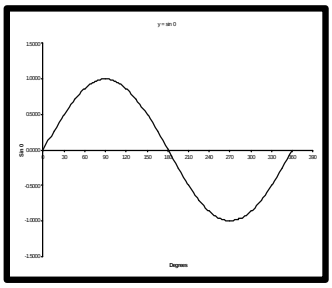
Graphing Trigonometric Functions

Level: College Preparation Mathematics



Goal: To become familiar with Microsoft Excel and the Chart Wizard in order to create graphs the Trigonometric Functions

Learning Outcomes:

- Use a spreadsheet to construct a table of values
- Use the Chart Wizard to create graphs of Trigonometric Functions

Contents

Prerequisite:

Spreadsheet Mathematics: Statistics and Graphing Lab 1:

Entering, Formatting and Saving Data in an Excel Spreadsheet

Acknowledgements:

All screens captured by permission of Microsoft

Graphing Trigonometric Functions

We will plot the following Trigonometric Function using Excel and Chart Wizard

y = sin q **for** q **from 0° to 360°**

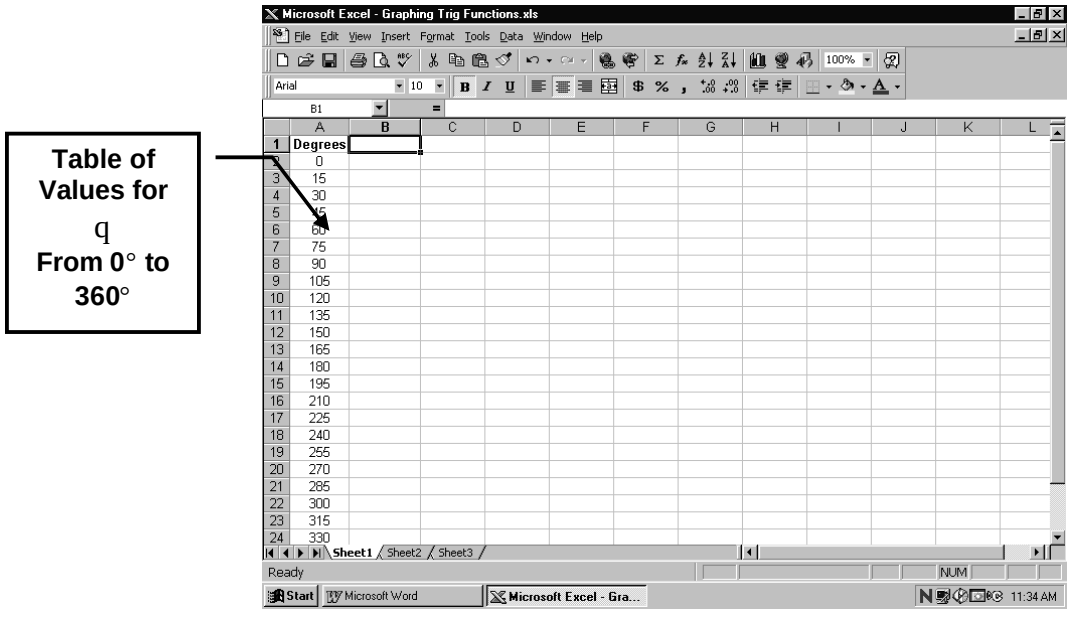
Step 1: Construct a Table of Values Using Microsoft Excel

Open an Excel spreadsheet.
In cell **A1**, enter **Degrees** This is the **header** for the q values or the degrees from **0°** to **360°**.
In cell **B1**, enter **y = sin** q. This is the **header** for the corresponding **y** values.

For the equation **y = sin** q you will select the values for q and Excel will calculate the corresponding **value of *y***
When you plot the graphs by hand on graph paper, you have to do the calculation for the value of **y** yourself.

We will pick a range of values for q. In this example, the **range of values for** q **are 0°** to **360°**. We will enter this range in a spreadsheet.

So starting at **A2**, **enter 0° , 15 °, 30°**. Now highlight **A2, A3, A4** . Then at the black square on **A4** drag down column A until you reach 360. This should be at **A26**. This gives you a **Table of Values for** q **from 0° to 360°**



Step 2: Enter a Formula to convert Degrees to Radians

Excel will calculate the sin ratio for the angles from 0° to 360°, but we must change the degrees to radians.
We know from our study of Trigonometry that radians is another way to measure rotation of an angle.
180° is equivalent to π radians = 3.14 radians
360° is equivalent to 2π radians = 6.28 radians
90° is equivalent to $\frac{p}{2}$ radians = 1.57 radians

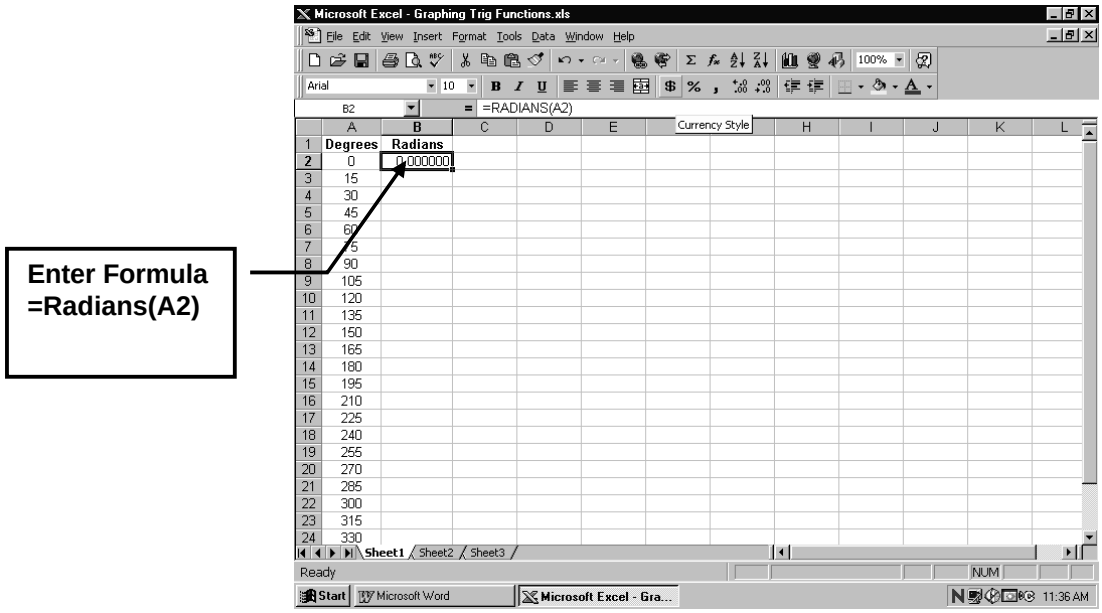
If we **enter a formula** in the **B column** of our Excel spreadsheet, we can convert degrees **in A column** to **radians**
Remember when you converted angles measured in degrees to radians in the Trigonometry module. There, you used the conversion factor $\frac{p}{180°}$ to convert degrees to radians

Example:
Convert 30° to radians

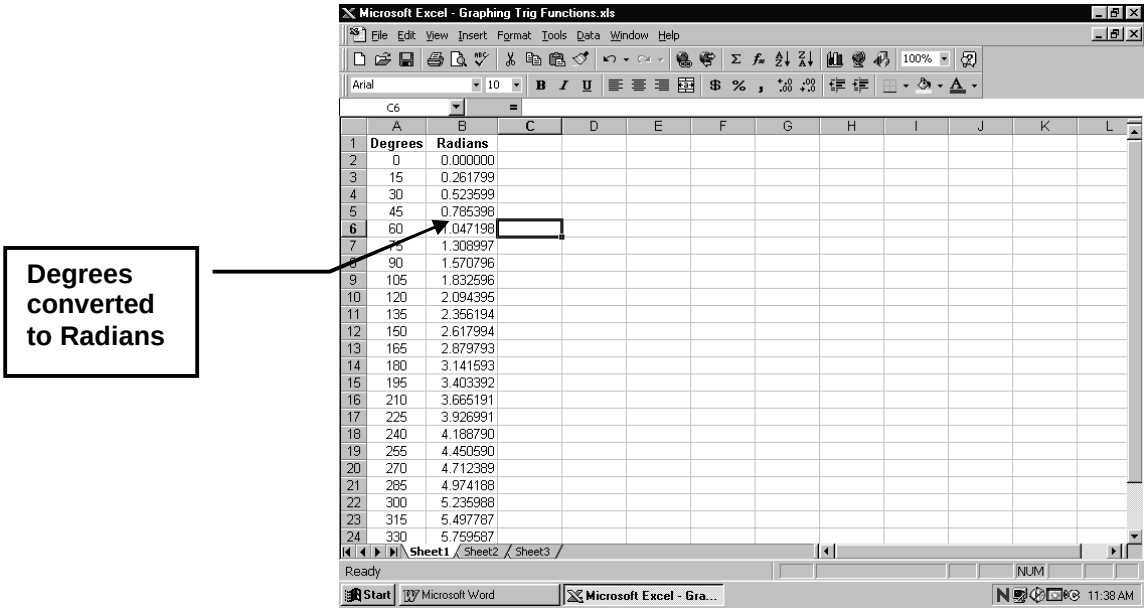
$30° \times \frac{p}{180°} = 0.52$ radians

