Name: ____ S2
Unit 9 – Polar Coordinates PC

9-3 Continued – Investigating graphs of Polar Equations

Set your calculator to <u>radians</u>
Set your window so x ranges from 0 to 6.28 and y ranges from -10 to 3.

1. Graph all four equations on one grid:
   $y = \sin(x)$
   $y = \sin(x) + 2$
   $y = 4\sin(x) - 5$
   $y = -2\sin(6x) + 1$

2. Label the appropriate graphs. Explain briefly what happens for each graph.

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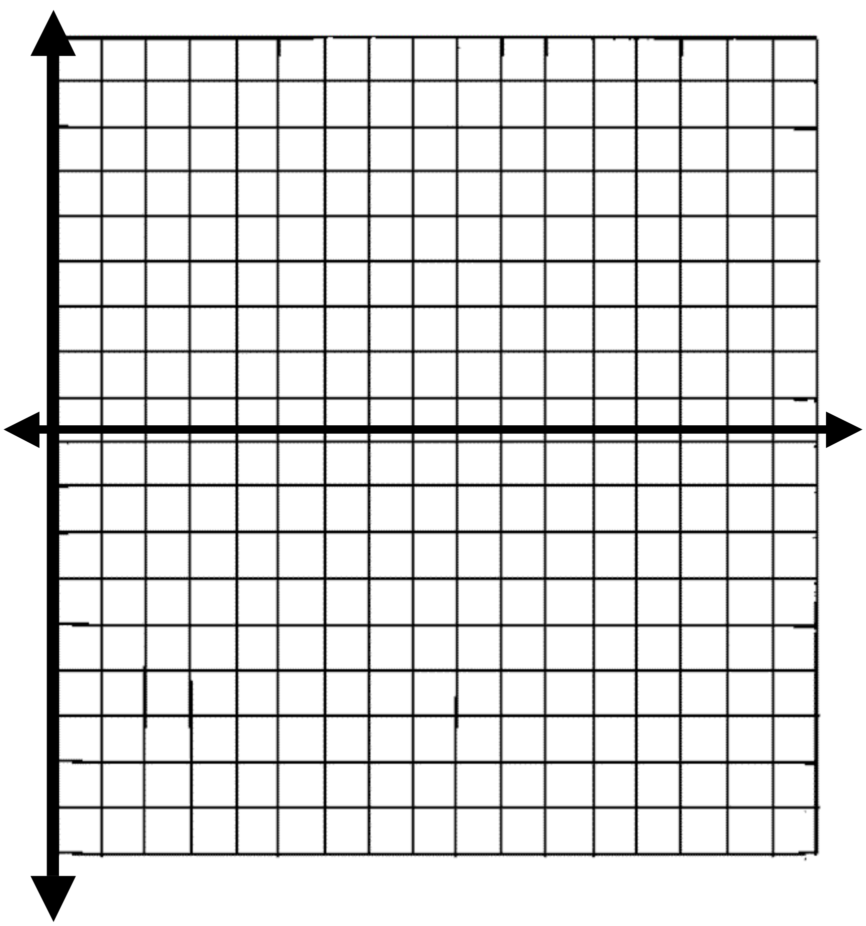
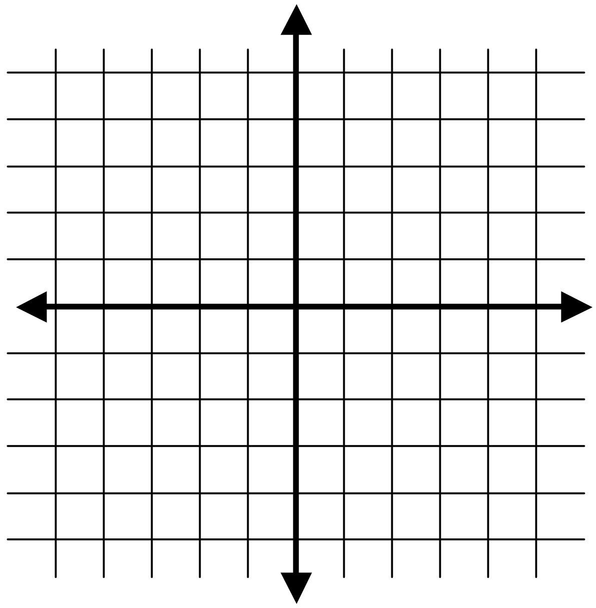


POLAR GRAPHING:

Change your function to **polar** in the mode menu.

Reset the window to: θmin = 0 Xmin = -5 Ymin = -5
θmax = 6.28 Xmax = 5 Ymax = 5
θstep = .13 Xscl = 1 Yscl = 1

3. Graph all four equations on one grid:
   $r = \sin \theta$
   $r = 2 \sin \theta$
   $r = 3 \sin \theta$
   $r = 4 \sin \theta$



4. State a conjecture relating the equations to the equation $r = A \sin \theta$.
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5. Why isn't the graph of $r = A \sin \theta$ in all four quadrants?
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Now examine cosine.

