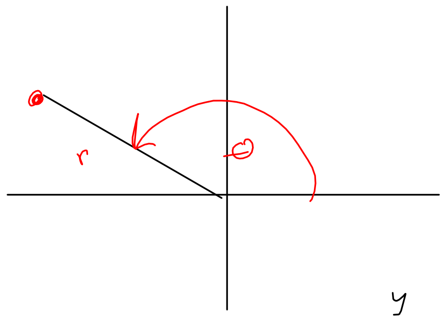
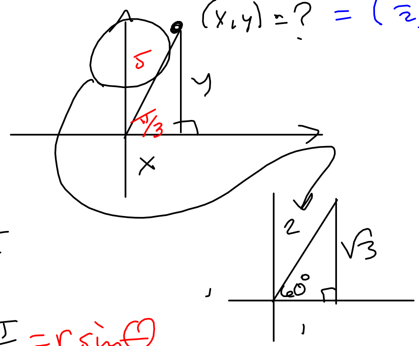
$r = 2\sin\theta + 1$ in polar coordinates

$(r, \theta) = (5, \frac{\pi}{3})$



$(x, y) = ? = (\frac{5}{2}, \frac{5\sqrt{3}}{2})$



$\frac{y}{5} = \sin\frac{\pi}{3}$

Similar triangles

$2 \longrightarrow 5$

$2 \cdot \frac{5}{2} = 5$, so

$\frac{5}{2}\sqrt{3}$

$1 \cdot \frac{5}{2} = \frac{5}{2}$

$\Rightarrow y = 5\sin\frac{\pi}{3} = r\sin\theta$

$= 5 \cdot \frac{\sqrt{3}}{2} = \frac{5\sqrt{3}}{2}$ 2 $\sqrt{3}$

$\frac{x}{5} = \cos\frac{\pi}{3}$

$x = 5\cos\frac{\pi}{3} = r\cos\theta$

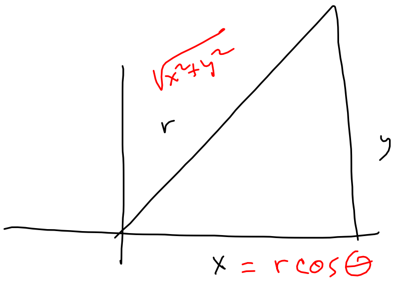
$= 5 \cdot \frac{1}{2} = \frac{5}{2}$

$x = r\cos\theta$

$y = r\sin\theta$

$r^2 = x^2 + y^2$

$\tan\theta = \frac{y}{x}$

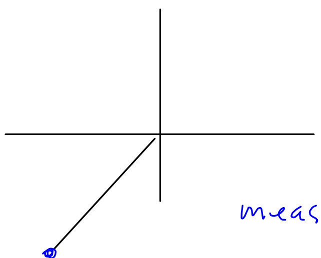


$y = r\sin\theta$

$x = r\cos\theta$

Before today $r \geq 0$, always. Now, not so much.

Consider $(-5, \frac{\pi}{3})$ in polar coords.



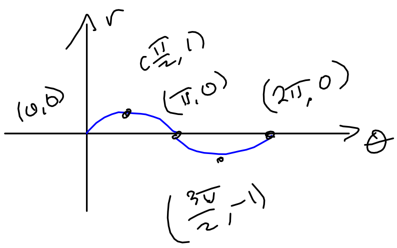
$(-5, \pi/3)$

measure the $-r$ by reflecting thru the origin.

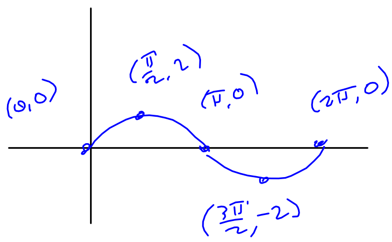
SPIROGRAPH!!!!