However, in Excel we can simply enter the formula: = Radians() in Column B and then drag the formula down column B in order to copy the formula for each degree value.
Of course, the **Degrees** are found in **column A**. The first degree, **0°,** is in **A2**
So, the formula we enter is **=Radians(A2)**
Hit Enter

See the resulting screens on the following page:

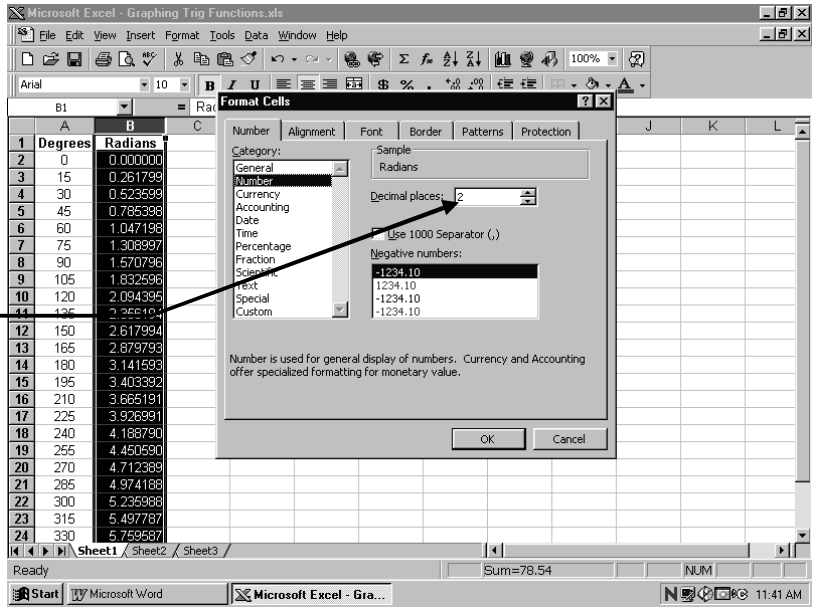


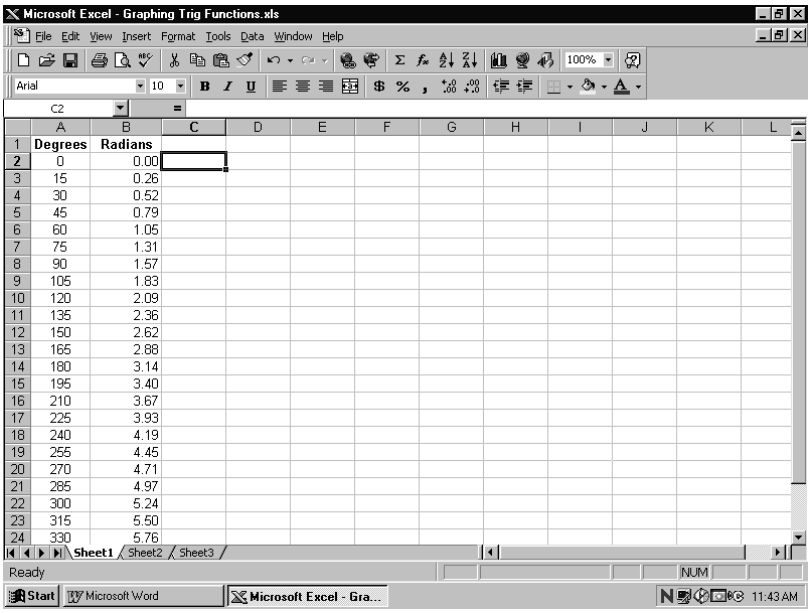
Then, we will drag the formula down column B to convert all the degrees to radians.



You can round off the radians in Column B to 2 decimal places by"
Clicking on Column B (Click right on the B .. this selects the column)
Selecting Format from Toolbar:
Next Select Cells
Next Select Number and under decimal places, select 2
Click on OK

Select 2 decimal places





Now, the radians **column B** has been rounded off **to two decimal places**

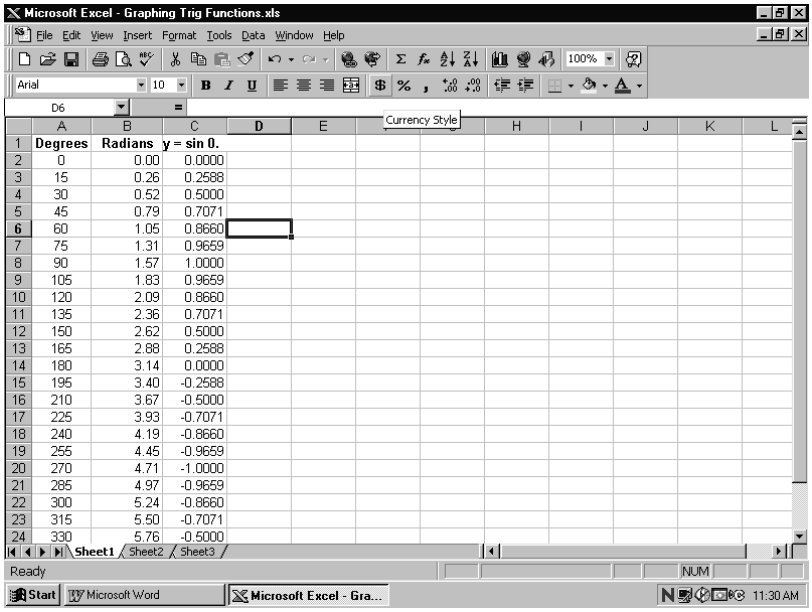
Now would be a good time to Save your spreadsheet.
Select **File** from Toolbar, then select **Save as**
You might want to call the file : **Graphing Trig Functions**
Save the file on your Floppy disk
From now on you can **Save** by Clicking on the **Save icon** (little disk) on the **Toolbar**

Step 3: Find the Sine Ratio for the Radians in Column B

We can enter a formula so that Excel will calculate all the sine ratios for our range from 0° to 360° or 0 radians to 2π radians (6.28 radians)
Heading for **Column C** is **y = sin** q

In column C, enter the formula: **= SIN(B2).** Then drag the formula down Column C.
Select Format from the Toolbar, then Cell and then round off Column C to 4 decimal places.

The screen you will see is:



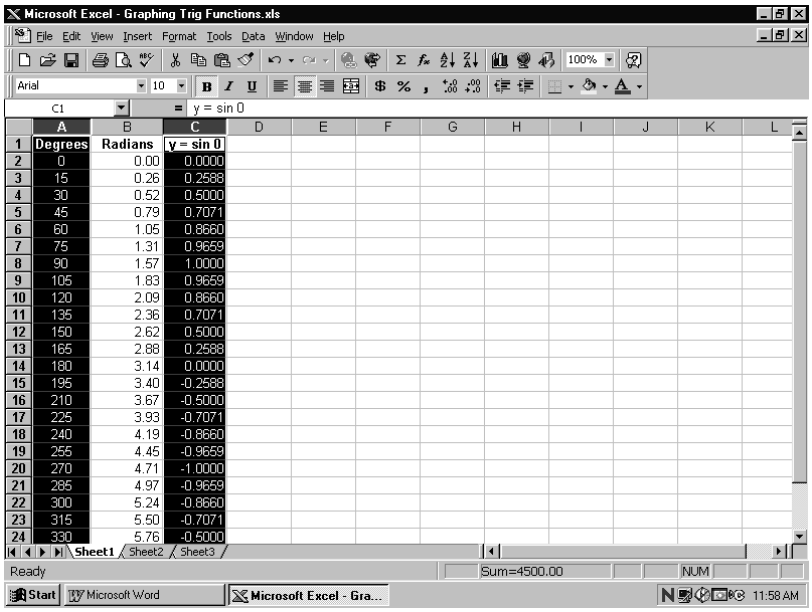
	A	B	C	D	E	H	I	J	K	L
1	Degrees	Radians	y = sin 0.							
2	0	0.00	0.0000							
3	15	0.26	0.2588							
4	30	0.52	0.5000							
5	45	0.79	0.7071							
6	60	1.05	0.8660							
7	75	1.31	0.9659							
8	90	1.57	1.0000							
9	105	1.83	0.9659							
10	120	2.09	0.8660							
11	135	2.36	0.7071							
12	150	2.62	0.5000							
13	165	2.88	0.2588							
14	180	3.14	0.0000							
15	195	3.40	-0.2588							
16	210	3.67	-0.5000							
17	225	3.93	-0.7071							
18	240	4.19	-0.8660							
19	255	4.45	-0.9659							
20	270	4.71	-1.0000							
21	285	4.97	-0.9659							
22	300	5.24	-0.8660							
23	315	5.50	-0.7071							
24	330	5.76	-0.5000							

