To Y13 Calculus

This is part of an article I wrote for the New Zealand Mathematics Magazine a few years ago. It has a LOT of things in it that you NEED to know.

WHY DO WE BOTHER WITH RADIANS IN YEAR 12/13 MATHEMATICS?

The ONLY reason to use radians in preference to using degrees is when we differentiate or integrate trigonometric functions in Year 13 Calculus. (***You will learn this later***.)

In all other situations such as calculating arc length, area of sectors, sketching graphs, solving trigonometric equations and modelling, there is no real need for radians.

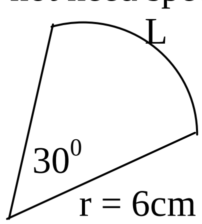
The special "aesthetic quality" of radians is simply a myth!

Both "radians" and "degrees" are really just different ways of measuring angles, just as "metres" and "feet" are just different ways of measuring lengths.

The requirement for students to use radians at this level is making mathematics <u>more inaccessible</u> than it needs to be.

Eg

We do not need special radian formulae to find **arc length** and **areas of sectors**.



This is simply $\frac{30^{th}}{360}$ or $\frac{1^{th}}{12}$ of a full circle.

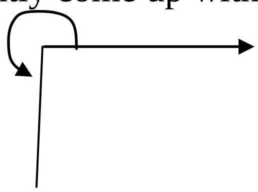
so arc length $L = \frac{1}{12} \times \pi d = \frac{1}{12} \times \pi \times 12 = \pi$ cm

and Area $A = \frac{1}{12} \times \pi r^2 = \frac{1}{12} \times \pi \times 36 = 3\pi$ cm^2

There is **never** a need to resort to formulae such as $\mathbf{L = r\theta}$ or $\mathbf{A = \frac{1}{2} r^2\theta}$ when all that is required is simple YEAR 9 LEVEL LOGIC.

<u>My next point is this: Who really THINKS in radians?</u>

Ask **any** mathematician or scientist to **VISUALISE an angle of 4.7 rads.**
On the other hand, ask any Year 9 student to visualise an angle of 269^0 and they will confidently come up with an angle as follows :



Now be honest, did YOU know that 4.7 rads is just less than 270^0?

When we SAY we are using radians, we are **usually** talking about angles such as:
$\frac{\pi}{6}$, $\frac{\pi}{4}$, $\frac{3\pi}{2}$, 2π etc

Again, if we are honest, when we are talking about $\frac{\pi}{6}$ radians **we really mean 30^0**,

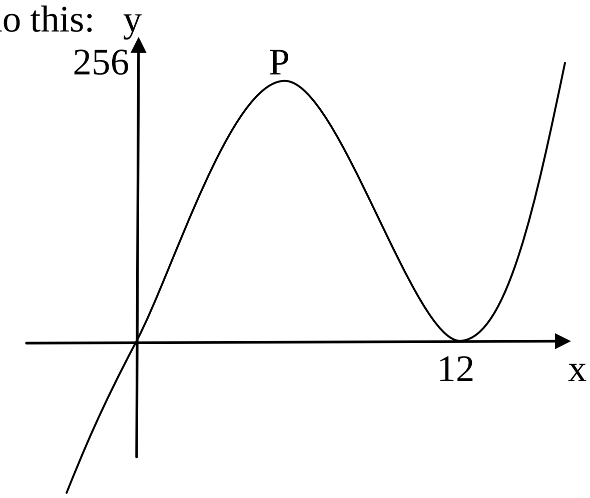
Actually, $\frac{\pi}{6}$ radians is really just 30^0 **in disguise** !!

The actual value of $\frac{\pi}{6}$ is of course 0.523598775… How silly is that?

Similarly $\frac{\pi}{4}$ is really 45^0 , $\frac{3\pi}{2}$ is really 270^0 and 2π radians is really 360^0

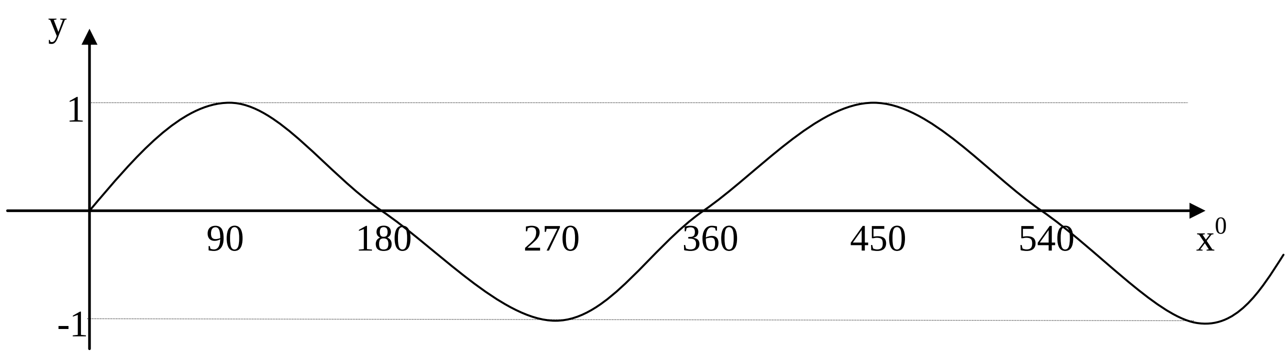
We do not use angles of $\frac{\pi}{7}$ for instance, **because it has no nice equivalent in degrees**!

