Name: ______________________ Group Members: ____

Exploration 3-1a: Periodic Daily Temperatures

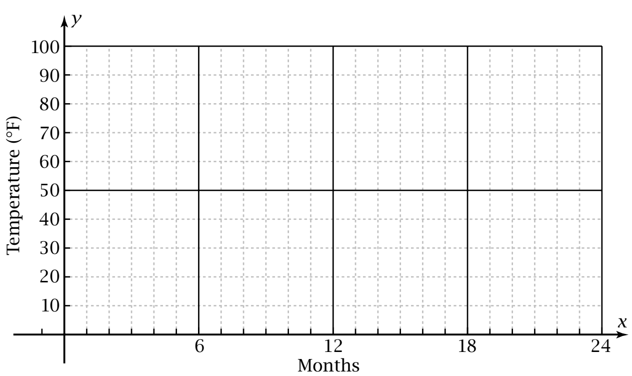
Date: ____________

Objective: Transform the cosine function so that it fits, approximately, data on the average daily temperatures for a city.

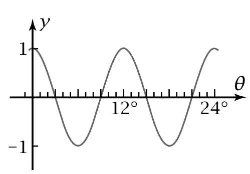
Here are average daily high temperatures for San Antonio, by month, based on data collected over the past 100 years and published by NOAA, the National Oceanic and Atmospheric Administration. Such data are used, for example, in the design of heating and air conditioning systems.

Month	Temperature (°F)	Month	Temperature (°F)
Jan.	61.7	July	94.9
Feb.	66.3	Aug.	94.6
Mar.	73.7	Sept.	89.3
Apr.	80.3	Oct.	81.5
May	85.6	Nov.	70.7
June	91.8	Dec.	64.6

1. On the graph paper, plot the average daily high temperatures for two years. Assume that January is month 1 and so forth. Determine a time-efficient way for your group members to do the plotting. What should you plot for month zero? Connect the points with a smooth curve.

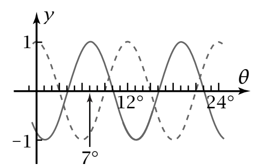


2. The graph of $y = \cos\theta$ completes a cycle each 360° (angle, not temperature). What horizontal dilation factor would make it complete a cycle each 12°, as shown? Write an equation for this transformed sinusoid and plot it on your grapher.



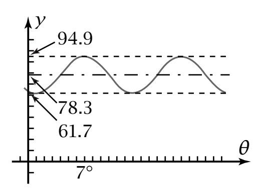
3. Earth rotates 360° around the Sun in 12 months. How do these numbers relate to the dilation factor you used in Problem 2?

4. The temperature graph in Problem 1 has a high point at $x = 7$ months. What transformation would you apply to the sinusoid in Problem 2 (dashed in the next figure) to make it have a high point at $\theta = 7°$ (solid) instead of at $\theta = 0°$? Write the equation and confirm it by plotting on your grapher.



5. The average of the highest and lowest temperatures in the table is $\frac{94.9 + 61.7}{2} = 78.3$. Write an equation for the transformation that would translate the graph in Problem 4 upward by 78.3 units.

6. The 94.9 high point in Problem 1 is 16.6 units above 78.3, and the 61.7 low point is 16.6 units below 78.3. Write an equation for the transformation that would dilate the sinusoid in Problem 5 by a factor of 16.6 so that it looks like this graph. Confirm your answer by grapher.



7. On your grapher, plot the points you plotted in Problem 1. How well does the sinusoidal equation in Problem 6 fit the points?

8. What did you learn as a result of doing this Exploration that you did not know before?