We will now go on to producing a graph of **y = sin** q using Excel Chart Wizard

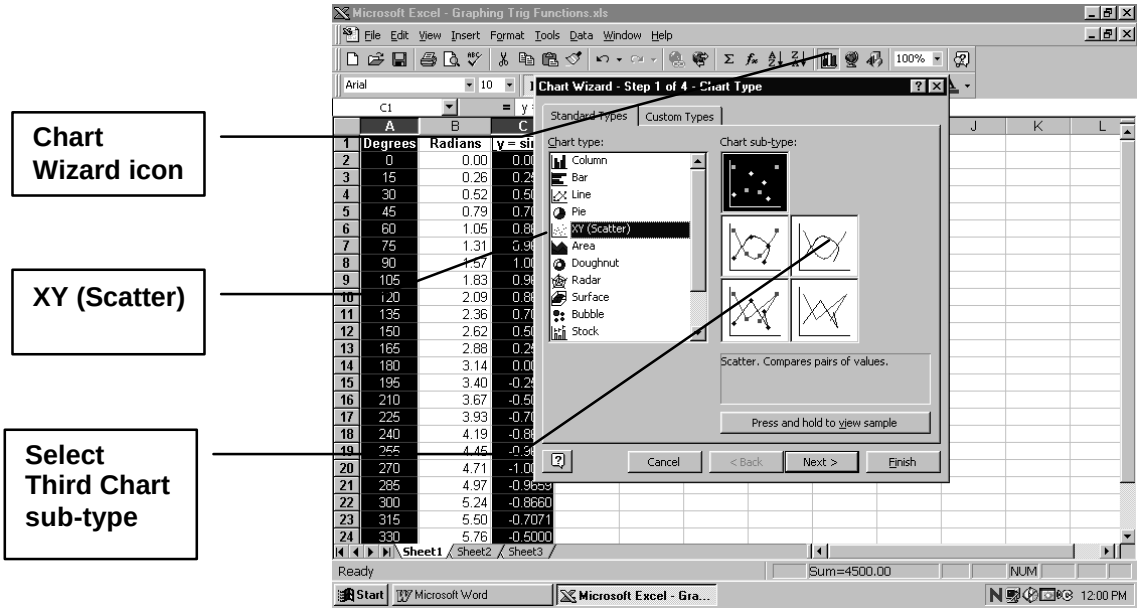
Step 4: Use Chart Wizard in Excel to Graph y = sin q

To make the Graph, you will need to **Select Column A** and **Column C** on your spreadsheet.

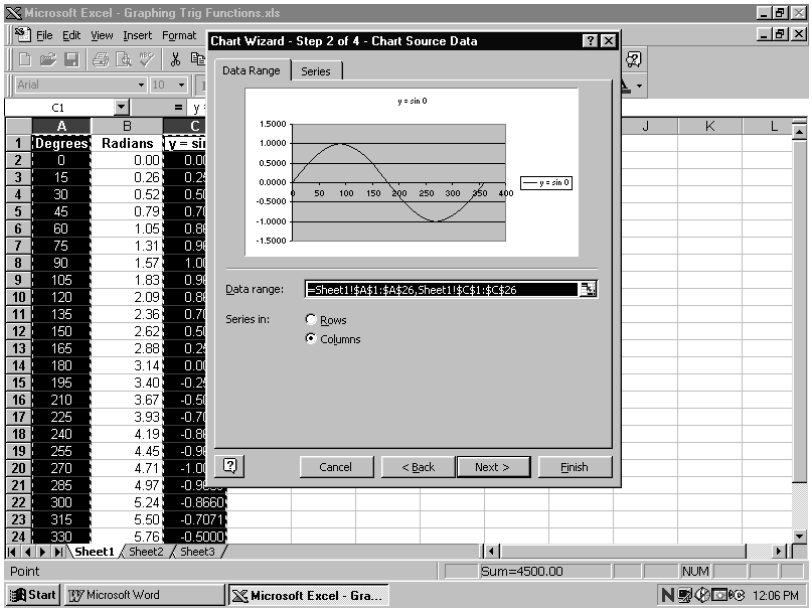
To do this, **Click on Column A** and then **holding down** Control (**Ctrl**), Click on **Column C.** This selects the two columns that you want to use for the graph.



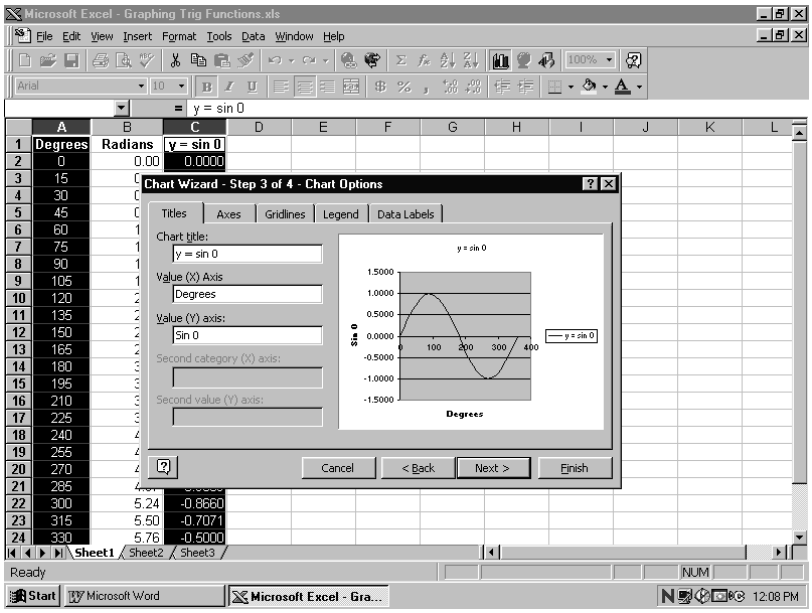
On the Excel Toolbar, select the **Chart Wizard icon** , then Select **XY(Scatter) Chart Type** and choose the **Third Chart Sub-type.** This the screen you will see



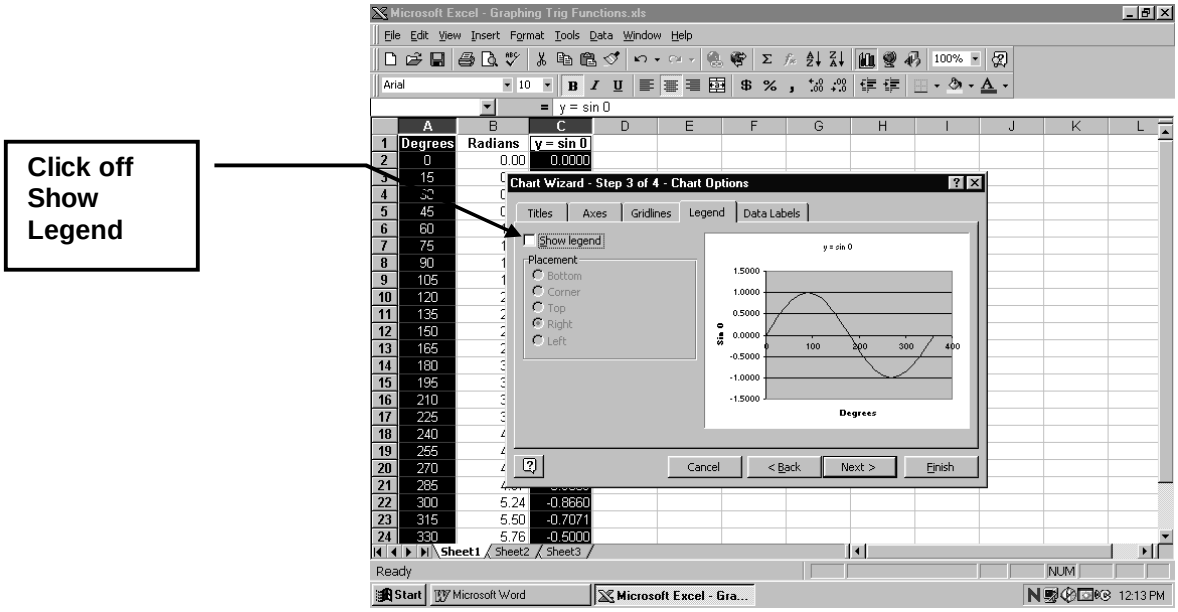
Now, Click on ***Next>***. You will see the graph as on this next screen.



