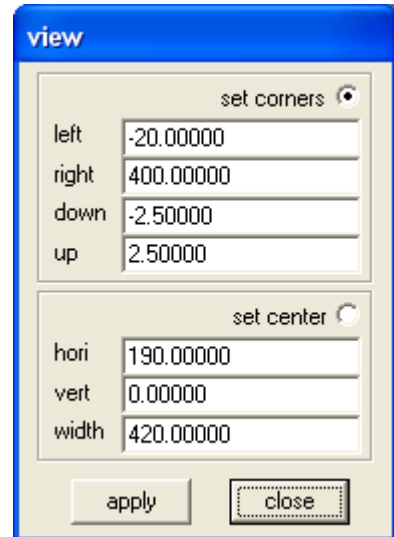




Simple trigonometric graphs using Winplot with degrees.

Winplot uses a measurement called radians instead of degrees. You will learn about radians in the Higher course but here is how to use Winplot with degrees.

1. Find and launch the Winplot program.
2. Select **Window** and **2 Dim** from the menu bar.
3. Select View and View.
Copy the values shown.
Check the **set corners** radio button then **apply**.

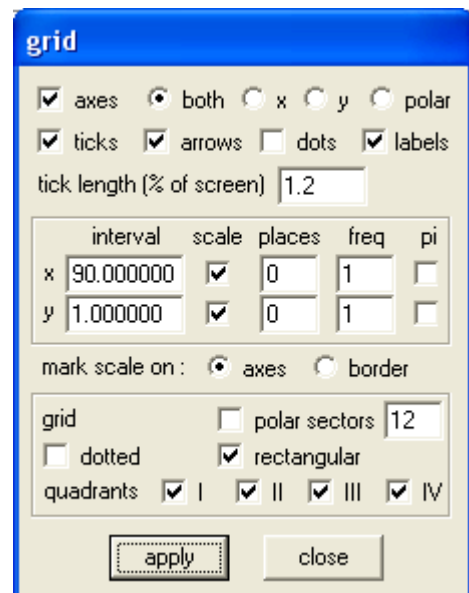


4. To improve the layout, select **Misc**, **Colors**, **Background** and choose white (then close this dialogue box).

Next, select view, grid.

Carefully change the values in this dialogue box to those shown opposite. You will also need to check some radio buttons.

Once completed, click **apply**.



5. Select View, Axes, Screen thickness and change this value to 2.

Finally click on the full screen icon in the display window.

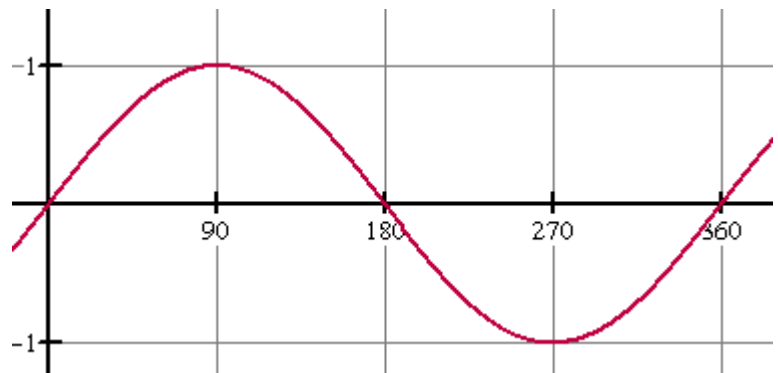


You should save these settings by selecting **File** then **Save As**. Choose a suitable location and name the file **360degrees**.

6. Let's begin by drawing $f(x)=\sin x$.
 Select **Equa, Explicit**. Delete the default function, $x\sin(x)$, and replace it with $\sin(x \text{ deg})$. Also change the pen width to 2.

Winplot needs to be told that you wish to work in degrees.
 That is why **x deg** must be used here.