Some people say we use radians so that the x and y scales on the trig graphs are more even. Let's get real! When we sketch a cubic graph such as $y = x(x - 12)^2$
we just do this:

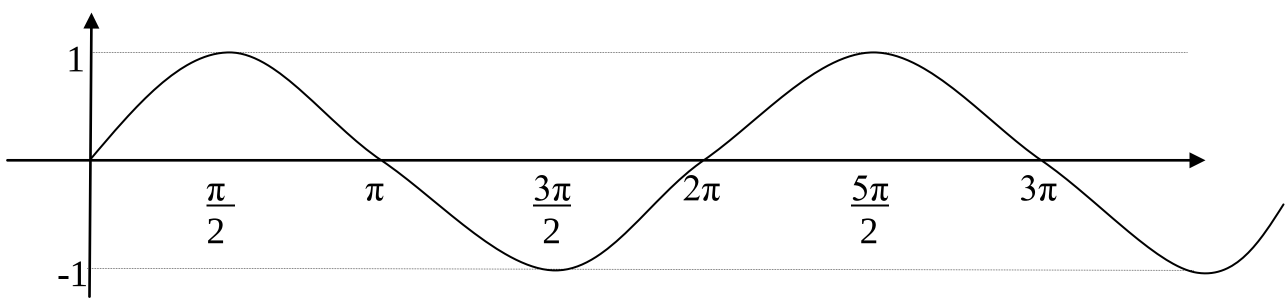


We do not concern ourselves that the scales are not even!
The coordinates of P are (4, **256**) ?

Similarly the graph of $y = \sin x$, where x is in degrees, is fine just the way it is.
The scales on x and y axes **do not** have to be the same.

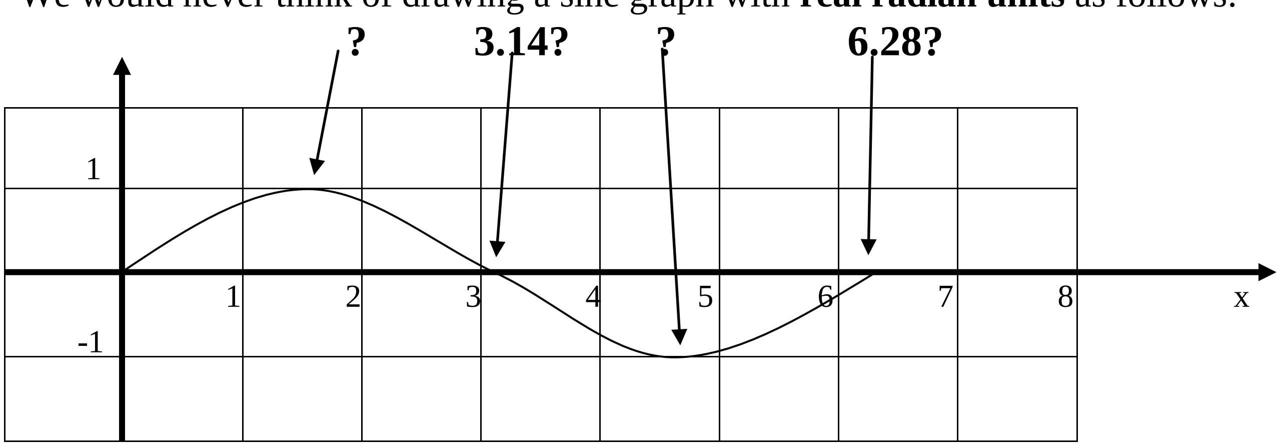


<u>Now here is a VERY interesting point</u>.
When we draw a sine graph with a "radian scale", this is what we draw:



This is an absolute fraud!
We are really marking the special points as they occur **in degrees**.

We would never think of drawing a sine graph with **real radian units** as follows:



The intercepts on the x axis and positions of max/min points are not at all obvious!