Introductory Notes

How to graph "WILL YOU MARRY ME?" using just one equation.

Thank you for downloading this file. In it, you will find a very large equation and graph paper.

In order to understand the equation and graph it successfully, a number of very important graphing skills are used. They are described for you.

I recommend that you carefully read the instructions and graph the equation yourself before passing the document on to someone else ☺.

You may wish to print out the following pages and hand them to your friend. Alternatively, you can download the shorter file from my website. It is simply the identical information without this first page. You can then send it electronically if you wish.

If you genuinely have a special person that you propose to using this graph, please consider posting a video on YouTube and linking it as a response to my video. That would be greatly appreciated. Thank you and best wishes!

Graeme

A Life-Changing Equation

Allow me to introduce a life-changing equation to you. Although it is extremely long and detailed, it is not particularly difficult to understand or graph.

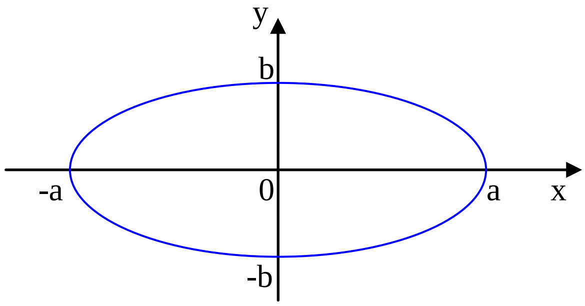
Let me explain the principles involved, and then you can go ahead and graph the result!

First, observe that the equation is made up of lots of factors (enclosed by brackets []) that multiply to give zero. I hope you can also see that each factor, except the last one, has the same structure — an x-term squared plus a y-term squared minus one.

Explaining Each Factor

Step One (Constructing the Equation or an Ellipse)

Each of these factors describes an ellipse — an ellipse made so thin that it looks like a line interval. The equation for an ellipse has the form $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$. This is very similar to the equation for a circle, $x^2+y^2=1$, except that the extra constants, a^2 and b^2 distort the shape. If you closely examine the equation for the ellipse you will notice that, when $x=0$, the first term has a zero value and $\frac{y^2}{b^2}=1$ which means that $y=\pm b$. Similarly, when $y=0$, the second term has a zero value and $\frac{x^2}{a^2}=1$ which means that $x=\pm a$. This produces a graph like the one below:



Step Two (Making the Ellipse Look Like Very Flat, Like a Line Interval)

In order to get a very thin horizontal ellipse (that looks like a line interval to the naked eye), we need b to have a value of, say, $\frac{1}{1000}$. This means that b^2 will have a value of $\frac{1}{1{,}000{,}000}$ or 10^{-6}.

This will produce equations of the form $\frac{x^2}{a^2}+\frac{y^2}{10^{-6}}=1$. Such equations are more easily written in the form $\frac{x^2}{a^2}+10^6 y^2=1$.

Similarly, very thin vertical ellipses would be written in the form $10^6 x^2+\frac{y^2}{b^2}=1$.

Step Three (Making the Interval a Given Length)

Now that we have very thin ellipses, how do we make the ellipse the **length** that we want? Let's play with the above graph above a bit more. If we have constructed a very thin horizontal ellipse (by making b a very small number as we just described, the length of the ellipse is governed by the value of a. If we need an ellipse that is four units long, then a would have the value 2 (i.e. 2 units each side of the origin). For an ellipse two units long, a would have a value of 1. For an ellipse one unit long, a would have a value of 0.5.

In the formula for the ellipse you will notice that we use the expression a^2.

So, for an ellipse four units long, $a = 2$ and $\frac{x^2}{4} + 10^6 y^2 = 1$. This describes a very thin ellipse that extends from $x = -2$ to $x = +2$.

For an ellipse three units long, $a = 1.5$ and $\frac{x^2}{2.25} + 10^6 y^2 = 1$. This describes a very thin ellipse that extends from $x = -1.5$ to $x = +1.5$).

For an ellipse two units long, $a = 1$ and $\frac{x^2}{1} + 10^6 y^2 = 1$. This describes a very thin ellipse that extends from $x = -1$ to $x = +1$).

For an ellipse one unit long, $a = 0.5$ and $\frac{x^2}{0.25} + 10^6 y^2 = 1$. This describes a very thin ellipse that extends from $x = -0.5$ to $x = +0.5$).

Step Four (Moving the Ellipse to a New Location on the Plane)

If every ellipse was centred on the origin, we would not have much scope at all for variety and fun. Fortunately, it is very easy to move any graph to a new location. To shift the centre of the ellipse to (3,2), for example, we need the formula to behave at this point as though it was still back at the origin (0,0). This is achieved by altering the x values by 3 and the y values by 2 before any other operations are carried out on them. The term (x – 3) gives a value of zero when x = 3; and the term (y – 2) gives a value of zero when y = 2.

