- observations:
  - If we know a, α, β then we know $a/\sin\alpha$, so then we know $b/\sin\beta$, so we know b

    $\gamma = 180° - \alpha - \beta$

    we know $c/\sin\gamma$, so we know c
  - If we know b, c, α, then $2bc\cos(\alpha) = b^2 + c^2 - a^2$

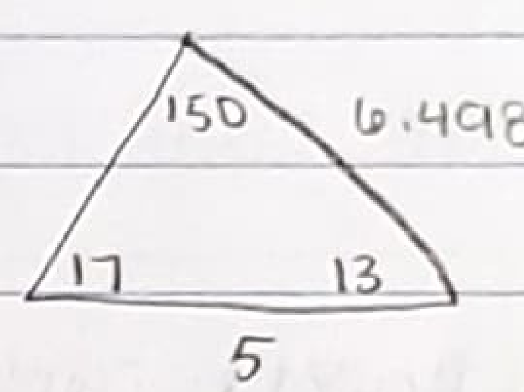
    $a^2 = b^2 + c^2 - 2bc\cos(\alpha)$

    $a = \sqrt{b^2 + c^2 - 2bc\cos(\alpha)}$ → then we know $a/\sin\alpha$, then we know $\sin\beta$ + $\sin\gamma$

ex) find the missing side lengths + angles

1) $\alpha = 13°$ $\beta = 17°$ $a = 5$

$\gamma = 180 - 13 - 17 = 150$



$\frac{5}{\sin 13} = 22.22$ $\frac{b}{\sin\beta} = 22.22$

$b = 22.22(\sin\beta)$

$= 22.22(\sin 17)$

$= 6.498$

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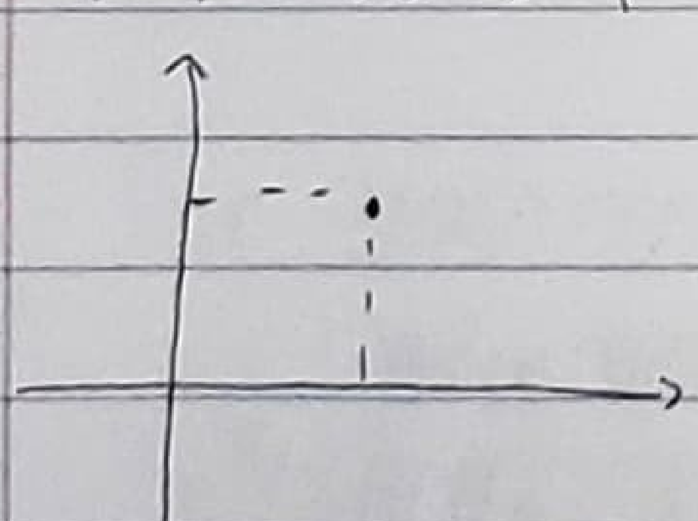
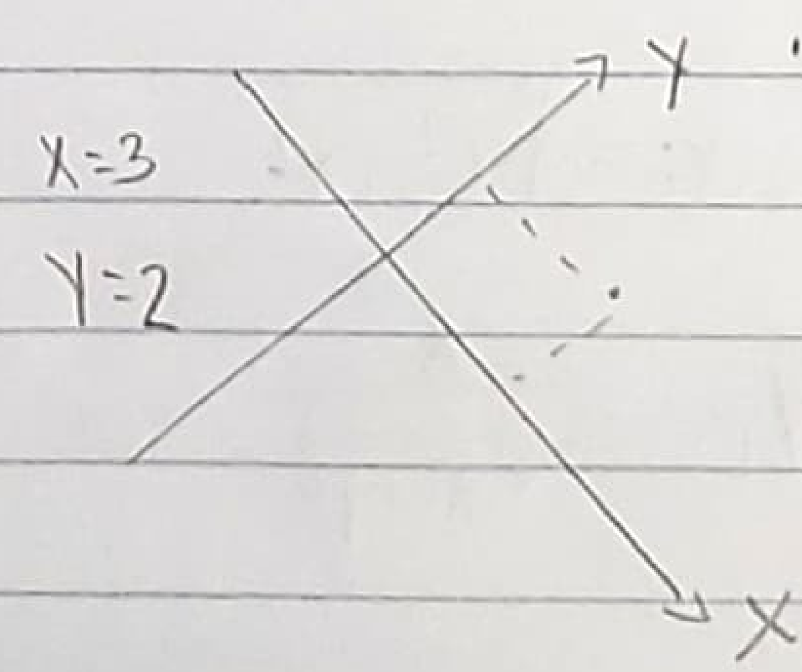
Polar coordinates