Close the inventory box that appears and you should see the graph of $f(x)=\sin x$ as shown here.



Note the maximum and minimum values of $f(x)=\sin x$ and also the period of the graph.
 Select **equa, Inventory** and delete the graph. Close the inventory dialogue box.

7. Select **Equa, Explicit**. Delete the default function, $x\sin(x)$, and replace it with $\cos(x \text{ deg})$. Also change the pen width to 2.

Note the maximum and minimum values of $f(x)=\cos x$ and also the period of the graph.
 Select **equa, Inventory** and delete the graph. Close the inventory dialogue box.

8. Repeat step 7 for $f(x)=\tan x$, remembering to type $\tan(x \text{ deg})$ in the function box.

Of course, $f(x)=\tan x$ has no maximum or minimum but what is its period?

9. Check that there are no graphs on the current display by selecting **equa, Inventory** and deleting any entries. Close the inventory dialogue box.

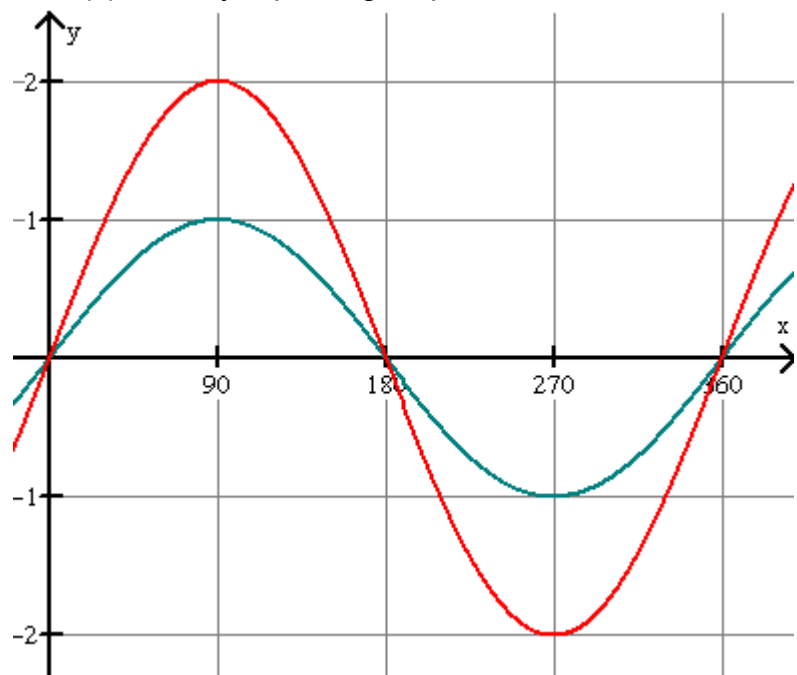
Ask Winplot to draw the graph of $f(x)=\sin x$ by repeating step 6.

Now select **Equa, Explicit** and enter the function $f(x)=2\sin x$, remembering to type $2\sin(x \text{ deg})$ in the function box.

How does the graph of $f(x)=\sin x$ compare with $f(x)=2\sin x$?

Note the new maximum and minimum values.

Has the period changed?

