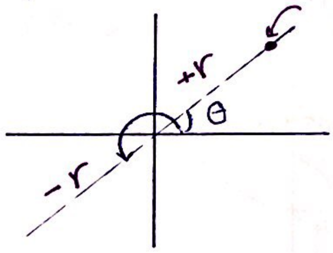
11.4

Graphing in Polar Coordinates

To Graph in Polar Coordinates you need to Remember :-

- That point can be written as:-

(r, θ) , $(-r, \pi+\theta)$



Note: In Cartisian origin $(0, 0)$
But In Polar origin $(0, \theta_0)$ where θ_0 can be any angle

How to Graph

- Table
- symmetry
- By drawing r] → The most efficient

1- Table :-

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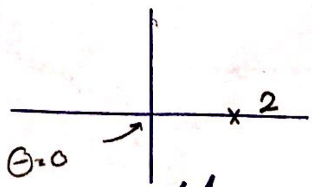
$r = 1 + \cos\theta$

θ	$r = f(\theta)$
0	2
$\pi/2$	1
π	0
$3\pi/2$	1
2π	2

- Notice that r is the distance from the origin

step 1:-



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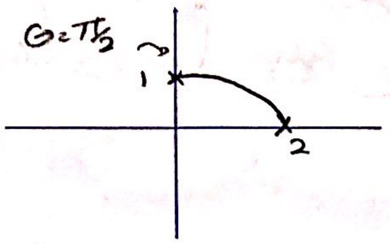
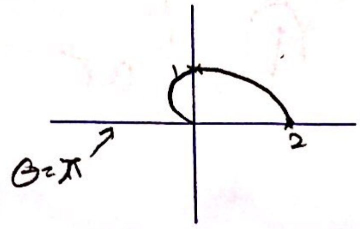
step 2:-

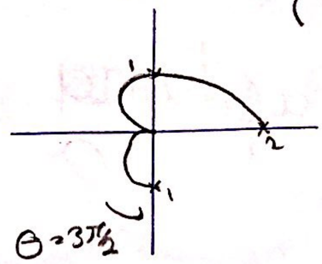


step 3:

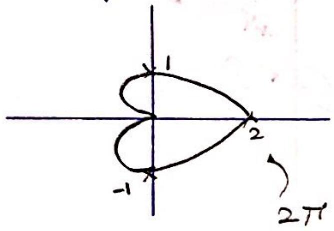


step 4:-

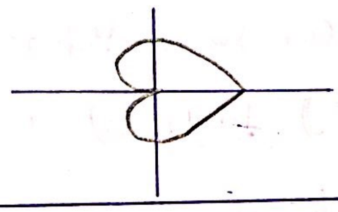
$(1, 3\pi/2)$



step 5:-



final shape



There is a symmetry around x-axis

2- Using the Graph of r

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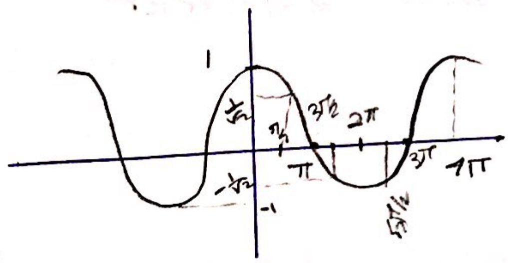
$r = \cos(\theta/2)$

الدورة الجديدة : $\frac{2\pi}{\frac{1}{2}} = \boxed{4\pi}$

عندما تغير معامل الزاوية يبقى الجتا محصوراً بين (-1) و(1).



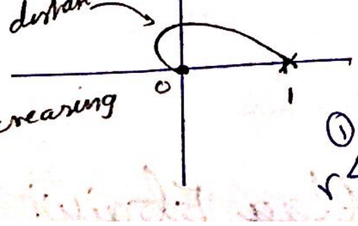
Now you look at the change in r
(decreasing , increasing ——)

step 1

from $0 \to \pi$

③ الربع ① ، ②

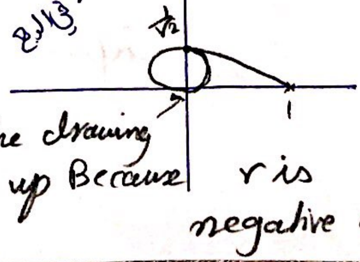
the distance is decreasing



step 2

from π to $\frac{3\pi}{2}$

③ الربع ③ ، وبعد التحويل ① لأنه $r<0$

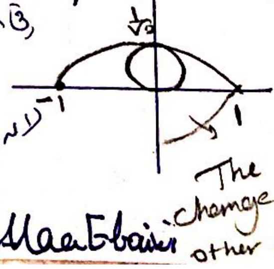


The drawing is up Because r is negative at $3\pi/2$

step 3

from $3\pi/2 \to 2$

③ الربع الرابع ، ويكون الصفر ③ الثاني لأن $r<0$



The change goes to other side

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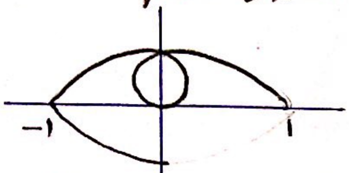
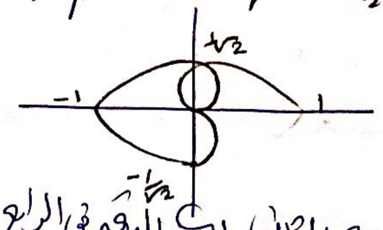
step 4 from $2\pi \rightarrow 5\pi/2$