The ellipse $\frac{(x-3)^2}{a^2} + \frac{(y-2)^2}{b^2} = 1$ has been moved so that its centre is at (3, 2).

Similarly, $10^6(x-24)^2 + \frac{(y-1.5)^2}{0.25} = 1$ has been moved so that its centre is at (24, 1.5).

And $10^6(x-25)^2 + \frac{(y+0.5)^2}{0.25} = 1$ has been moved so that its centre is at (25, -0.5).

Step Five (How to Put Lots of Ellipses in the One Equation and Graph)

This last step is also based on a very simple concept. It depends upon my favourite "times table," the zero times table! You know that any number times zero yields zero as the answer. In fact, you could multiply many numbers together. As long as one of them is zero, the answer will be zero. Mathematicians use this concept in algebra as well. If we write (x + y – 7)(x – y + 1)(xy – 4) = 0, then any one of those three factors could be zero! I.e., x + y – 7 = 0, or x – y + 1 = 0, or xy – 4 = 0.

In order to do that with our ellipses, we rearrange their equations so they equal zero.

$\frac{(x-3)^2}{a^2}+\frac{(y-2)^2}{b^2}=1$ would become $\frac{(x-3)^2}{a^2}+\frac{(y-2)^2}{b^2}-1=0$.

$10^6(x-24)^2+\frac{(y-1.5)^2}{0.25}=1$ would become $10^6(x-24)^2+\frac{(y-1.5)^2}{0.25}-1=0$.

And $10^6(x-25)^2+\frac{(y+0.5)^2}{0.25}=1$ would become $10^6(x-25)^2+\frac{(y+0.5)^2}{0.25}-1=0$.

We can then assemble them all into one long product equal to zero. Each factor of this long equation describes a separate ellipse, but they all belong to the same formula and graph!

Step Six (Beginning Our Graph)

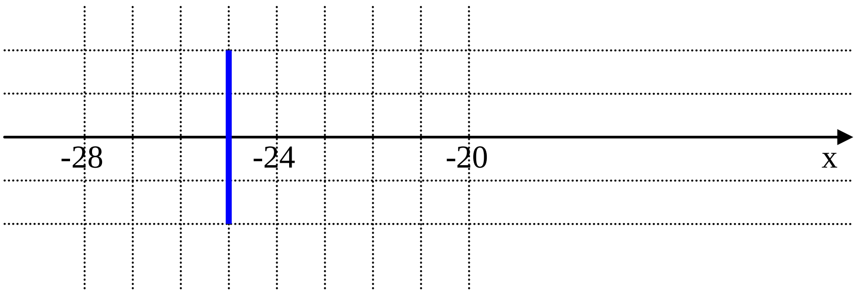
In the equation which I have provided, the first factor is $\left[10^6(x+25)^2+\frac{y^2}{4}-1\right]$. You will notice that it looks like an ellipse with its x^2 and y^2 terms.

Let's find its centre first. Because of the (x + 25), we know the centre of this ellipse is at (-25, 0).

Because the 10^6 is the coefficient of the "x" term, we know that the ellipse is "squashed" along the x-axis, so it is a very thin vertical ellipse.

Because the y^2 term is divided by 4, we know that the vertical line extends two units ($\sqrt{4}$) above and below the centre.

This means that $\left[10^6(x+25)^2+\frac{y^2}{4}-1\right]$ is a thin vertical ellipse centred at (-25, 0) and extending vertically to (-25, 2) and (-25, -2). It will appear to be a vertical line interval as shown:



Step Seven (Over to You)

In order to graph the equation provided on the next page, examine just one factor at a time and plot the ellipse (line interval) on the graph paper provided. Enjoy, and discover just how life changing mathematics can be!

Note: I have left a denominator of one in some factors, e.g. $\left[10^6(x+23.5)^2+\frac{(y+1)^2}{1}-1\right]$. This will serve to emphasise that the ellipse will extend one unit either side of the centre point.

