



كلية : التربية للعلوم الصرفة

القسم او الفرع : الرياضيات

المرحلة : الثانية

أستاذ المادة : ميمون ابراهيم اسماعيل

اسم المادة باللغة العربية : التفاضل المتقدم

اسم المادة باللغة الإنكليزية : Advance Calculus

اسم المحاضرة الثامنة باللغة العربية : التناظر في الاحداثيات القطبية

اسم المحاضرة الثامنة باللغة الإنكليزية : symmetry in polar coordinates

This lecture describes techniques for graphing equations in polar coordinates.

### Symmetry Tests for Polar Graphs

1. *Symmetry about the x-axis:* If the point  $(r, \theta)$  lies on the graph, the point  $(r, -\theta)$  Or  $(-r, \pi - \theta)$  lies on the graph (Figure 5).
2. *Symmetry about the y-axis:* If the point  $(r, \theta)$  lies on the graph, the point  $(r, \pi - \theta)$  or  $(-r, -\theta)$  lies on the graph (Figure 5).
3. *Symmetry about the origin:* If the point  $(r, \theta)$  lies on the graph, the point  $(-r, \theta)$ , or  $(r, \pi + \theta)$  lies on the graph (Figure 5).

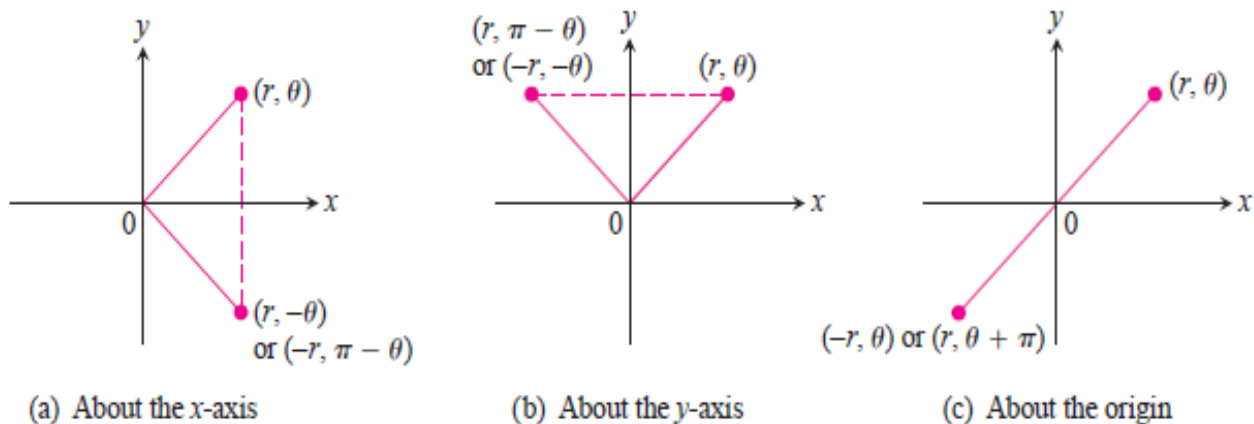


Figure 5

Example : What symmetries do these curves have

- 1)  $r = 4 \cos \theta$
- 2)  $r = 4 \sin \theta$
- 3)  $r^2 = 4 \cos \theta$
- 4)  $r = \cos \theta - \sin \theta$

Solution:

1) The curve is symmetric about the  $x$ -axis because  $(r, \theta)$  on the graph then  $r = 4 \cos(-\theta) \rightarrow r = 4 \cos \theta \rightarrow (r, -\theta)$  on the graph

There is not symmetric about the  $y$ -axis and the origin point

2) The curve is symmetric about the  $y$ -axis because  $(r, \theta)$  on the graph then

$$-r = 4 \sin(-\theta) \rightarrow r = 4 \sin \theta \rightarrow (-r, -\theta) \text{ on the graph}$$

There is not symmetric about the  $x$ -axis and the origin point

3) • The curve is symmetric about the  $x$ -axis because  $(r, \theta)$  on the graph then

$$r^2 = 4 \cos(-\theta) \rightarrow r^2 = 4 \cos \theta \rightarrow (r, -\theta) \text{ on the graph}$$

• The curve is symmetric about the  $y$ -axis because  $(r, \theta)$  on the graph then

$$(-r)^2 = 4 \cos(-\theta) \rightarrow r^2 = 4 \cos \theta \rightarrow (-r, -\theta) \text{ on the graph}$$

• The curve is symmetric about the origin point because  $(r, \theta)$  on the graph then

$$(-r)^2 = 4 \cos(\theta) \rightarrow r^2 = 4 \cos \theta \rightarrow (-r, \theta) \text{ on the graph}$$

4) There is not symmetry about  $x$ -axis because  $(r, -\theta) \implies r = \cos -\theta - \sin -\theta \implies r = \cos \theta + \sin \theta$

$$(-r, \pi - \theta) \implies -r = \cos(\pi - \theta) - \sin(\pi - \theta) \implies -r = -\cos \theta - \sin \theta \implies r = \cos \theta + \sin \theta$$

There is not symmetry about  $y$ -axis because

$$(-r, -\theta) \implies -r = \cos -\theta - \sin -\theta \implies r = -\cos \theta - \sin \theta$$

$$(r, \pi - \theta) \implies r = \cos(\pi - \theta) - \sin(\pi - \theta) \implies r = -\cos \theta - \sin \theta$$

There is not symmetric about the origin point because

$$(-r, \theta) \implies -r = \cos \theta - \sin \theta \implies r = \sin \theta - \cos \theta$$

$$(r, \pi + \theta) \implies r = \cos(\pi + \theta) - \sin(\pi + \theta) \implies r = -\cos \theta - [-\sin \theta] \rightarrow r = \sin \theta - \cos \theta$$