Graph $r = 2\sin(x)+1$

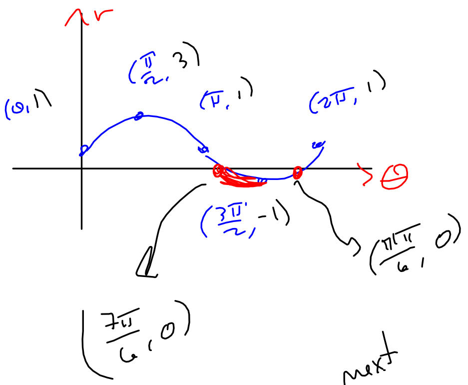
1. Graph in Rectangular Coords.
2. Interpret to go to Polar coords



$2\sin(x)$



$2\sin(x)+1$



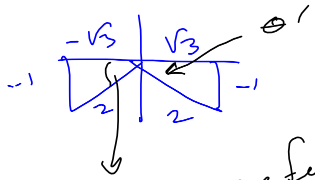
$2\sin(x)$

Intercepts!

$2\sin(x)+1=0$

$2\sin(x)=-1$

$\sin(x)=-\frac{1}{2}$

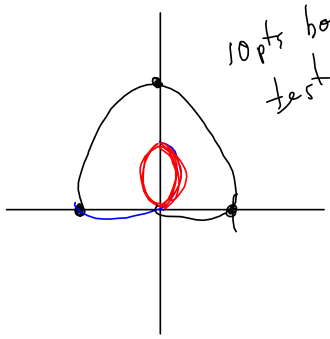


$\theta' = 30^\circ$ or $\frac{\pi}{6}$ = reference angle

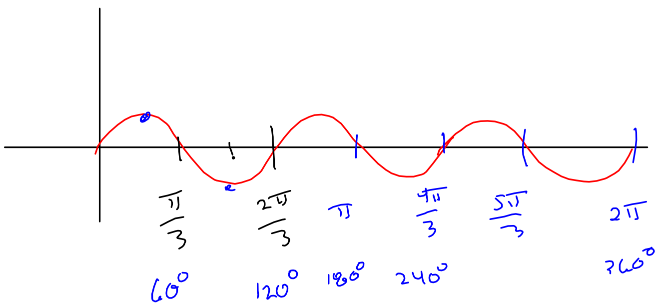
$\Rightarrow \theta = 210^\circ = \frac{7\pi}{6}$

OR $330^\circ = \frac{11\pi}{6}$

10pts bonus, on next test, at least.



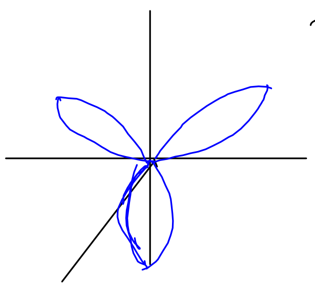
$r = \sin(3x)$ A rose!



$3x = 2\pi$ when $x = \frac{2\pi}{3}$ = Period

i.e. if we run x from 0 to 2π, then this thing will complete 3 full periods

3-petal rose.



$z = 16\left(\cos\frac{5\pi}{3} + i\sin\frac{5\pi}{3}\right)$

$\Rightarrow \sqrt[4]{z} = \sqrt[4]{16}\left(\cos\left(\frac{5\pi}{3}\cdot\frac{1}{4}\right) + i\sin\left(\frac{5\pi}{12}\right)\right)$

$= 2\left(\cos\frac{5\pi}{12} + i\sin\frac{5\pi}{12}\right)$

$n = 4 \rightsquigarrow \frac{2\pi}{4} = \frac{\pi}{2} =$ increment

$\frac{5\pi}{12} + \frac{\pi}{2}\cdot\frac{6}{6} = \frac{5\pi+6\pi}{12} = \frac{11\pi}{12}$

$\frac{11\pi}{12} + \frac{6\pi}{12} = \frac{17\pi}{12}$

$\frac{17\pi}{12} + \frac{6\pi}{12} = \frac{23\pi}{12}$

$\frac{23\pi}{12} + \frac{6\pi}{12} = \frac{29\pi}{12}$

$= \frac{24\pi + 5\pi}{12} = 2\pi + \frac{5\pi}{12}$

$x^n = 11$ has n roots.

$\sqrt[n]{x^n} = \sqrt[n]{11}$ = principal root.

Then build the other $n-1$ roots.