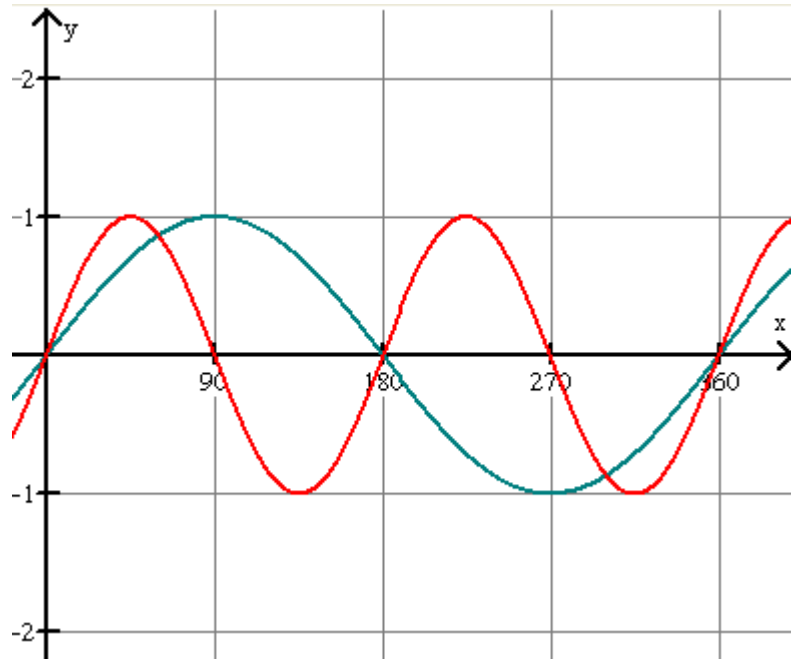


10. Select **Equa, Inventory** and delete the $f(x) = 2\sin x$ function.

Select **Equa, Explicit** and enter the function $f(x) = \sin(2x \text{ deg})$ and again set the pen width to 2.

Normally the function is written as $f(x) = \sin 2x$

Note the maximum and minimum values of the function.
What is the period of the graph?



Delete all graphs by selecting **Equa, Inventory** and use the delete button with each graph.

11. Let's look at $f(x) = \sin x$ and $f(x) = \cos x$ together.
Select **Equa, Explicit** and again enter $f(x) = \sin(x \text{ deg})$. Remember to use a pen width of 2 and choose a colour you can see clearly.
Select **Equa, Explicit** and enter $f(x) = \cos(x \text{ deg})$.

You should see the following.

Notice that both graphs are actually the same shape, but at different positions in the x-axis.

Notice also that the graphs intersect each other. You can determine this point approximately using Winplot.

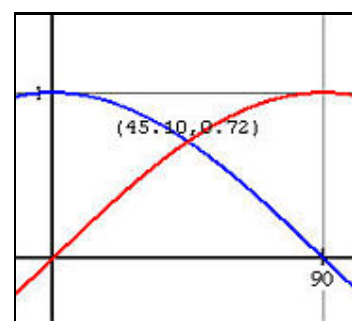
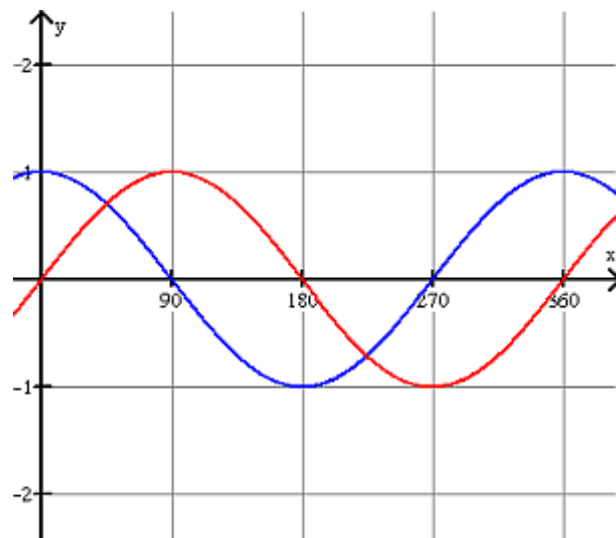
Select Misc, Decimal Places and change the value to 2.

Use the mouse to position the cursor over the intersection point.

Now left click the mouse and a coordinate will appear.

Although not exact, you should find the x value to be about 45° .

Check if $\sin(45^\circ) = \cos(45^\circ)$ on your calculator.