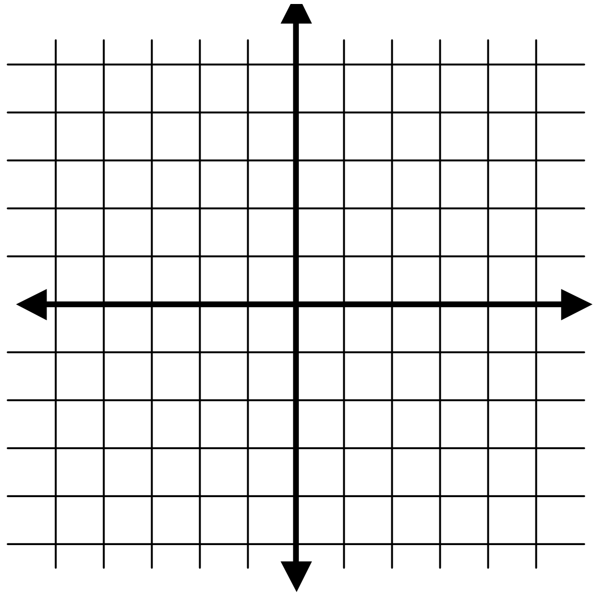
6. On one grid, graph:

$r = \cos\theta$

$r = 2\cos\theta$

$r = 3\cos\theta$

$r = 4\cos\theta$



7. State a conjecture relating the equations to the equation $r = A\cos\theta$.

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Five classical curves exist in polar graphing. We will explore <u>three</u> of them in this activity. The goal of this exploration is for you to make enough observations to sketch the curves WITHOUT a graphing calculator.

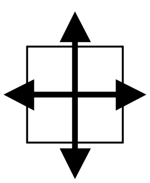
<u>ROSES:</u>

Your previous graphs were the simplest form of a classical polar curve called the rose. Can we get more petals on the rose? Of course!

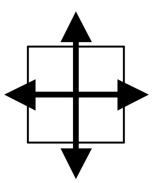
Pull your window in to range from -2 to 2 on the x and y axes.

8. Graph:

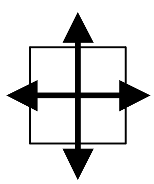
$r = \cos(2\theta)$



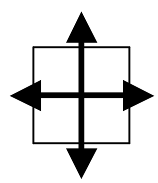
$r = \cos(4\theta)$



$r = \cos(6\theta)$



$r = \cos(10\theta)$



9. Write a conjecture to remember a quick way to sketch the graphs of $r = \cos(B\theta)$ if B is any **<u>even</u>** integer.

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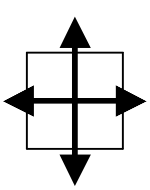
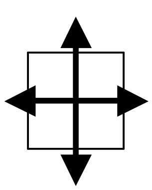
10. Graph:

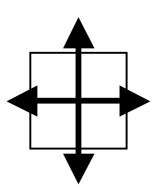
$r = \sin(2\theta)$



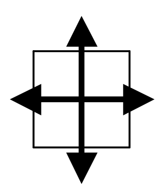
$r = \sin(4\theta)$



$r = \sin(6\theta)$



$r = \sin(10\theta)$



11. Write a conjecture to remember a quick way to sketch the graphs of $r = \sin(B\theta)$ if B is any **<u>even</u>** integer.

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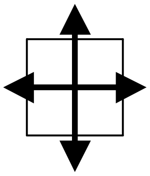
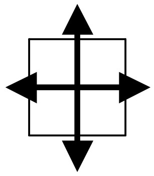
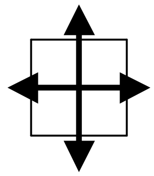
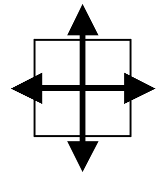
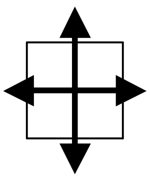
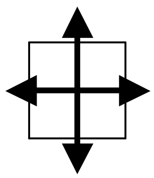
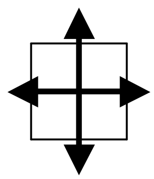
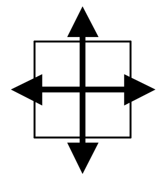
12. Now examine and graph:

$r = \cos(3\theta)$ $r = \cos(5\theta)$ $r = \cos(7\theta)$ $r = \cos(15\theta)$

13 Now look at and graph:

$r = \sin(3\theta)$ $r = \sin(5\theta)$ $r = \sin(7\theta)$ $r = \sin(15\theta)$

14. State a conjecture for graphing $r = \cos(B\theta)$ if B is any **odd** integer and not equal to zero.

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15. State a conjecture for graphing $r = \sin(B\theta)$ if B is any **odd** integer and not equal to zero.