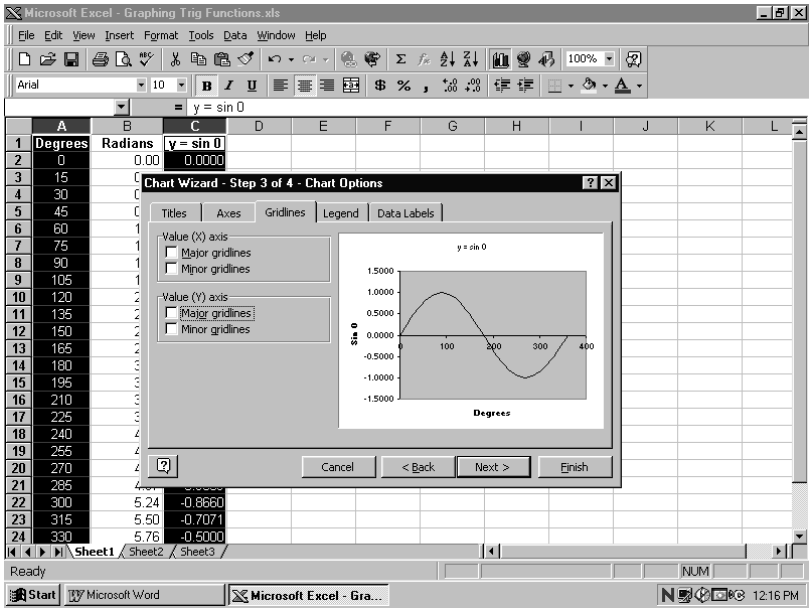
Click on ***Next>.*** Chart Title should already be there **y = sin** q
For **value (X) axis,** type in the label **Degrees.**
For **value (Y) axis**, type in label **sin** q**.**
These labels will appear on the graph



Next, Click on **Legend Tab**, and ***deselect*** by Clicking off check mark in **Show Legend**

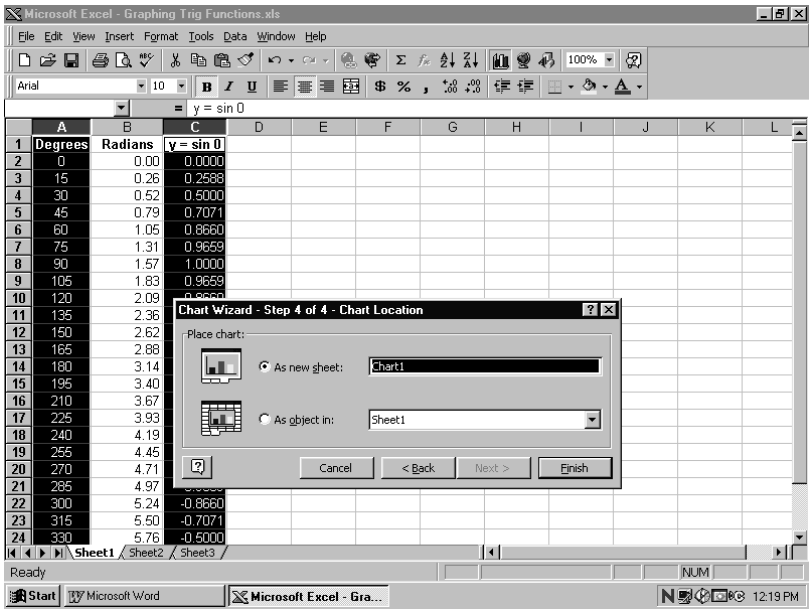


Next, remove gridlines. Select **Gridlines Tab** and ***deselect*** by Clicking off **Value (Y) axis Show Major Gridlines**

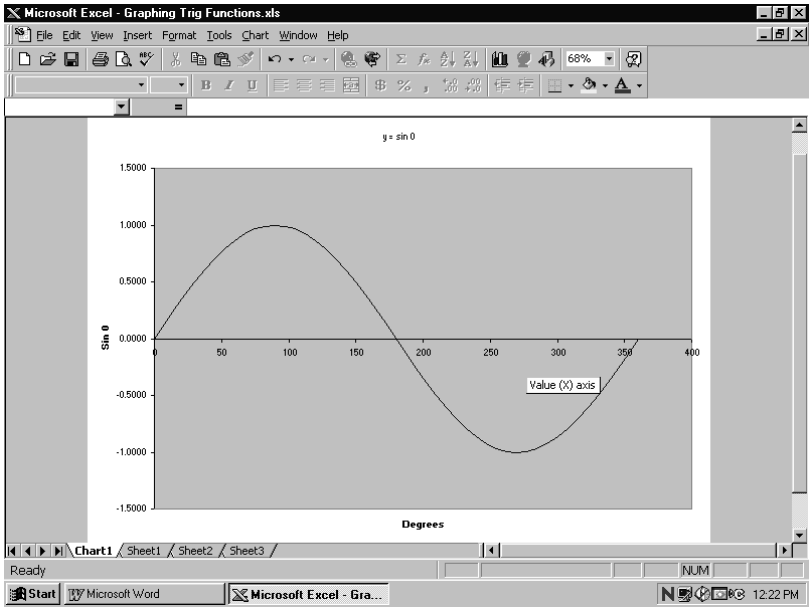


Click ***Next>***

For **Chart Location**, Select **Save as New Sheet** as shown on the following screen.



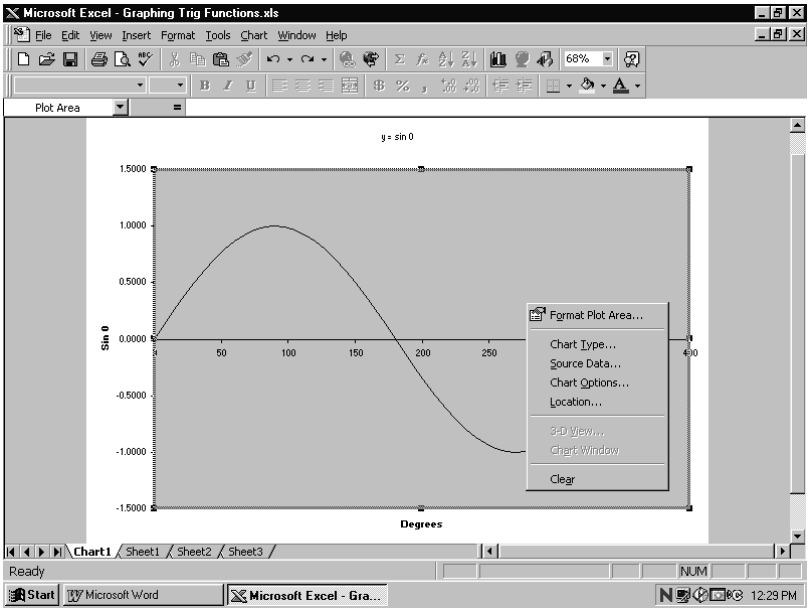
Now, Click on ***Finish***. The following graph appears.

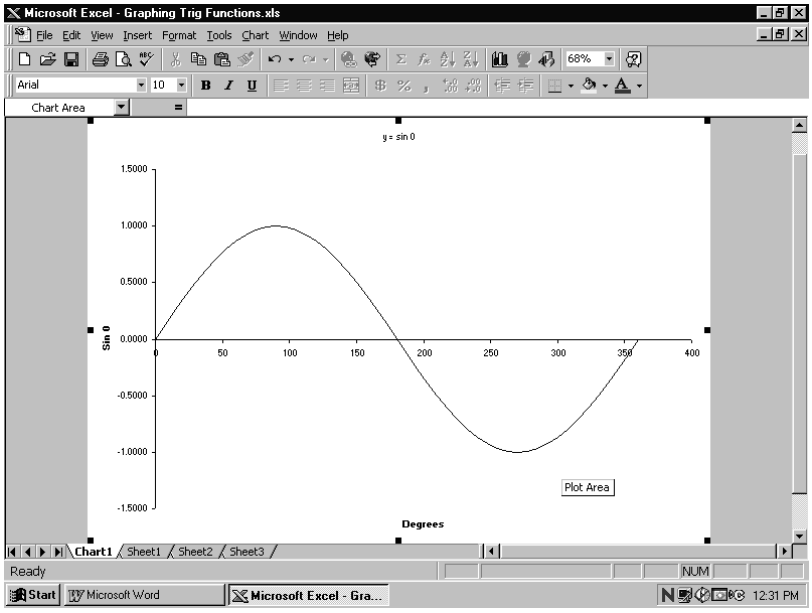


We can now do several steps to format or "dressup" the graph.
Now would be a good time to Save your work by Clicking on the **Save** icon

