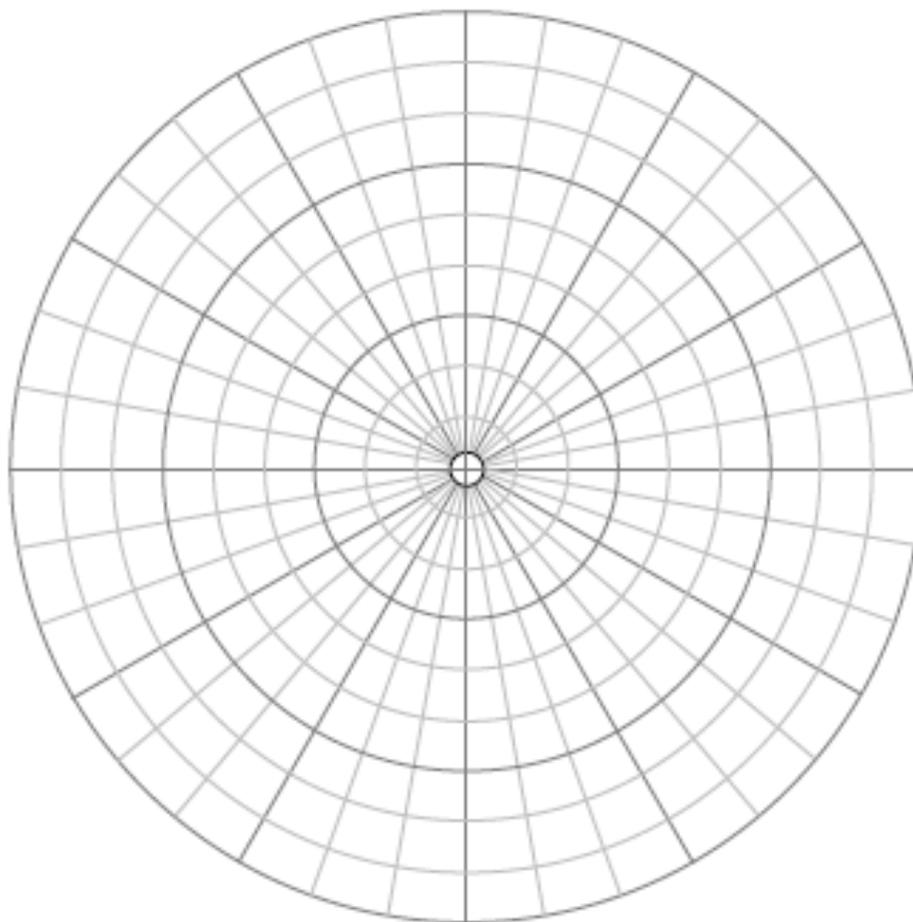


## Polar Graph Paper



[Waterproof Paper.com](http://WaterproofPaper.com)

Polar Coordinates  $[r, \theta]$   $r$  = radius, directed distance from the origin

$\theta$  = angle, counterclockwise from polar axis.

1. Plot the following points:

$$A = \left[ 2, \frac{\pi}{3} \right] \quad B = \left[ 6, -\frac{\pi}{6} \right] \quad C = [5, 3\pi] \quad D = \left[ -3, \frac{\pi}{2} \right]$$

$[r, \theta] = [r, \theta + 2\pi n]$  The point will land in the same place if you add/subtract  $2\pi$ .

$[-r, \theta] = [r, \theta + 2\pi n + \pi]$  When  $r$  is negative it lands in the same place as a positive  $r$  and  $\theta + \pi$ .

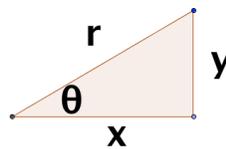
Rectangular coordinates  $(x,y)$  relate to polar coordinates  $[r,\theta]$  as follows:

$$x = r \cos \theta$$

$$y = r \sin \theta$$

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

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



Convert the rectangular coordinate into polar form.