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LEMNISCATE:

Another classical curve is the lemniscate. It follows the equation $r^2 = A^2 \cos(2\theta)$ and $r^2 = A^2 \sin(2\theta)$.

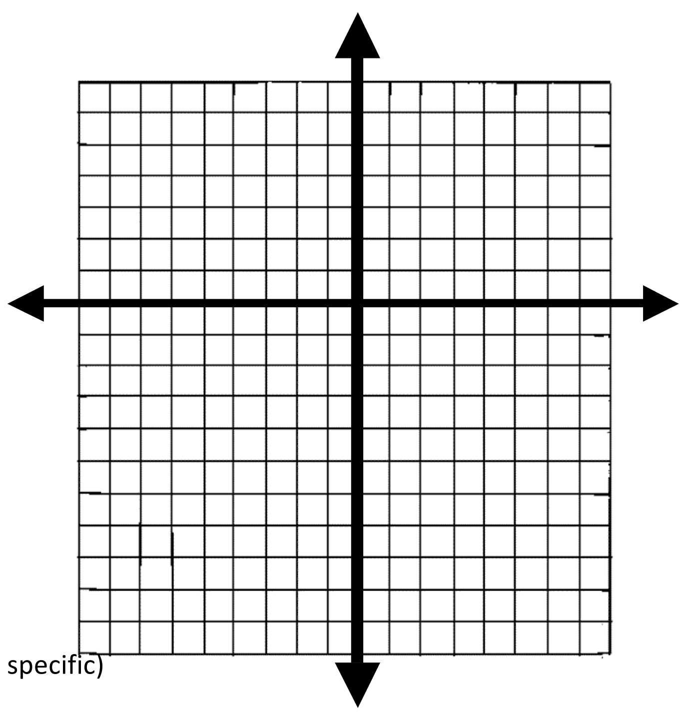
Change your window to range from -10 to 10 on the x and y axes.

16. On one grid, graph:

$r^2 = 25 \sin(2\theta)$

$r^2 = 36 \sin(2\theta)$

$r^2 = 64 \sin(2\theta)$



17. State a conjecture on what you found (be specific)

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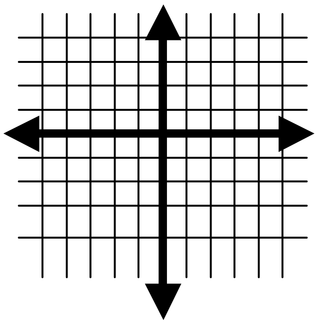
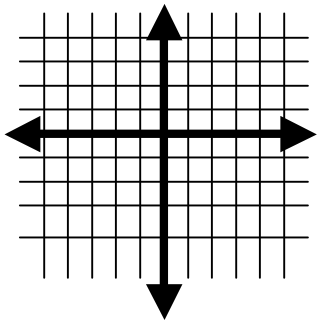
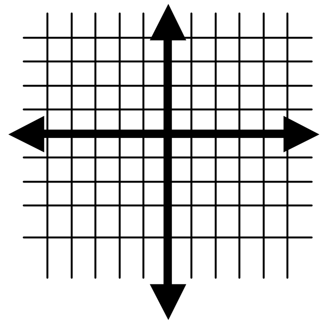
18. Now graph:

$r^2 = 25 \cos(2\theta)$ $r^2 = 36 \cos(2\theta)$ $r^2 = 64 \cos(2\theta)$







19. State a conjecture on what you found (be specific)

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SPIRAL OF ARCHIMEDES:

Finally, the spiral of Archimedes follows the equation $r = A\theta$. Examine the graph with different values of A, and be sure to note where the curve crosses the axes.

20. State a conjecture for graphing $r = A\theta$ if a is **any** integer and not equal to zero.

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Follow up questions:

21. A change in the constant A in the equations of the form $r = A \cos(B\theta)$ and $r = A \sin(B\theta)$ has what effect on the graph?

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22. How many rose "petals" do the graphs of $r = A \cos(B\theta)$ and $r = A \sin(B\theta)$ have when:

a. B is an **even positive** integer? ____________________________

b. B is an **odd positive** integer? ____________________________

23. How do the graphs of $r = A \cos(B\theta)$ and $r = A \sin(B\theta)$ differ if A and B are the same?

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24. Given either $r^2 = A^2 \cos(2\theta)$ and $r^2 = A^2 \sin(2\theta)$,

a. how does the value of A change the graph?

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b. how is $r^2 = A^2 \cos(2\theta)$ different from $r^2 = A^2 \sin(2\theta)$ if A is the same?

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25. Given $r = A\theta$, how does the value of A alter the graph?

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26. How will the graphs of $r = \cos(2\theta)$ and $r = \cos(-2\theta)$ differ?

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27. How will the graphs of $r = \sin(2\theta)$ and $r = \sin(-2\theta)$ differ?

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28. Explain mathematically why you got the results you did for #26 and #27. Using the calculator as your explanation is not enough.