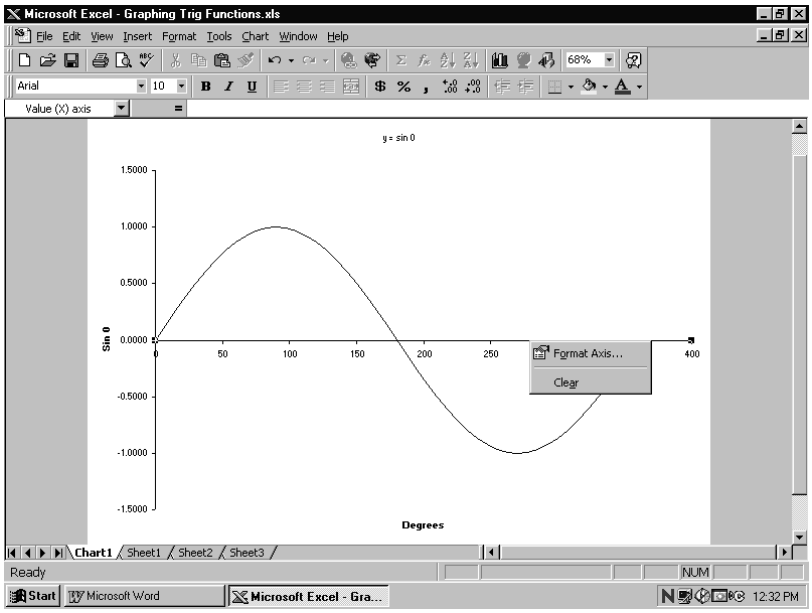
Step 5: Formatting the Graph of y = sin q

Right Click on the graph and a menu called **Format Plot area** will come up. Left Click on **Clear.** This will remove the grey graph background.

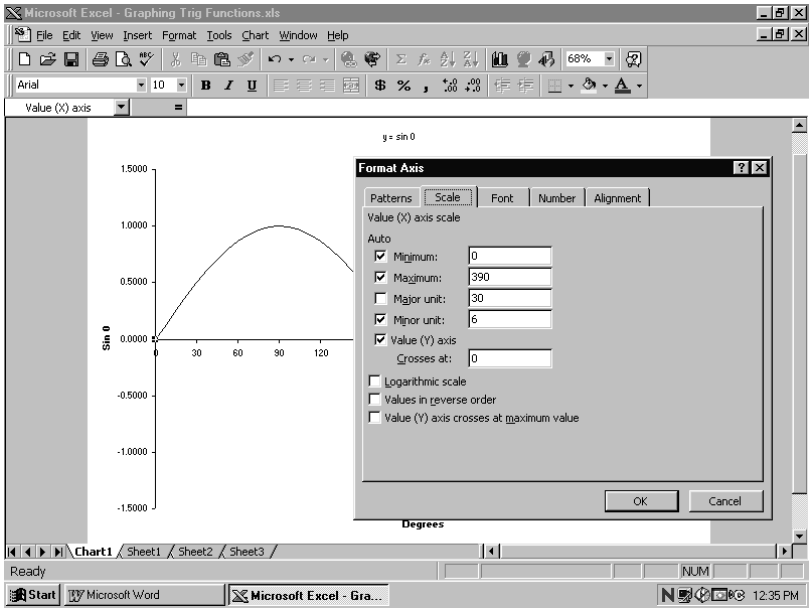




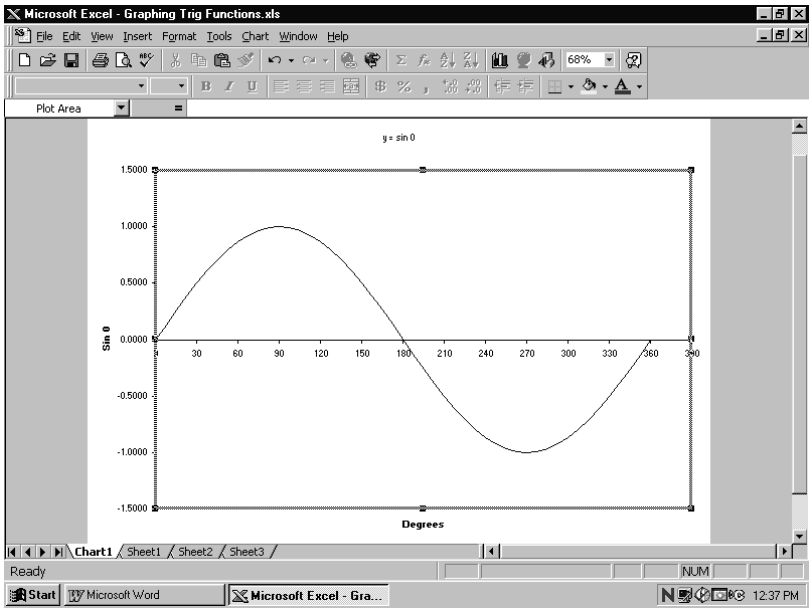
Next, Right Click on the x-axis. A **Format Axis** menu will appear.



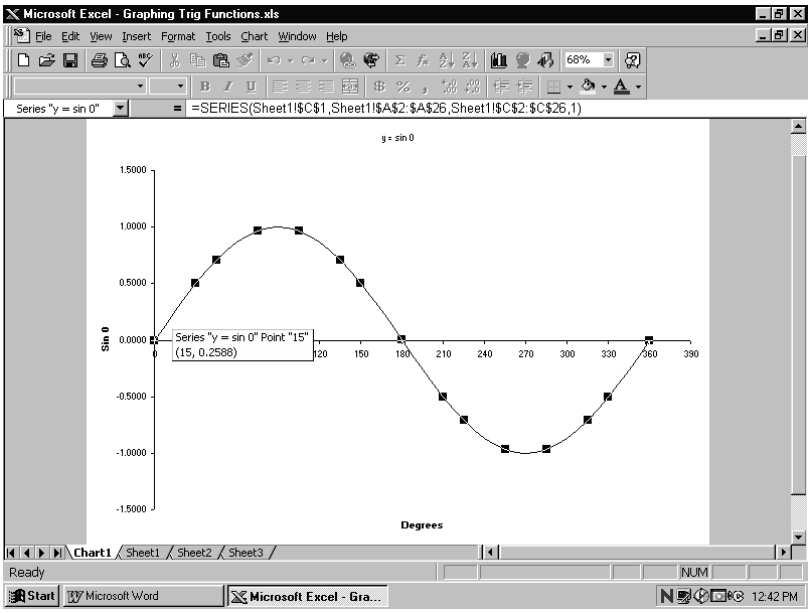
Left Click on **Format Axis** and select **Scale Tab**. Change the number in the **Major Unit** box to **30**. Then Click on OK

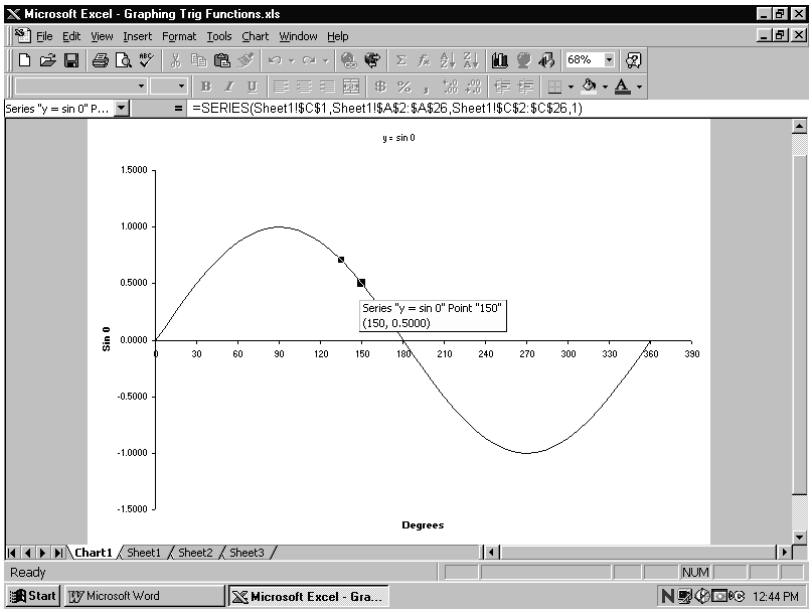


This is the completed graph for **y = sin** q



If you Left Click on the curved graph line, the plotted points will appear. You can then read the Sine Ratio for the degrees from 0° to 360° at 15° intervals.





