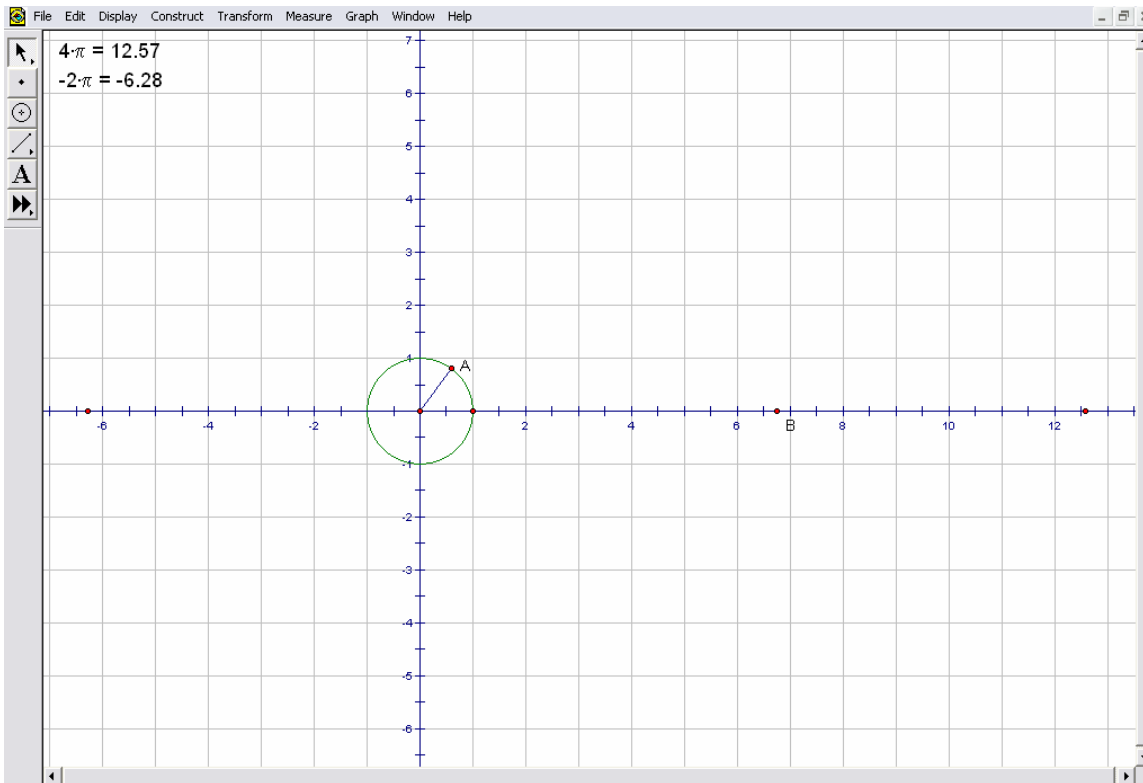


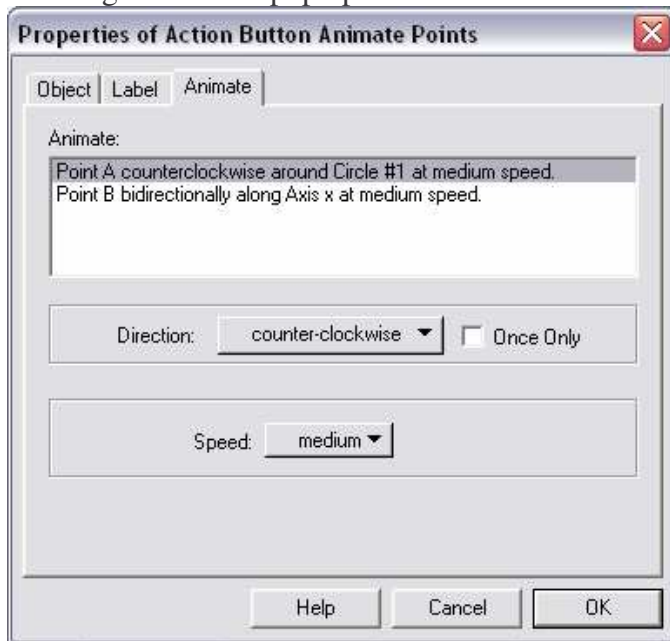
Construction of a Sine Wave with Geometer's Sketchpad