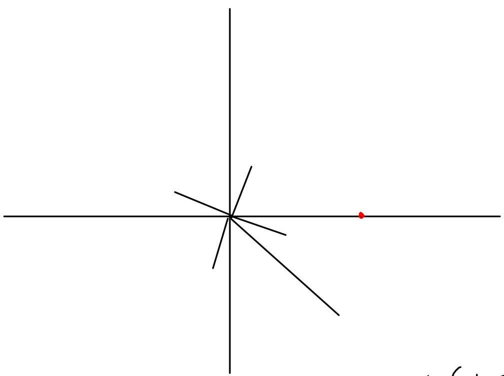
$\sqrt{2}$

$n = 2 \rightsquigarrow \frac{2\pi}{2} = \pi$

Other 4th roots!

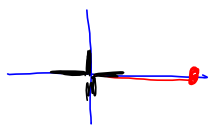
$$\boxed{\begin{array}{l} 2\left(\cos\frac{11\pi}{12} + i\sin\frac{11\pi}{12}\right) \\ 2\left(\cos\frac{17\pi}{12} + i\sin\frac{17\pi}{12}\right) \\ 2\left(\cos\frac{23\pi}{12} + i\sin\frac{23\pi}{12}\right) \end{array}}$$

$\frac{5\pi}{3} = \theta$



$x^4 = 16 \Rightarrow$

$x = \pm 2, \pm 2i$!



$z = 16\left(\cos\frac{5\pi}{3} + i\sin\frac{5\pi}{3}\right)$

Exercises for Polar Coordinates

Graph the following:

1. $r = 2\cos(x) - 1$

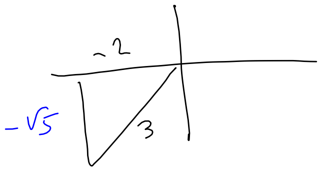
2. $r = 2\cos(2x) + 1$

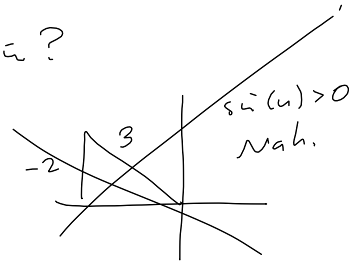
Re-work the $r = \sin(3x)$ & $r = 2\sin(x) + 1$ from class & check against what we did

B9 from T3

$\cos u = -\frac{2}{3}$ & $\sin u < 0$

what quadrant is $2u$ in?





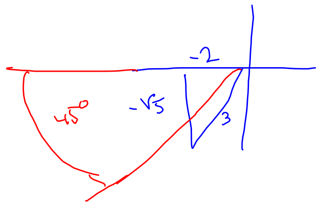
$3^2 - (-2)^2 = 9 - 4 = 5 \rightsquigarrow \sqrt{5}$

$\sqrt{5} > 2$

$u \in QIII \Rightarrow$

$\pi < u < \frac{3\pi}{2} \Rightarrow$

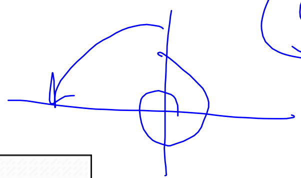
$2\pi < 2u < 3\pi \Rightarrow$ 2 quadrants from which to choose.



$\frac{5\pi}{4} < u < \frac{3\pi}{2}$

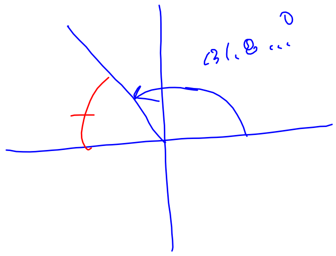
$\frac{5\pi}{2} < 2u < 3\pi$

QII



```
cos⁻¹(-2/3)
        131.8103149
Ans-360
       -228.1896851
```

Calculator



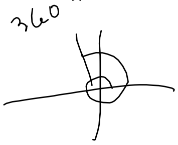
$360° - 131.8...°$

$= 228.1896...°$

Times 2 for 2u:

$456...°$

$= 360 + 96°$ QII



Wait $228...° = 360 - 131.8...°$