Answer the following Questions by taking readings from your graph:

1. What is the sin ratio for: 45°
   180°
   165°
   225°
   270°
   330°
   360°

2. Which angle has the maximum sine ratio?
3. Which angle has the minimum sine ratio?
4. Which angles have a sine ratio of 0 ?

Practice Assignment 1:

1. Using the steps as shown in the Example, produce a graph for the trigonometric function:

   y = cos q

Using the graph you produce using Chart Wizard, answer the following questions:

2. What is the cosine ratio for: 45°
   180°
   165°
   225°
   270°
   330°
   360°

5. Which angles have the maximum cosine ratio?
6. Which angle has the minimum cosine ratio?
7. Which angles have a cosine ratio of 0 ?

Practice Assignment 2:

1. Using the steps as shown in the Example, produce a graph showing both trigonometric functions, **y = sin** q and **y = cos** q **<u>on the same graph</u>**

Using the graph you produce using Chart Wizard, answer the following questions:

2. What angles have the same sine and cosine value ?

3. At what degree is the cosine value at its maximum and the sine value is at 0?

4. At what degree is the cosine value at its minimum and the sine value is at 0 ?

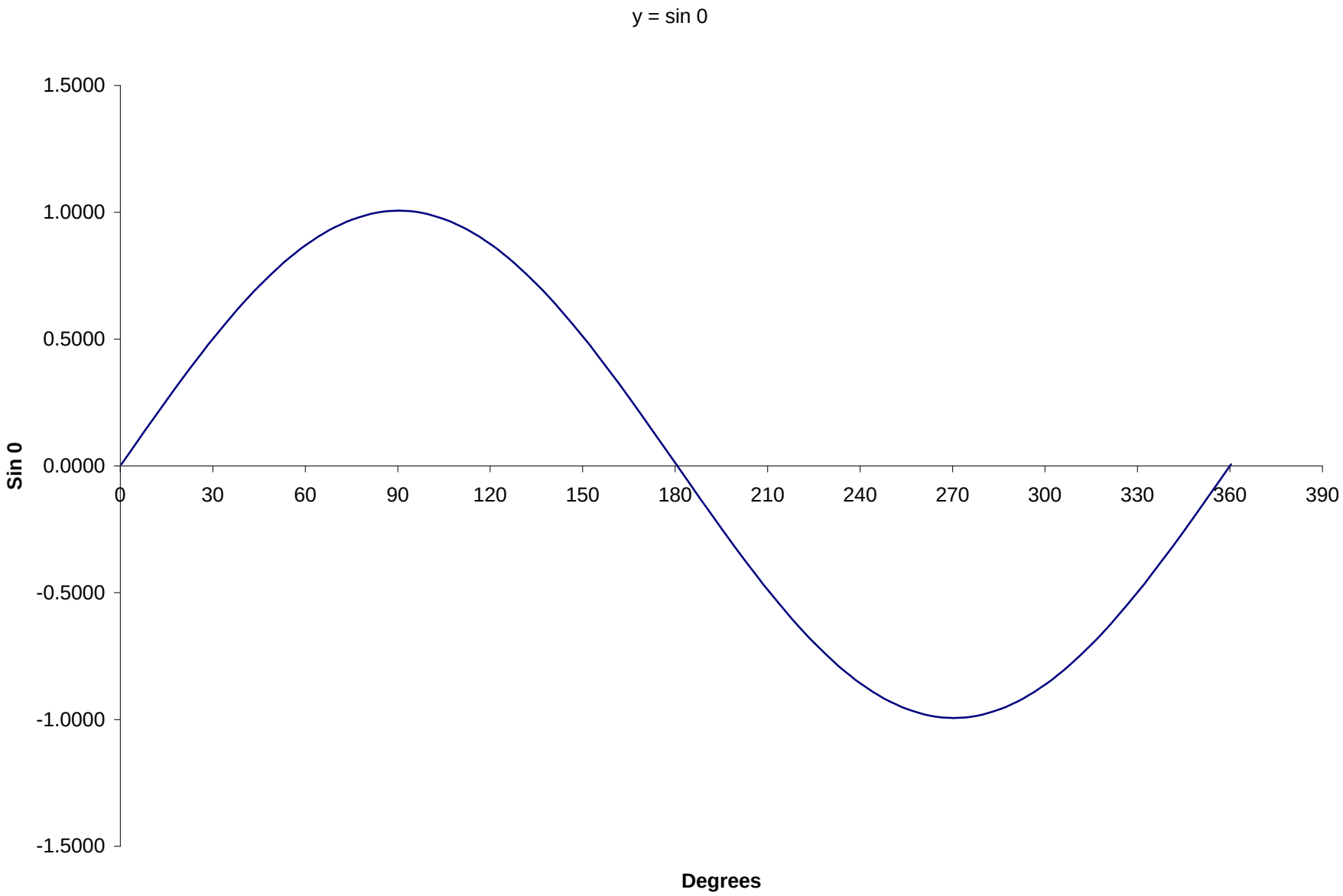
5. At what degree is the sine value at its minimum and the cosine value is at 0 ?

Practice Assignment 3:

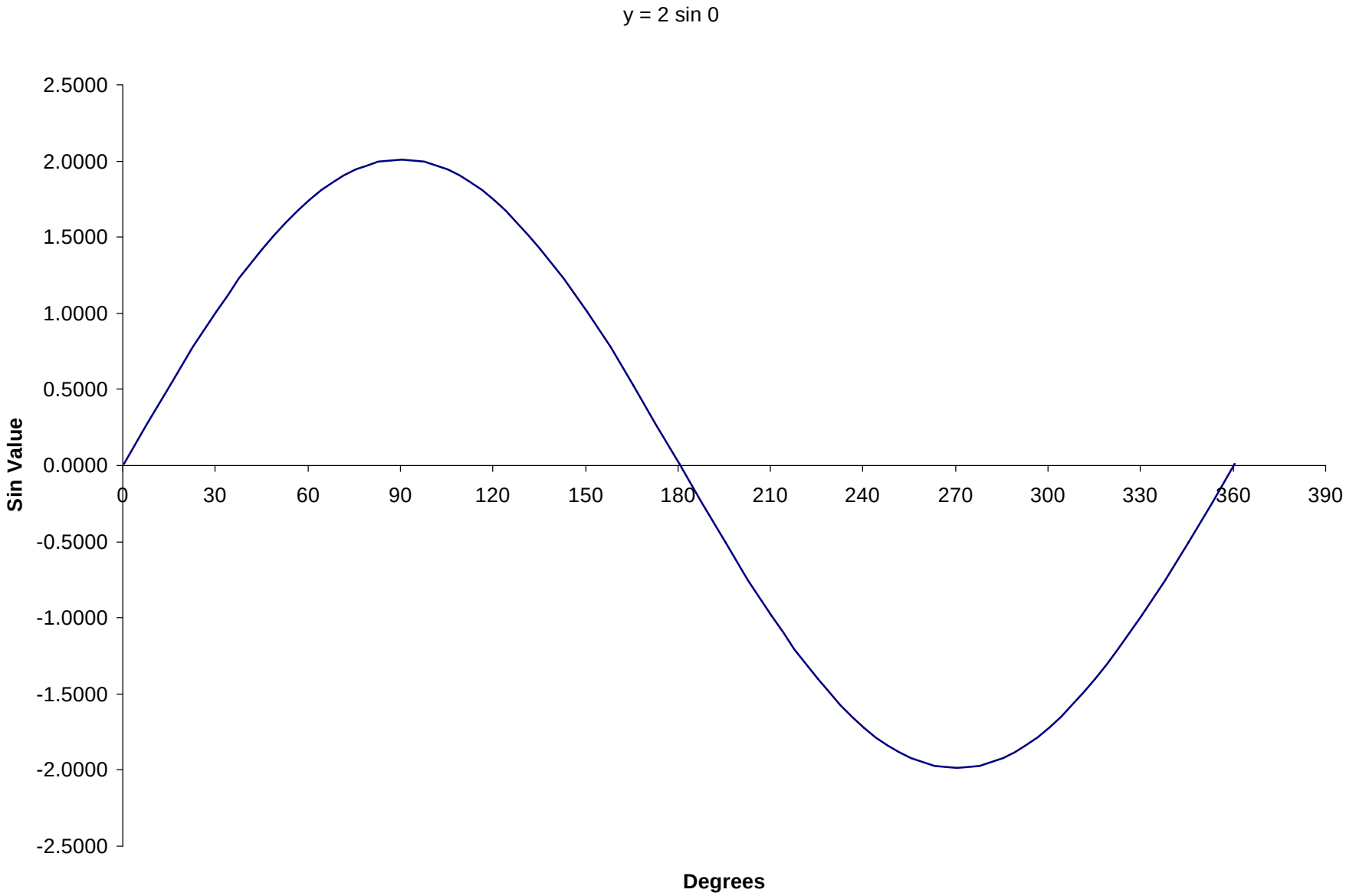
1. Using the steps as shown in the Example, produce a graph showing the trigonometric function, **y = 2 sin** q

