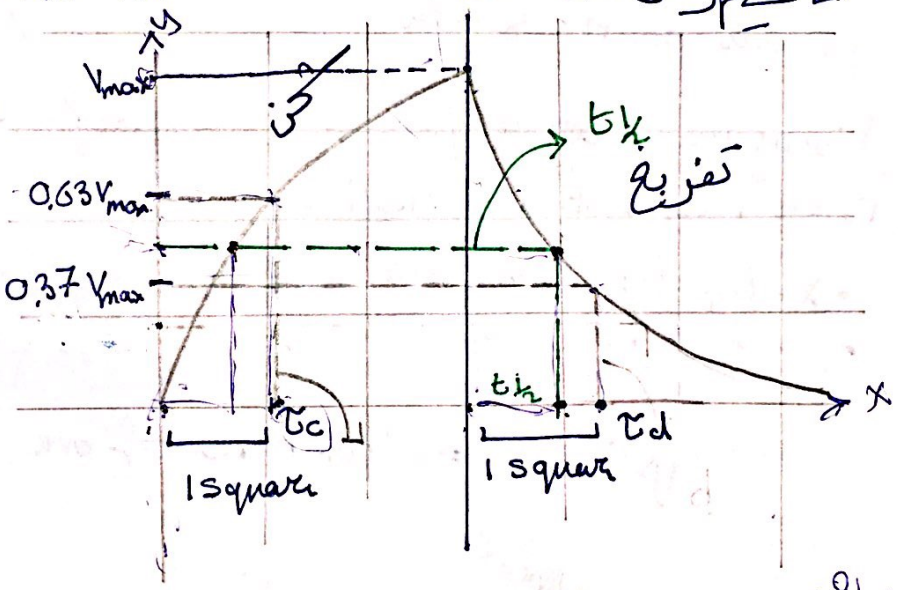
$$V(t) = \frac{Q_0}{C} e^{\frac{t}{RC}} \quad \text{(discharging)}$$

$\tau_c = 0.63 V_{max}$

$\tau_d = 0.37 V_{max}$



-: CRO على الشاشة ما نظهر



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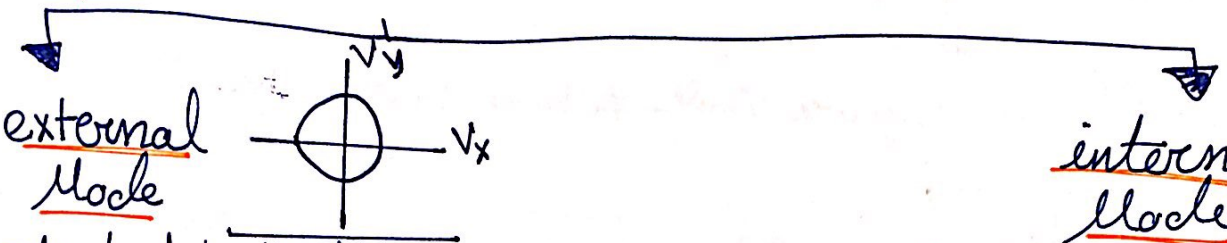
To summerize the process :- 6 steps

Cathode is heated → electrons are emitted → electrons are accelerated → electrons move toward the screen → electrons hit the screen → screen emits light

Modes of the CRO

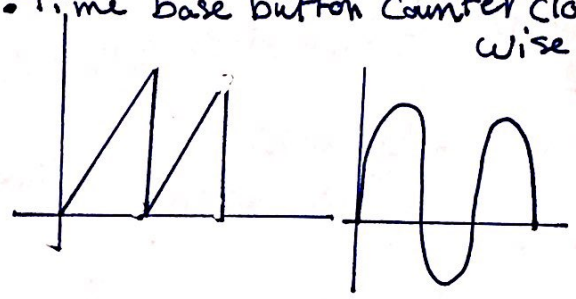


external Mode

- selected by the time base button to the x-y ext. mode
- screen acts as an x-y plotter
- The Voltage .Vs Time plot appears on the screen
- lissajous figures
- Time base button clockwise

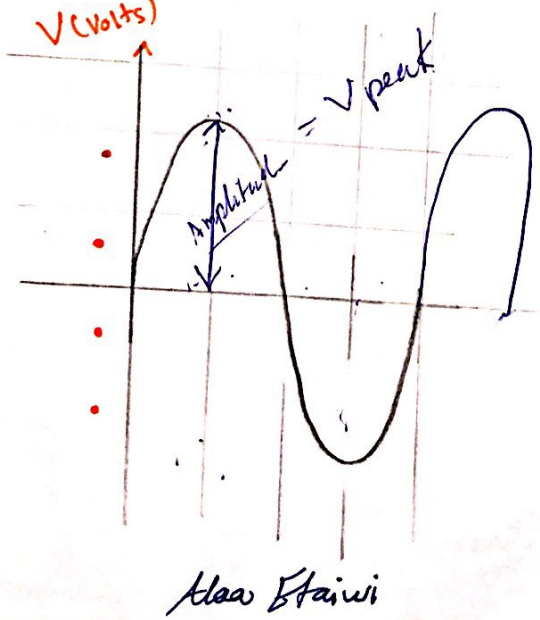
internal Mode

- x-axis becomes a time axis
- a sawtooth ~~wave~~ potential difference
- Time base button counter clock wise



- x- input :- recieves external signals
- y- " :- " " " "

T (period) = No of boxes of one Wave x time base Reading



$V_{p-p} = 4 \times 1$ Volts

$= 4$ Volts

$T = 4 \times 1$ se

$= 4$ sec

In case That Time base Reading is

1 Volts/ square

1 sec / square

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