2.  $(-4,2)$

3.  $(1,1)$

4.  $(3,0)$

Convert the points to rectangular form:

5.  $\left[2, \frac{\pi}{6}\right]$

6.  $\left[-2, -\frac{5\pi}{4}\right]$

Rewrite #3 as two other equivalent polar coordinates.

## Starship -- Polar Coordinates Game

From the *Mathematics Teacher*, February 1995

Name \_\_\_\_\_

Your mission, as commander of the Centerprize fleet, is to eliminate the dominance of the Cartesian fleet forever!

1. Each of the two players must distribute his or her fleet of squadrons on the left grid of his or her sheet at intersection points other than the center. Use a solid circle to represent each fighter. Each squadron must be contiguous, either along a spoke or fanned out along a circle.

Remember, the squadrons are of sizes 5, 4, 3, 3, and 2, respectively.

2. One player is selected to go first.

3. Each player is given four shots on each turn. Because of the damages to the ship, the polar coordinates must consist of all combinations of sign, that is, one each of (+, +), (-, +), (+, -), and (-, -). A player who violates this rule forfeits the rest of the turn. Both players should record the shots on the charts for further reference.

4. If a shot misses, the opponent declares "miss" and both players place an open circle in the appropriate location.

5. If a shot hits, the opponent declares "hit" and both players place an X in the appropriate location.

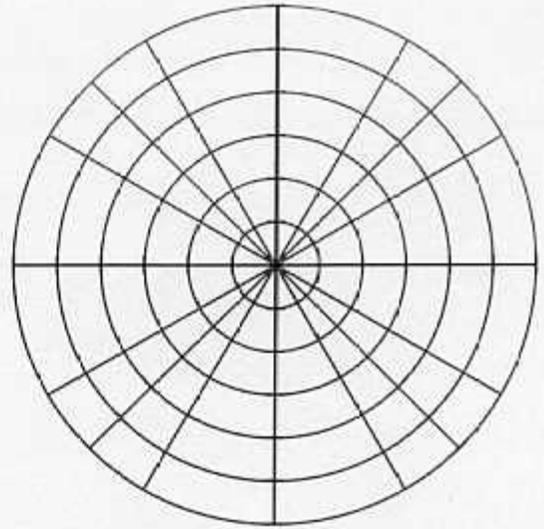
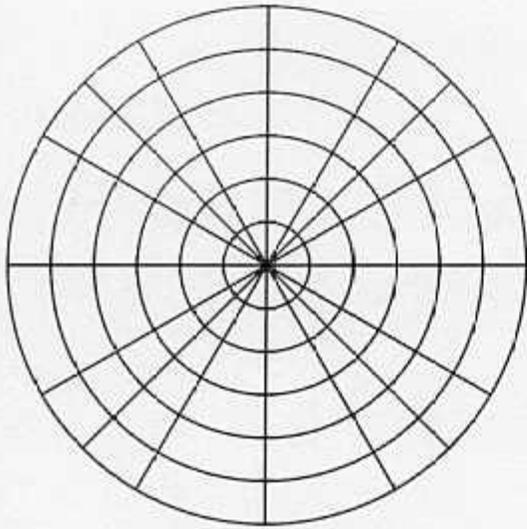
6. The opponent announces when an entire squadron is "polarized." For example, the opponent might say, "You polarized a squadron of five fighters." Of course, the weapons do not destroy the Cartesians but convert them into mathophiles.

7. Players alternate until one polarizes the other's entire fleet.

From The Mathematics Teacher, February 1995

Name \_\_\_\_\_

Opponent's Name \_\_\_\_\_



Turn    (+, +)   (+, -)   (-, +)   (-, -)

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 17
- 18
- 19
- 20

Turn    (+, +)   (+, -)   (-, +)   (-, -)

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 17
- 18
- 19
- 20