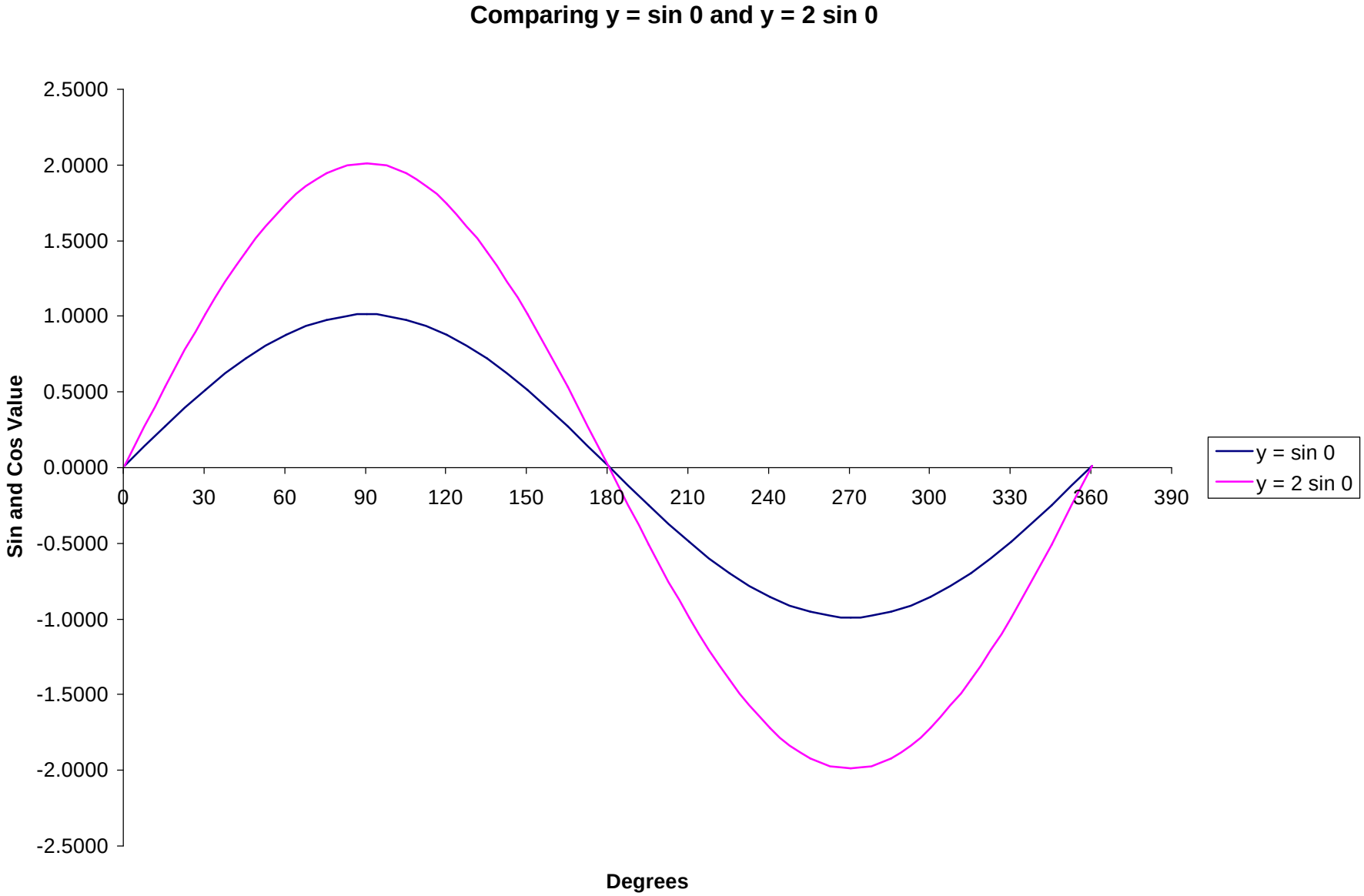
2. Finally, using Chart Wizard, produce a graph showing both **y = 2 sin** q and **y = sin** q on the **same graph**

3. By taking readings from your graph, at 30 °, 165° and 270° what can you say is the relationship between the sin values on the two curves.

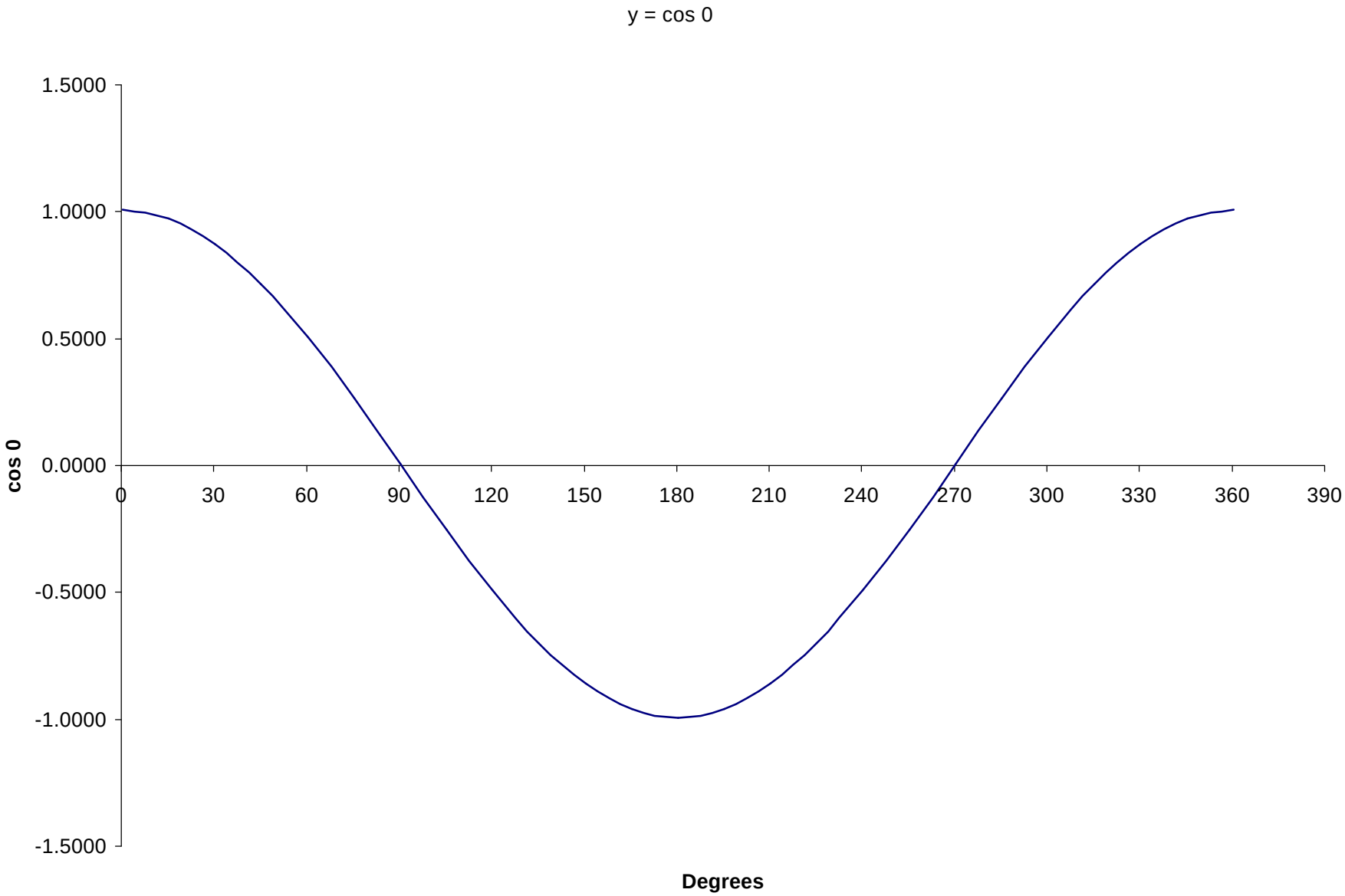

y = sin 0
1.5000
1.0000
0.5000
0.0000
-0.5000
-1.0000
-1.5000
Sin 0
0
30
60
90
120
150
180
210
240
270
300
330
360
390
Degrees