The equation:

$$\left[10^6(x+25)^2+\frac{y^2}{4}-1\right]\left[10^6(x+22)^2+\frac{y^2}{4}-1\right]\left[10^6(x+21)^2+\frac{y^2}{4}-1\right]\left[10^6(x+20)^2+\frac{y^2}{4}-1\right]\left[10^6(x+17)^2+\frac{y^2}{4}-1\right]$$

$$\left[10^6(x+10)^2+\frac{y^2}{4}-1\right]\left[10^6(x+9)^2+\frac{y^2}{4}-1\right]\left[10^6(x+7)^2+\frac{y^2}{4}-1\right]\left[10^6(x+6)^2+\frac{y^2}{4}-1\right]\left[10^6(x+4)^2+\frac{y^2}{4}-1\right]$$

$$\left[10^6(x+1)^2+\frac{y^2}{4}-1\right]\left[10^6(x-2)^2+\frac{y^2}{4}-1\right]\left[10^6(x-3)^2+\frac{y^2}{4}-1\right]\left[10^6(x-5)^2+\frac{y^2}{4}-1\right]\left[10^6(x-6)^2+\frac{y^2}{4}-1\right]$$

$$\left[10^6(x-9)^2+\frac{y^2}{4}-1\right]\left[10^6(x-14)^2+\frac{y^2}{4}-1\right]\left[10^6(x-17)^2+\frac{y^2}{4}-1\right]\left[10^6(x-20)^2+\frac{y^2}{4}-1\right]\left[10^6(x-21)^2+\frac{y^2}{4}-1\right]$$

$$\left[10^6(x+12)^2+\frac{(y-1)^2}{1}-1\right]\left[10^6(x-0.5)^2+\frac{(y-1)^2}{1}-1\right]\left[10^6(x-8)^2+\frac{(y-1)^2}{1}-1\right]\left[10^6(x-11)^2+\frac{(y-1)^2}{1}-1\right]$$

$$\left[10^6(x-12)^2+\frac{(y-1)^2}{1}-1\right]\left[10^6(x-18.5)^2+\frac{(y-1)^2}{1}-1\right]\left[10^6(x-26)^2+\frac{(y-1)^2}{1}-1\right]\left[10^6(x-24)^2+\frac{(y-1.5)^2}{0.25}-1\right]$$

$$\left[10^6(x+23.5)^2+\frac{(y+1)^2}{1}-1\right]\left[10^6(x-7.5)^2+\frac{(y+1)^2}{1}-1\right]\left[10^6(x-10.5)^2+\frac{(y+1)^2}{1}-1\right]\left[10^6(x-25)^2+\frac{(y+0.5)^2}{0.25}-1\right]$$

$$\left[\frac{(x+19)^2}{1}+10^6(y+2)^2-1\right]\left[\frac{(x+16)^2}{1}+10^6(y+2)^2-1\right]\left[\frac{(x+11)^2}{1}+10^6(y+2)^2-1\right]\left[\frac{(x+11)^2}{1}+10^6(y)^2-1\right]$$

$$\left[\frac{(x+8)^2}{1}+10^6(y+2)^2-1\right]\left[\frac{(x+8)^2}{1}+10^6(y-2)^2-1\right]\left[\frac{(x+5)^2}{1}+10^6(y+2)^2-1\right]\left[\frac{(x-4)^2}{1}+10^6(y)^2-1\right]$$

$$\left[\frac{(x-7)^2}{1}+10^6(y)^2-1\right]\left[\frac{(x-10)^2}{1}+10^6(y)^2-1\right]\left[\frac{(x-13)^2}{1}+10^6(y)^2-1\right]\left[\frac{(x-13)^2}{1}+10^6(y+2)^2-1\right]$$

$$\left[\frac{(x-22)^2}{1}+10^6(y-2)^2-1\right]\left[\frac{(x-4)^2}{1}+10^6(y-2)^2-1\right]\left[\frac{(x-7)^2}{1}+10^6(y-2)^2-1\right]\left[\frac{(x-10)^2}{1}+10^6(y-2)^2-1\right]$$

$$\left[\frac{(x-21.5)^2}{0.25}+10^6(y)^2-1\right]\left[\frac{(x-22)^2}{1}+10^6(y+2)^2-1\right]\left[\frac{(x-25)^2}{1}+10^6(y-2)^2-1\right]\left[\frac{(x-25.5)^2}{0.25}+10^6(y)^2-1\right]$$

$$\left[\frac{(x+23.5)^2}{2.25}+10^6(y+2)^2-1\right]\left[\frac{(x-0.5)^2}{2.25}+10^6(y-2)^2-1\right]\left[\frac{(x-18.5)^2}{2.25}+10^6(y-2)^2-1\right]$$

$$\left[(x-25)^2+(y+2)^2-\frac{1}{100}\right]=0$$

The equation in landscape:

$$\left[10^6(x+25)^2+\frac{y^2}{4}-1\right]\left[10^6(x+22)^2+\frac{y^2}{4}-1\right]\left[10^6(x+21)^2+\frac{y^2}{4}-1\right]\left[10^6(x+20)^2+\frac{y^2}{4}-1\right]\left[10^6(x+17)^2+\frac{y^2}{4}-1\right]\left[10^6(x+10)^2+\frac{y^2}{4}-1\right]\left[10^6(x+9)^2+\frac{y^2}{4}-1\right]$$

$$\left[10^6(x+7)^2+\frac{y^2}{4}-1\right]\left[10^6(x+6)^2+\frac{y^2}{4}-1\right]\left[10^6(x+4)^2+\frac{y^2}{4}-1\right]\left[10^6(x+1)^2+\frac{y^2}{4}-1\right]\left[10^6(x-2)^2+\frac{y^2}{4}-1\right]\left[10^6(x-3)^2+\frac{y^2}{4}-1\right]\left[10^6(x-5)^2+\frac{y^2}{4}-1\right]$$

$$\left[10^6(x-6)^2+\frac{y^2}{4}-1\right]\left[10^6(x-9)^2+\frac{y^2}{4}-1\right]\left[10^6(x-14)^2+\frac{y^2}{4}-1\right]\left[10^6(x-17)^2+\frac{y^2}{4}-1\right]\left[10^6(x-20)^2+\frac{y^2}{4}-1\right]\left[10^6(x-21)^2+\frac{y^2}{4}-1\right]\left[10^6(x+12)^2+\frac{(y-1)^2}{1}-1\right]$$

$$\left[10^6(x-0.5)^2+\frac{(y-1)^2}{1}-1\right]\left[10^6(x-8)^2+\frac{(y-1)^2}{1}-1\right]\left[10^6(x-11)^2+\frac{(y-1)^2}{1}-1\right]\left[10^6(x-12)^2+\frac{(y-1)^2}{1}-1\right]\left[10^6(x-18.5)^2+\frac{(y-1)^2}{1}-1\right]\left[10^6(x-26)^2+\frac{(y-1)^2}{1}-1\right]$$

$$\left[10^6(x-24)^2+\frac{(y-1.5)^2}{0.25}-1\right]\left[10^6(x+23.5)^2+\frac{(y+1)^2}{1}-1\right]\left[10^6(x-7.5)^2+\frac{(y+1)^2}{1}-1\right]\left[10^6(x-10.5)^2+\frac{(y+1)^2}{1}-1\right]\left[10^6(x-25)^2+\frac{(y+0.5)^2}{0.25}-1\right]$$

$$\left[\frac{(x+19)^2}{1}+10^6(y+2)^2-1\right]\left[\frac{(x+16)^2}{1}+10^6(y+2)^2-1\right]\left[\frac{(x+11)^2}{1}+10^6(y+2)^2-1\right]\left[\frac{(x+11)^2}{1}+10^6(y)^2-1\right]\left[\frac{(x+8)^2}{1}+10^6(y+2)^2-1\right]\left[\frac{(x+8)^2}{1}+10^6(y-2)^2-1\right]$$

$$\left[\frac{(x+5)^2}{1}+10^6(y+2)^2-1\right]\left[\frac{(x-4)^2}{1}+10^6(y)^2-1\right]\left[\frac{(x-7)^2}{1}+10^6(y)^2-1\right]\left[\frac{(x-10)^2}{1}+10^6(y)^2-1\right]\left[\frac{(x-13)^2}{1}+10^6(y)^2-1\right]\left[\frac{(x-13)^2}{1}+10^6(y+2)^2-1\right]$$

$$\left[\frac{(x-22)^2}{1}+10^6(y-2)^2-1\right]\left[\frac{(x-4)^2}{1}+10^6(y-2)^2-1\right]\left[\frac{(x-7)^2}{1}+10^6(y-2)^2-1\right]\left[\frac{(x-10)^2}{1}+10^6(y-2)^2-1\right]\left[\frac{(x-21.5)^2}{0.25}+10^6(y)^2-1\right]\left[\frac{(x-22)^2}{1}+10^6(y+2)^2-1\right]$$

$$\left[\frac{(x-25)^2}{1}+10^6(y-2)^2-1\right]\left[\frac{(x-25.5)^2}{0.25}+10^6(y)^2-1\right]\left[\frac{(x+23.5)^2}{2.25}+10^6(y+2)^2-1\right]\left[\frac{(x-0.5)^2}{2.25}+10^6(y-2)^2-1\right]\left[\frac{(x-18.5)^2}{2.25}+10^6(y-2)^2-1\right]$$

$$\left[(x-25)^2+(y+2)^2-\frac{1}{100}\right]=0$$

Please use this graph paper to graph the equation provided.