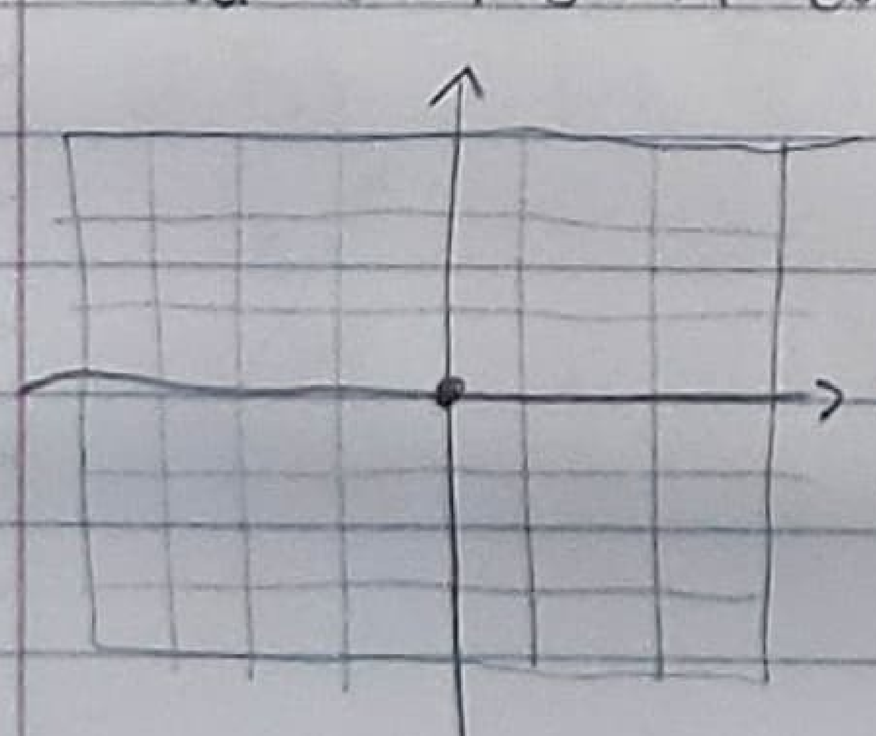
- to locate a position on a map, we give it an address