Degrees	Radians	y = sin 0
0	0.00	0.0000
15	0.26	0.2588
30	0.52	0.5000
45	0.79	0.7071
60	1.05	0.8660
75	1.31	0.9659
90	1.57	1.0000
105	1.83	0.9659
120	2.09	0.8660
135	2.36	0.7071
150	2.62	0.5000
165	2.88	0.2588
180	3.14	0.0000
195	3.40	-0.2588
210	3.67	-0.5000
225	3.93	-0.7071
240	4.19	-0.8660
255	4.45	-0.9659
270	4.71	-1.0000
285	4.97	-0.9659
300	5.24	-0.8660
315	5.50	-0.7071
330	5.76	-0.5000
345	6.02	-0.2588
360	6.28	0.0000

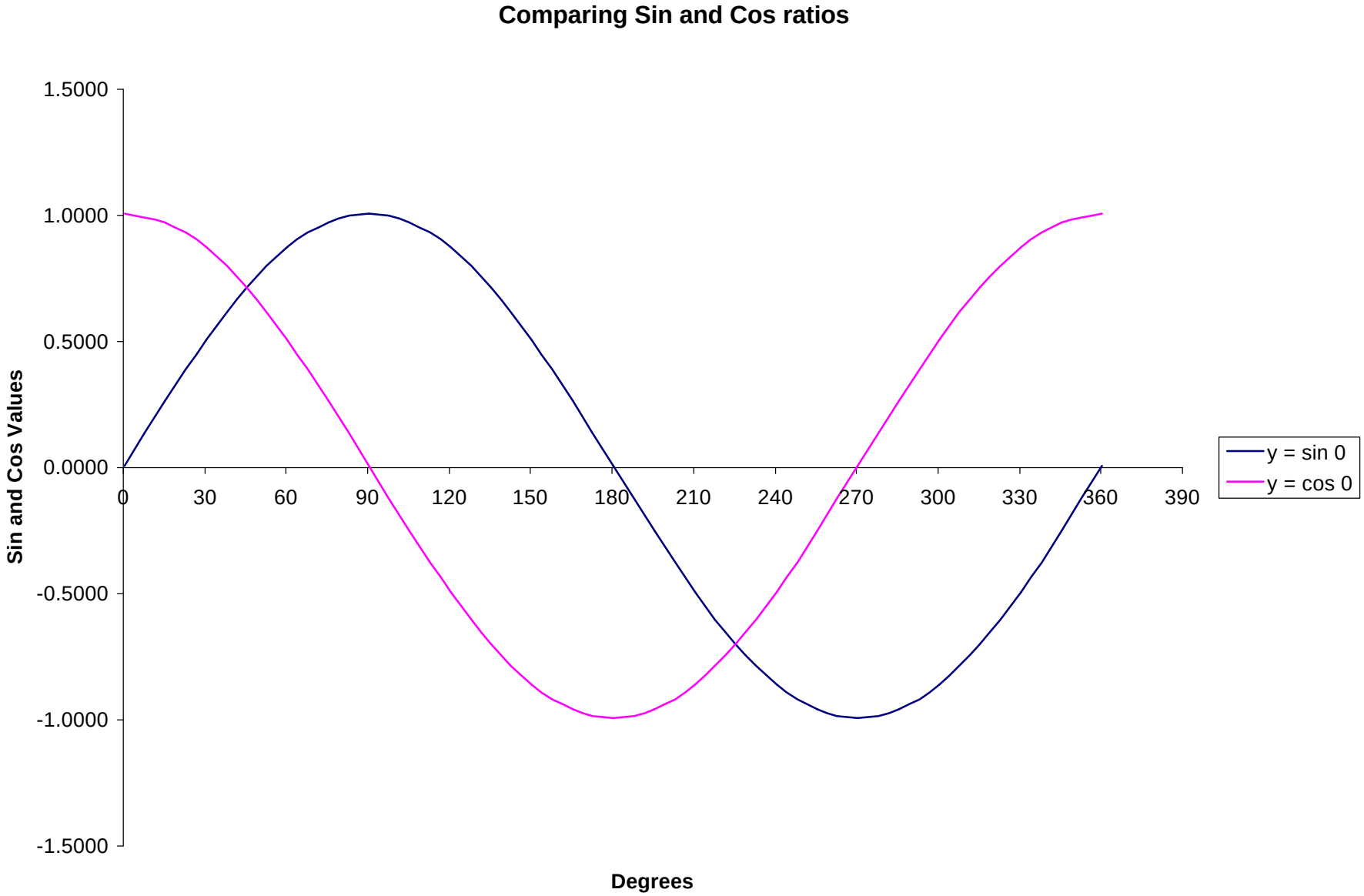

y = 2 sin 0
2.5000
2.0000
1.5000
1.0000
0.5000
0.0000
-0.5000
-1.0000
-1.5000
-2.0000
-2.5000
Sin Value
0
30
60
90
120
150
180
210
240
270
300
330
360
390
Degrees


Comparing y = sin 0 and y = 2 sin 0
2.5000
2.0000
1.5000
1.0000
0.5000
0.0000
-0.5000
-1.0000
-1.5000
-2.0000
-2.5000
Sin and Cos Value
0
30
60
90
120
150
180
210
240
270
300
330
360
390
Degrees
y = sin 0
y = 2 sin 0

Degrees	Radians	y = sin 0	y = 2 sin 0
0	0.00	0.0000	0.0000
15	0.26	0.2588	0.5176
30	0.52	0.5000	1.0000
45	0.79	0.7071	1.4142
60	1.05	0.8660	1.7321
75	1.31	0.9659	1.9319
90	1.57	1.0000	2.0000
105	1.83	0.9659	1.9319
120	2.09	0.8660	1.7321
135	2.36	0.7071	1.4142
150	2.62	0.5000	1.0000
165	2.88	0.2588	0.5176
180	3.14	0.0000	0.0000
195	3.40	-0.2588	-0.5176
210	3.67	-0.5000	-1.0000
225	3.93	-0.7071	-1.4142
240	4.19	-0.8660	-1.7321
255	4.45	-0.9659	-1.9319
270	4.71	-1.0000	-2.0000
285	4.97	-0.9659	-1.9319
300	5.24	-0.8660	-1.7321
315	5.50	-0.7071	-1.4142
330	5.76	-0.5000	-1.0000
345	6.02	-0.2588	-0.5176
360	6.28	0.0000	0.0000


y = cos 0
1.5000
1.0000
0.5000
0.0000
-0.5000
-1.0000
-1.5000
cos 0
0
30
60
90
120
150
180
210
240
270
300
330
360
390
Degrees

Degrees	Radians	y = cos 0
0	0.00	1.0000
15	0.26	0.9659
30	0.52	0.8660
45	0.79	0.7071
60	1.05	0.5000
75	1.31	0.2588
90	1.57	0.0000
105	1.83	-0.2588
120	2.09	-0.5000
135	2.36	-0.7071
150	2.62	-0.8660
165	2.88	-0.9659
180	3.14	-1.0000
195	3.40	-0.9659
210	3.67	-0.8660
225	3.93	-0.7071
240	4.19	-0.5000
255	4.45	-0.2588
270	4.71	0.0000
285	4.97	0.2588
300	5.24	0.5000
315	5.50	0.7071
330	5.76	0.8660
345	6.02	0.9659
360	6.28	1.0000


Comparing Sin and Cos ratios
1.5000
1.0000
0.5000
0.0000
-0.5000
-1.0000
-1.5000
Sin and Cos Values
0
30
60
90
120
150
180
210
240
270
300
330
360
390
Degrees
y = sin 0
y = cos 0

Degrees	Radians	y = sin 0	y = cos 0
0	0.00	0.0000	1.0000
15	0.26	0.2588	0.9659
30	0.52	0.5000	0.8660
45	0.79	0.7071	0.7071
60	1.05	0.8660	0.5000
75	1.31	0.9659	0.2588
90	1.57	1.0000	0.0000
105	1.83	0.9659	-0.2588
120	2.09	0.8660	-0.5000
135	2.36	0.7071	-0.7071
150	2.62	0.5000	-0.8660
165	2.88	0.2588	-0.9659
180	3.14	0.0000	-1.0000
195	3.40	-0.2588	-0.9659
210	3.67	-0.5000	-0.8660
225	3.93	-0.7071	-0.7071
240	4.19	-0.8660	-0.5000
255	4.45	-0.9659	-0.2588
270	4.71	-1.0000	0.0000
285	4.97	-0.9659	0.2588
300	5.24	-0.8660	0.5000
315	5.50	-0.7071	0.7071
330	5.76	-0.5000	0.8660
345	6.02	-0.2588	0.9659
360	6.28	0.0000	1.0000