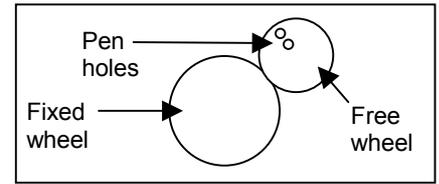


Fun - Activity 1

Spirograph patterns.

A spirograph is a fun toy for making beautiful patterns. The basic spirograph has two toothed wheels, one fixed (with pins or thumb tacks) and one free, as illustrated in this diagram:



The free wheel has a series of holes at various distances from its centre. To make a pattern, you put your pen tip through one of the holes, then rotate the free wheel around the fixed wheel.

In a spirograph set, there are usually several different sizes of wheels that can be used in any combination. Changing the wheel size or the pen hole will give a completely different pattern.

The spirograph patterns can be described by these two equations:

$$x = (A+B) \cos(T) - (B+C) \cos((A+B)/B) T$$

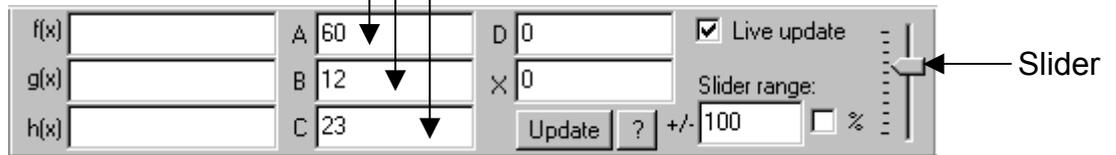
$$y = (A+B) \sin(T) - (B+C) \sin((A+B)/B) T$$

Where: 'A' is the radius of the fixed wheel,
 'B' is the radius of the free wheel, and
 'C' is the distance from the pen hole to the circumference of the free wheel.
 'T' determines how far you turn the free wheel while making the pattern.

If you make 'A' negative, then you have a fixed circular hole instead of a wheel. If 'B' or 'C' are negative you just get more great patterns. Let's do it!

1) Run Maths Helper Plus and open the document: 'Spirograph.mhp'

2) Press the F5 key to display the parameters box. This is where you change A, B, and C. To set an initial value for 'A', 'B' or 'C', click on the edit box for that variable and type your value.



You will use the up and down arrow keys on the keyboard to make step by step changes to A, B or C. To make a variable change when you press the up or down arrow keys, you:

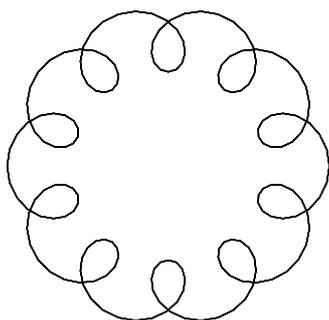
- Click the edit box for the required variable, then
- Click the slider to select it.

Now you can change that variable with the up and down arrow keys. If the arrow keys stop responding, just click the slider again.

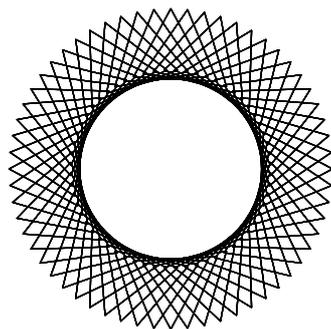
3) Pattern set 1.

- Set A = 60, B = 12 and C = 23. (As shown above.)
- Click the 'B' edit box, then click to select the slider button.
- Press the down arrow key to decrease 'B' and change the pattern. Good patterns occur for 'B' values down to -50.

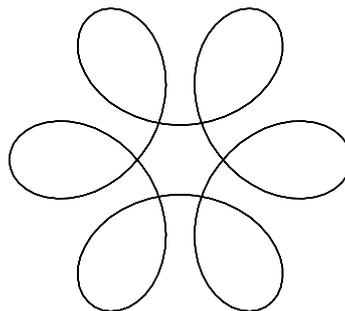
Watch for these patterns as you change 'B', and write the 'B' values underneath the patterns:



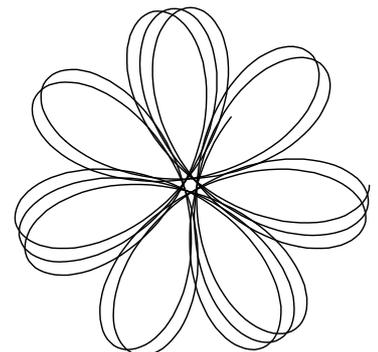
B = _____



B = _____



B = _____



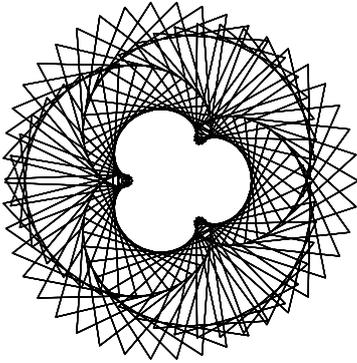
B = _____

4) Pattern set 2.