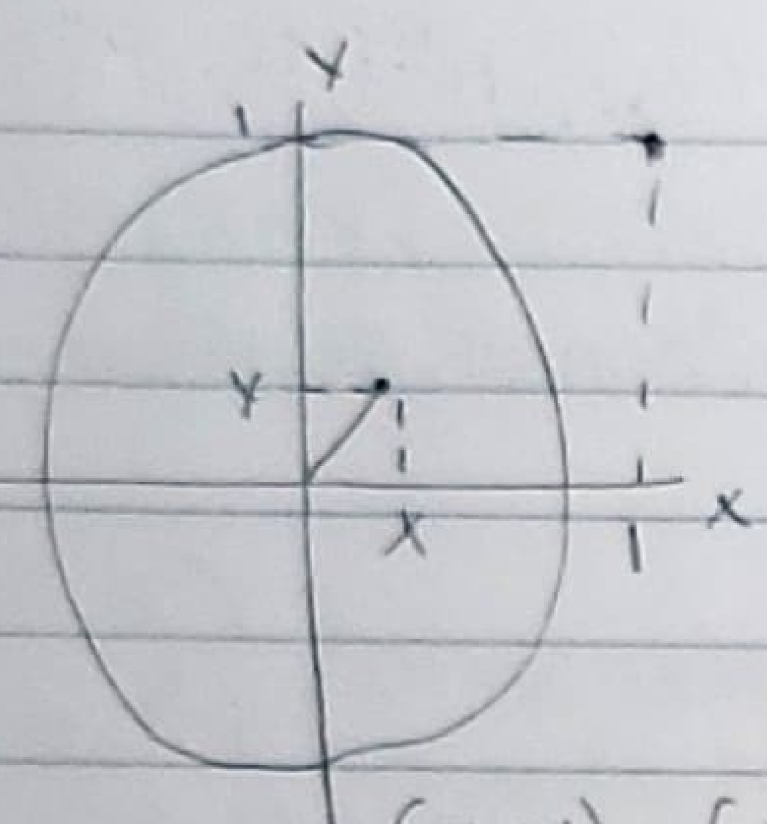


address/position depends on the coordinate system we use

(X,Y)- coordinates are called cartesian coordinate



cartesian coordinate is suitable to assign an address in a rectangular shape



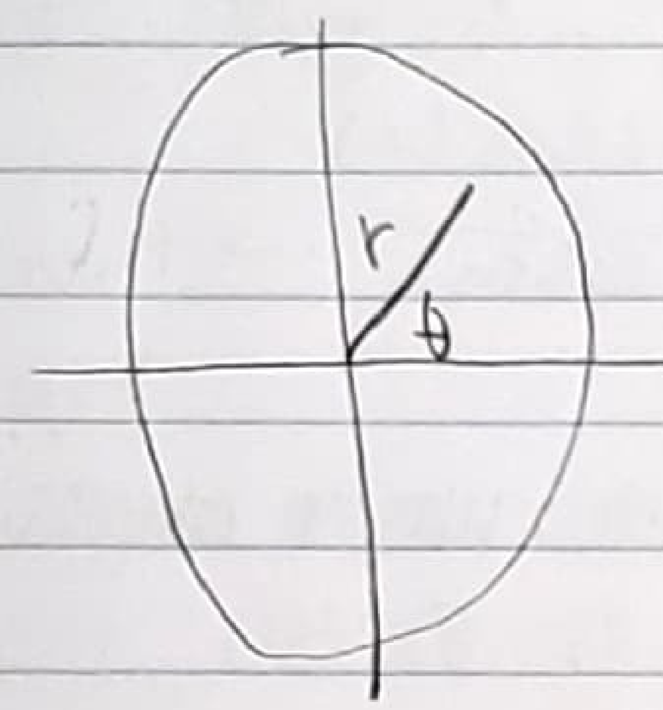
$d = \sqrt{x^2+y^2}$

$d > 1$: outside

$d = 1$: on boundary

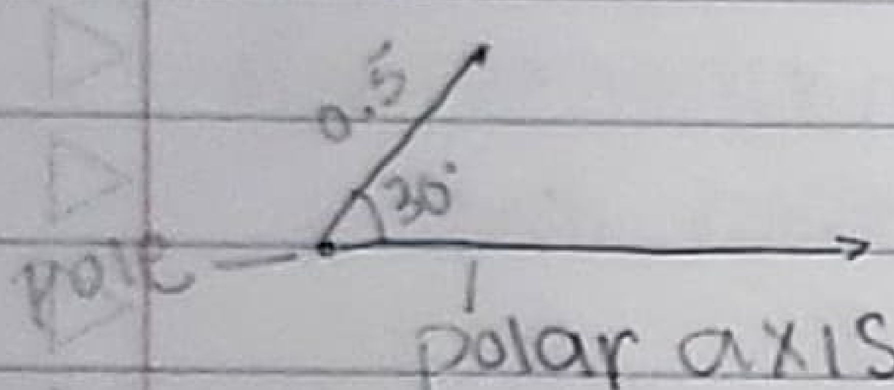
$d < 1$: inside

$(x,y) = (1,1)$



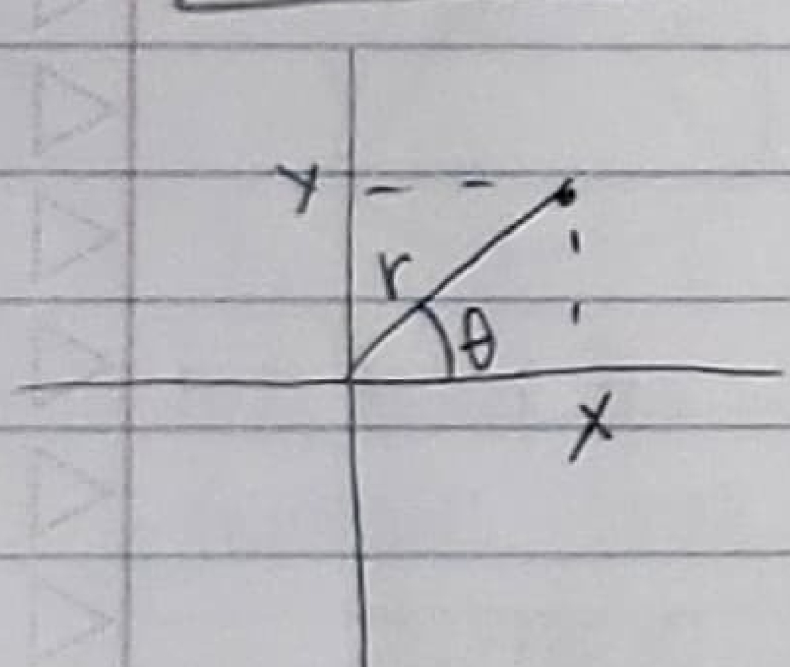
$r =$

$\theta =$



$(0.5, 30) \rightarrow$ polar coordinate

$\boxed{\text{conversion between cartesian + polar}}$



$$\left.\begin{array}{l}\cos\theta = x/r \\ \sin\theta = y/r\end{array}\right\} \rightarrow \begin{array}{l} x = r\cos\theta \\ y = r\sin\theta \end{array}$$

$r^2 = x^2 + y^2 \longrightarrow r = \sqrt{x^2+y^2}$

to find θ:

$$\cos\theta = x/r = \frac{x}{\sqrt{x^2+y^2}}$$

★ take into account the sign of $\sin\theta$

ex find the polar coordinate of (r,θ) with $r>0$, $0 \le \theta \le 2\pi$
of the point $(x,y) = (-1, \sqrt{3})$

$r = \sqrt{(-1)^2 + \sqrt{3}^2} \longrightarrow \sqrt{1+\sqrt{3}} \longrightarrow \sqrt{4} = 2$

$\cos\theta = \frac{x}{y} = -\frac{1}{2}$