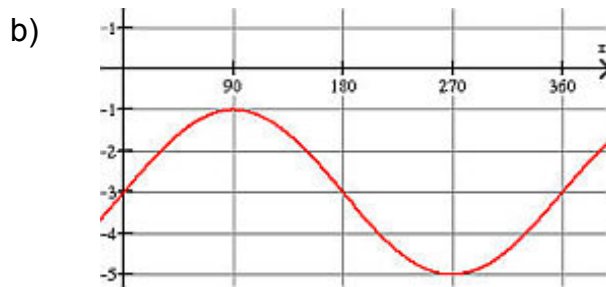
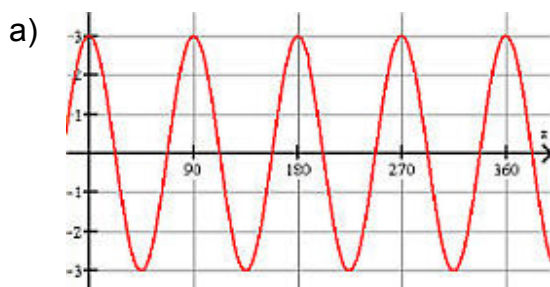
Now try the following exercise with Winplot. If you find yourself in a mess, simply select **File, Open** and locate your **360degrees** file.

Exercise (delete the graphs between questions)

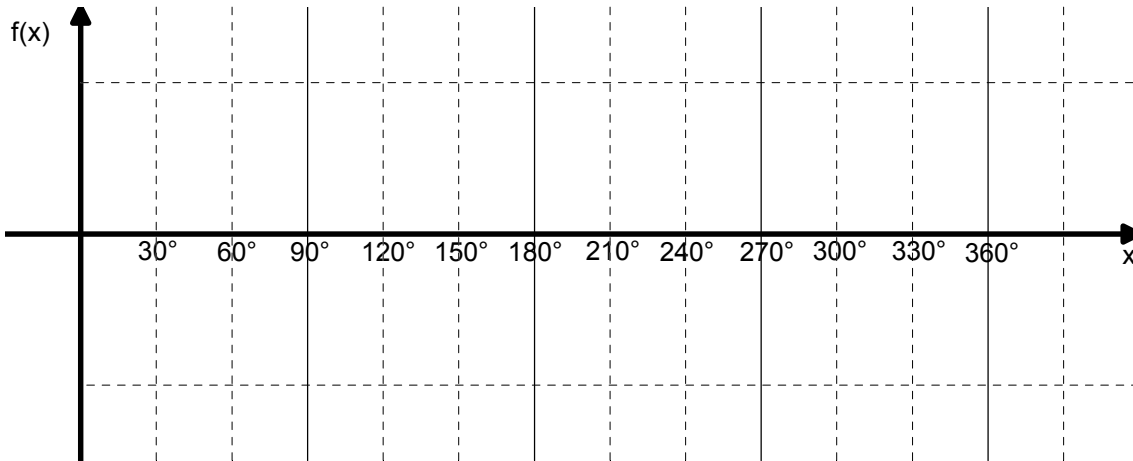
1. Use Winplot to draw $f(x) = 2 \cos x$. Remember to type **2cos(x deg)** in the function box. Complete the following:-
Maximum value of $f(x) = 2 \cos x$ is _____, Minimum value of $f(x) = 2 \cos x$ is _____.
The period of $f(x) = 2 \cos x$ is _____ °.
2. Use Winplot to draw $f(x) = \cos 3x$. Remember to type **cos(3x deg)** in the function box. Complete the following:-
Maximum value of $f(x) = \cos 3x$ is _____, Minimum value of $f(x) = \cos 3x$ is _____.
The period of $f(x) = \cos 3x$ is _____ °.
3. Use Winplot to draw $f(x) = 2 \cos 3x$. Remember to type **2cos(3x deg)** in the function box. Complete the following:-
Maximum value of $f(x) = 2 \cos 3x$ is _____, Minimum value of $f(x) = 2 \cos 3x$ is _____.
The period of $f(x) = 2 \cos 3x$ is _____ °.