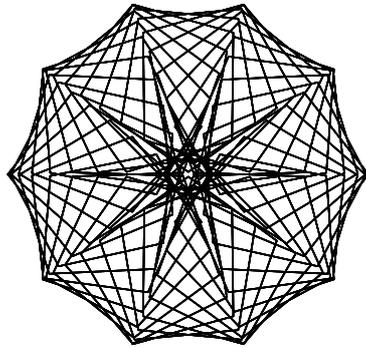
- Set $A = 35$, $B = -1$ and $C = 35$.
- Click the 'A' edit box, then click to select the slider button.
- Press the up arrow key to increase 'A' and change the pattern. Good patterns occur for 'A' values up to about 120.
- The size of the overall pattern changes as 'A' is increased. Change the screen magnification with the + and - toolbar buttons to get the best view.

Watch for these patterns as you change 'A', and write the 'A' values underneath the patterns:

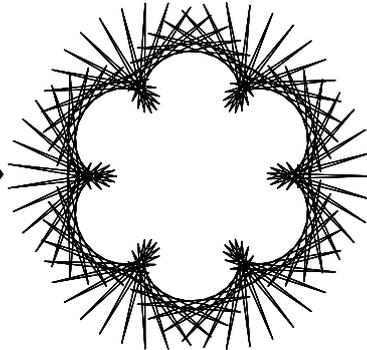
To see thousands more of these amazing patterns, first get one of these nice patterns displayed, then select the '%' option on the parameters box. Now select the slider and either use the keyboard arrow keys as before, or drag the slider up or down with the mouse.



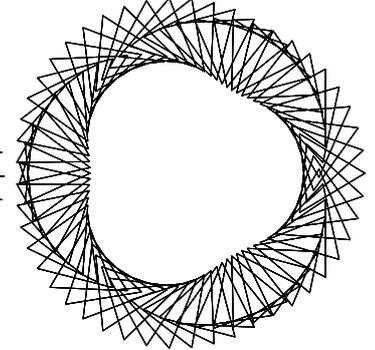
A = _____



A = _____



A = _____



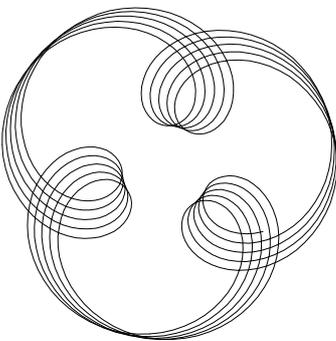
A = _____

5) Pattern set 3.

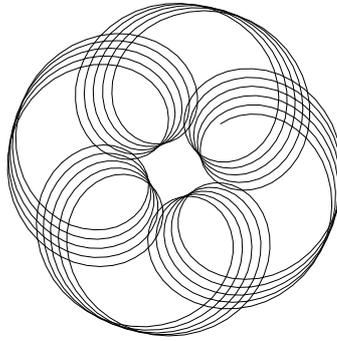
- Set $A = 53$, $B = 30$ and $C = 60$.
- Click the 'B' edit box, then click to select the slider button.
- Press the down arrow key to decrease 'B' and change the pattern. Good patterns occur for 'B' values down to about -30.
- If necessary, change the screen magnification with the + and - toolbar buttons to get the best view.

To get an entirely new set of patterns, display the options box for the plotted equations, then in the 'Plot Settings' tab, change the 'Graph plot resolution' option.

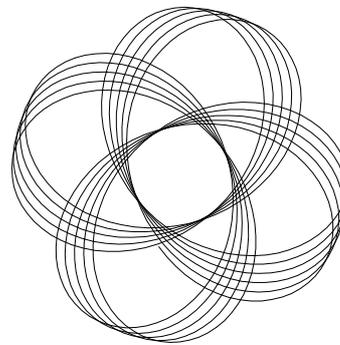
Watch for these patterns as you change 'B', and write the 'B' values underneath the patterns:



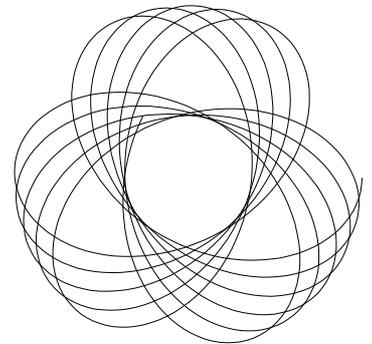
B = _____



B = _____



B = _____



B = _____

6) Experiment to find patterns of your own, and record the A, B and C values for your favourite patterns in the space below:

To change the colour and thickness of the lines or other characteristics of the patterns, double click near the equations on the text view. When the options dialog box appears, click to display the 'Plot settings' tab. Make your changes, then click the OK button.

Press the F2 key to print preview and print the patterns.