1. Open up a new sketch and show the grid.
2. Move the whole grid over to the left, and zoom in on the graph a little bit by moving the unit point. Try to position the window so that the x -axis goes from about -7 to about 14 or so.
3. Draw a circle with center at the origin and radius 1 (put the center at $(0, 0)$ and the circle on $(1, 0)$).
4. Draw a segment from the origin to a point on the circle other than $(1, 0)$. Label the point A . Move point A around the circle. It should move freely around the circle without leaving it. The circle should not change size.
5. Double click the point at the origin (which is also the center of the circle). A couple of circles will briefly form around it, and disappear. This marks the point as the center of rotations and dilations.
6. Select Calculate... from the Measure menu. You will get a dialogue box that allows you to calculate values. Calculate 4π and hit "OK". You will see a calculation for 4π at the top of your screen. Calculate -2π as well.
7. Select your calculation of 4π and then click on Transform/Mark Scale Factor. Now click on some blank space so that you have nothing selected. Select the point $(1, 0)$ and then select Transform/Dilate. For the ratio of dilation, it will suggest the marked ratio, so click Dilate. This will plot a point that will be slightly to the right of $(13, 0)$. Specifically, this point is at the point $(4\pi, 0)$. Now do the same thing with the calculation of -2π so that you get a point plotted at the location $(-2\pi, 0)$.
8. Draw a segment from $(-2\pi, 0)$ to $(4\pi, 0)$. Put a point on the segment. Label that point B .

Hopefully, your screen looks something like this now:



9. Create an Action Button that animates point A around the circle and point B forward on the x -axis.
 - a. Select both points A and B .
 - b. Click on Edit/Action Buttons/Animation
 - c. A dialogue box will pop up that looks like this:



Click on the line that talks about point B , and change the direction from “bidirectional” to “forward.” Then click OK. A button will appear on screen that says “Animate Points.”
 Note: *If you change the speed for one point, make sure you change the speed for the other point as well. If you don't, your graph will not be accurate.*

- d. Click on the button and notice that the points move. Click it again and watch them stop. Repeat until bored.
10. Create an Action Button that moves point A to the point $(1, 0)$ and point B to the origin.
 - a. Click on these points *in this order*: A , $(1, 0)$, B , $(0, 0)$. Make sure you have nothing else selected, and that you select the points in the correct order. Click on Edit/Action Buttons/Movement

b. You get a dialogue box that looks like this:



Change the speed to either fast or instant (medium is actually quite slow). Click OK.

c. A button will appear that says “Move Points.” Click on it and make sure that it moves point A to $(1, 0)$ and point B to the origin. If not, hit Edit/Undo until the button goes away, and try again.

11. Construct a line perpendicular to the x -axis that goes through point B .
12. Construct a line parallel to the x -axis that goes through point A .
13. Select the intersection of the lines you just constructed. Make sure nothing else is selected.
14. Click on Display/Trace Intersection (or Ctrl-T).
15. Hit the “Move Points” button that you just made. The points should go back to their starting points.
16. Hit Display/Erace Traces (or Ctrl-B) to erase any weird stray marks you just made.
17. Hit the “Animate Points” Button. Hit it again to stop it.
18. Check out the cool sine wave.
19. Hit Display/Erace Traces (or Ctrl-B) to erase the traces so you can do it again.

Note: if you want to change something about the animation (for example, if things are moving too slow, and you want to speed up the animation), then right-click the button and choose *properties*. If you change the speed of one point, make sure you change the speed of the other as well.

Another Note: To make the traces fade out over time, choose Edit/Preferences and click the Color tab. Check the box that says “Fade traces over time.” You can also change default colors for points, lines, etc here. The fading property is a pretty cool effect.

Yet Another Note: Modify this sketch to trace out cosines, tangents, secants or cosecants! Go to File/Document Options, and then create a new page that is a duplicate of the one you just created. Tweak it so that it will trace a different trigonometric function. Impress your friends, family and classmates! Great fun for parties!