**Sinusoidal functions and radian measure**

The radian is an alternative unit for angles which you should know about at AS level to describe the **phase** of waves, i.e. what part of the cycle they are on. Radians are also used for A2 work in circular motion and oscillations.

All you need to know about radians is that one full cycle is 2π radians. In other words:

2π radians = 3600

Complete the following table. **You will need to set your calculator into radian mode** – ask if you need help. **When you have finished, remember to set your calculator back into degrees mode!**

(Note that sin 2 θ means the value of sin θ squared, as opposed to sin θ2)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| θ | Sin θ | Cos θ | Sin 2 θ | Cos 2 θ | Sin 2 θ + Cos 2 θ |
| 0 |  |  |  |  |  |
| π/6 |  |  |  |  |  |
| π/3 |  |  |  |  |  |
| π/2 |  |  |  |  |  |
| 2 π/3 |  |  |  |  |  |
| 5 π/6 |  |  |  |  |  |
| π |  |  |  |  |  |
| 7 π/6 |  |  |  |  |  |
| 4 π/3 |  |  |  |  |  |
| 3 π/2 |  |  |  |  |  |
| 5 π/3 |  |  |  |  |  |
| 11 π/6 |  |  |  |  |  |
| 2 π |  |  |  |  |  |

* What do you notice about the column of Sin 2 θ + Cos 2 θ values?

**Plotting sinusoidal functions**

You are now going to use the values in your table to plot some graphs which you may meet in Physics:

* **Wave graphs and waveforms:**

Plot a graph of Sin θ on the y-axis against θ on the x-axis. Note that the values of Sin θ vary from -1 to +1, so you will need to draw your x-axis across the middle of the graph paper. **Don’t try to work out decimal values of π – simply divide you x scale into 12 units of π/6.**

When you have done this, add to your graph in different colour a plot of Cos θ against θ, using the same θ axis as before.

* **Rotating Polaroids:**

When two sheets of Polaroid are placed on top of each other and rotated, the light transmitted varies between full brightness and nothing. The intensity of the transmitted light is given by:

I = Io Cos 2 θ

Where Io is the maximum intensity and θ is zero when the Polaroids are aligned.

Plot a graph of Cos 2 θ on the y-axis against θ on the x-axis. In this case the y-axis values vary between 0 and 1.

You should find the graph plots the variation in intensity from light (1) to dark (0).

* **Lissajous Figures:**

A possible extension activity for the C.R.O. experiment is to display the inputs from 2 separate signal generators on the 2 channels. By pressing the X-Y button, one signal is plotted against the other and it is possible to produce some interesting shapes. To model this, plot a graph of Sin θ on the y-axis against Cos θ on the x-axis.

Note that both quantities vary from -1 to +1, and so the axes will need to be drawn in the middle of the graph paper, giving 4 quadrants.

What shape is produced?