Now change the view by selecting View, View and change the up value to 5.5 and the down value to -5.5. Apply the changes.

4. Use Winplot to draw the graph of $f(x) = \sin x + 2$. Remember to type **sin(x deg)+2** in the function box. Complete the following:-
Max value of $f(x) = \sin x + 2$ is _____, Min value of $f(x) = \sin x + 2$ is _____.
The period of $f(x) = \sin x + 2$ is _____ °.
5. Use Winplot to draw the graph of $f(x) = 3 \cos x - 1$. Remember to type **3cos(x deg)-1** in the function box. Complete the following:-
Max value of $f(x) = 3 \cos x - 1$ is _____, Min value of $f(x) = 3 \cos x - 1$ is _____.
The period of $f(x) = 3 \cos x - 1$ is _____ °.
6. Identify the two graphs below.



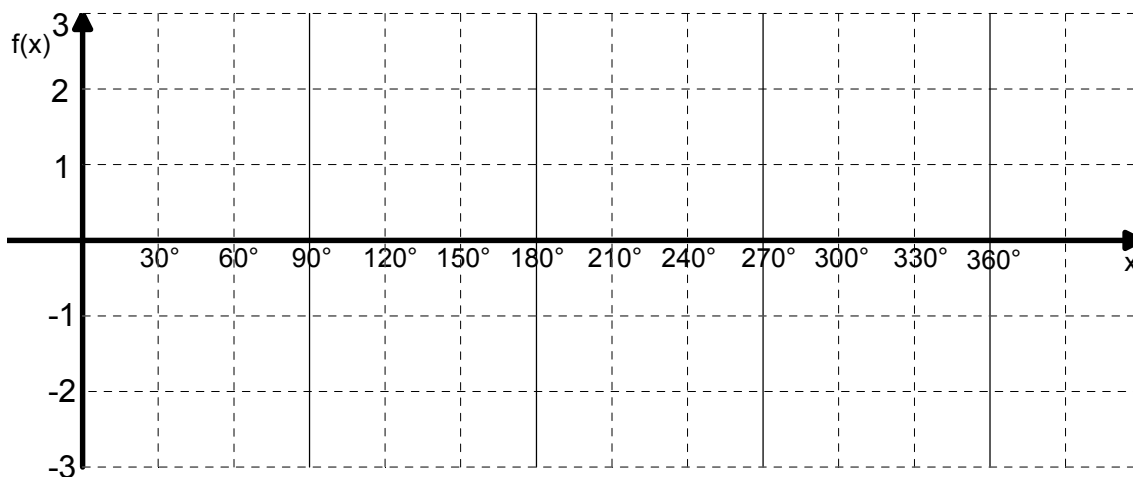
7. Try making a sketch of the graph $f(x) = \sin 3x$ on the grid below.



Clearly mark in the maximum and minimum values.

Check you graph by plotting $f(x) = \sin(3x \text{ deg})$ on Winplot.

8. Sketch the graph of $f(x) = 2 \cos 2x - 1$ on the grid below.



Check you graph by plotting $f(x) = 2\cos(2x \text{ deg}) - 1$ on Winplot.

9. What does the graph of $f(x) = -\sin x$ look like?
Use Winplot to find out by plotting $f(x) = -\sin(x \text{ deg})$
Describe the effect of the minus sign in words below.

10. Ask Winplot to draw the following graphs and discuss your results with a friend.
- a) $f(x) = \cos \frac{x}{2}$ (note the max, min and period)
 - b) $f(x) = -\tan x$ (note again the effect of the negative)
 - c) $f(x) = \sin x / \cos x$ (do you recognise this graph as something else)
 - d) $f(x) = \sin(90 - x)$ (This must be entered as $f(x) = \sin((90-x) \text{ deg})$,
....do you recognise this graph as something else)

Experiment with your own choice of graphs with your learning partner.