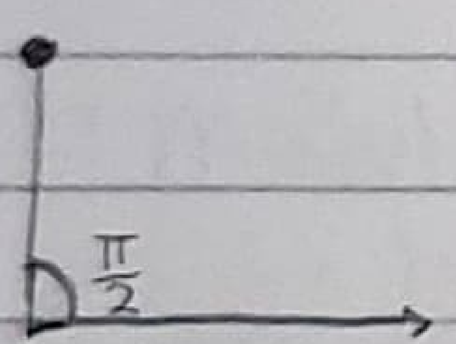
$\theta = \frac{2\pi}{3}$ $\qquad \theta = \frac{2\pi}{3} + k2\pi$ $\qquad \theta = -\frac{2\pi}{3} + k2\pi$

$\cos\theta = \cos\left(\frac{2\pi}{3}\right)$ $\qquad \theta = \frac{2\pi}{3}$ $\qquad \theta = \frac{4\pi}{3}$ $\qquad \boxed{\left(2, \frac{2\pi}{3}\right)}$

$\sin\theta = \frac{y}{r} = \frac{\sqrt{3}}{2}$, so we pick $\frac{2\pi}{3}$ since $\sin\theta$ is positive

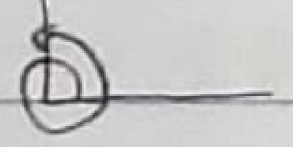
$\boxed{\text{converting examples cont}}$ 30 may 2023

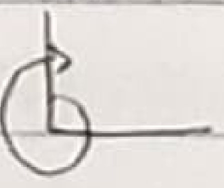
$r = 1$, $\theta = \frac{\pi}{2}$



$\underbrace{\hspace{3cm}}_{}$ equivalent to $(1, \pi/2)$

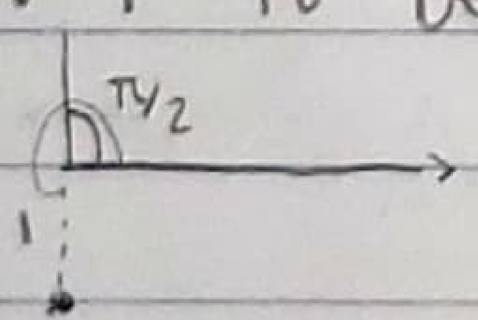
$(1, \pi/2) \longrightarrow +2\pi = \left(1, \frac{5\pi}{2}\right) \longrightarrow -2\pi = \left(1, \frac{3\pi}{2}\right)$





- for graphing:
  - we allow r to be negative

$(-1, \pi/2) \longrightarrow$



but $\left(1, \frac{3\pi}{2}\right)$ is equiv. to $\left(-1, \frac{\pi}{2}\right)$

ex Draw the points with polar coordinates:
$(1, \pi/3)$, $\left(-1, \frac{2\pi}{3}\right)$, $\left(-1, \frac{4\pi}{3}\right)$, $\left(1, -\frac{4\pi}{3}\right)$