في الربع الأول ولكن التغير في الثالث

decreasing in negative

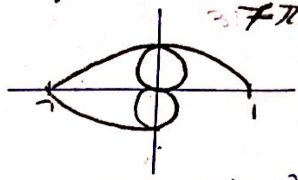
step 5 from $5\pi/2 \rightarrow 3\pi$



في الربع الثاني لكن التغير في الرابع

لأنه $r<0$

step 6 from $3\pi \rightarrow 7\pi/2$

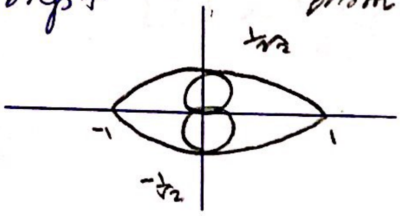


في الربع الثالث

والتغير في الثالث

لأنه $r>0$

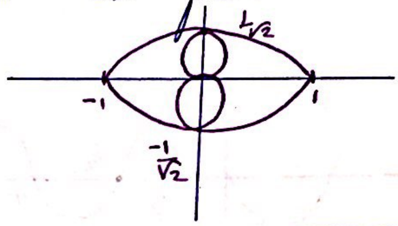
step 7 from $7\pi/2 \rightarrow 4\pi$



في الربع الرابع والتغير في الرابع

لأنه $r>0$

- final shape :-



3- symmetry :- it can help you

about x-axis

- if (r, θ) is on the Graph Then $(r, -\theta)$ or $(-r, \pi-\theta)$ is on the Curve

about y-axis

- If (r, θ) is on the Graph then $(-r, -\theta)$ or $(r, \pi-\theta)$ is on the Graph

about origin

- if (r, θ) is on the graph then $(-r, \theta)$ or $(r, \pi+\theta)$ is on the Graph

- If the Conditions above are proved There is a symmetry

if not we have No info (it doesnt mean there is no symmetry)

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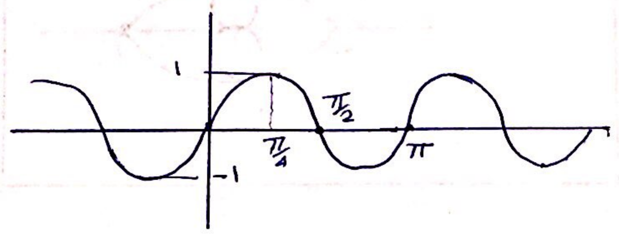
Additional Graph

Outline → $\boxed{15}$ page 634

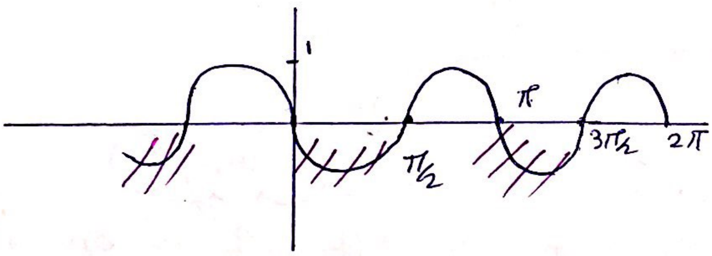
$r^2 = -\sin 2\theta$

$r = \pm\sqrt{-\sin 2\theta}$

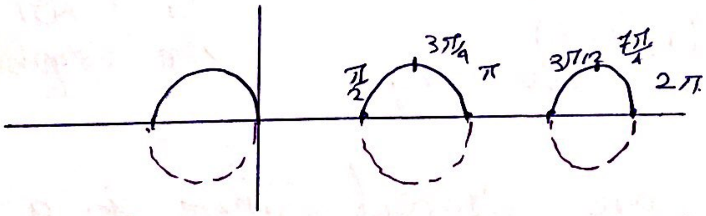
- first: Draw $\sin 2\theta$ New period: $\frac{2\pi}{2} \to \boxed{\pi}$



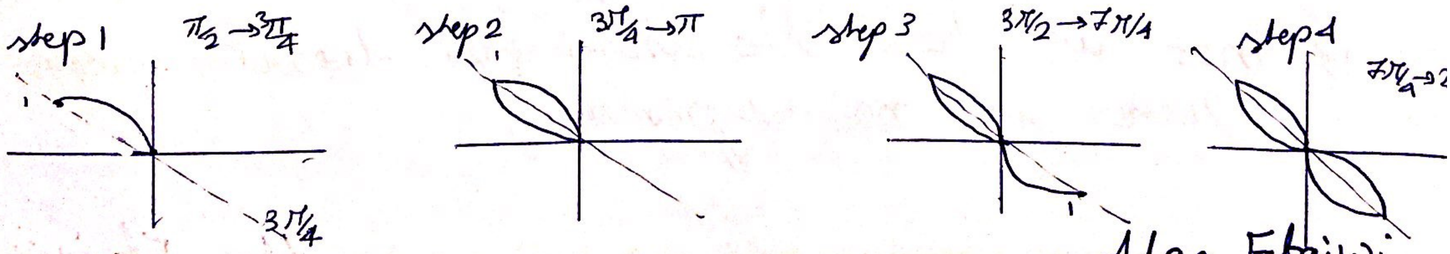
- Then:- Draw $-\sin 2\theta$ and take only positive parts ($\sqrt{-\sin 2\theta}$)



- Then: Draw $+\sqrt{\sin 2\theta}$ and $-\sqrt{\sin 2\theta}$



In Polar :-



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