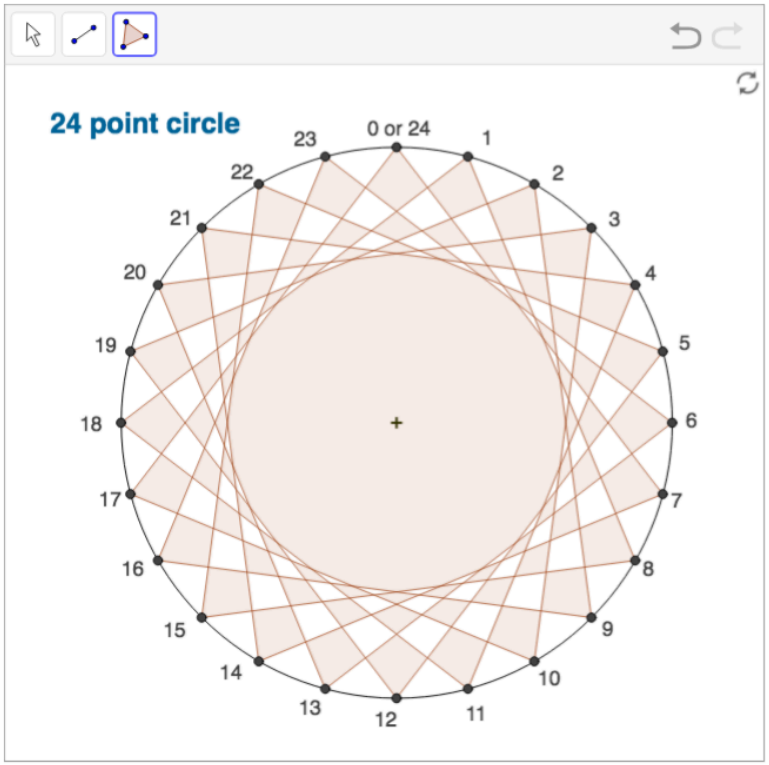
# Star Drawings Project

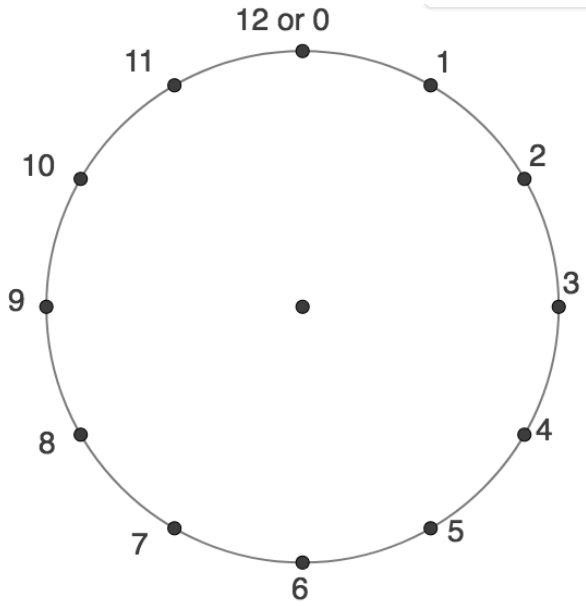
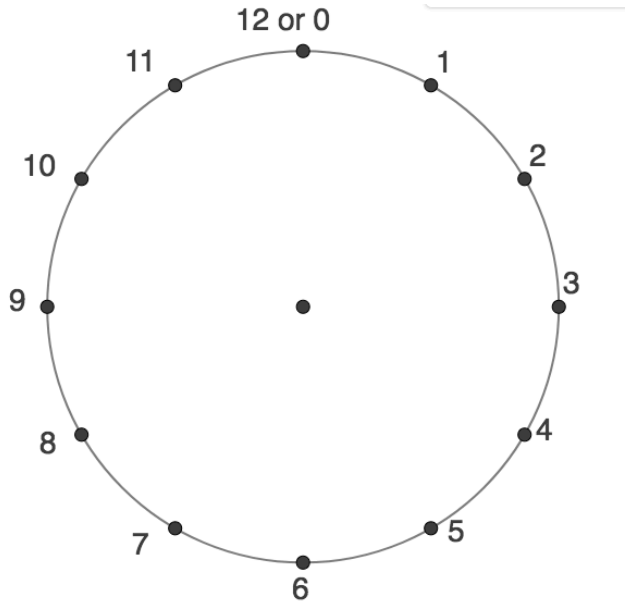



On this diagram, chords are drawn starting from zero and joining every 7$^{th}$ point: zero to seven; seven to fourteen and so on until after several times around the circle we return to our first point. The result of using an increment of 7 on a 24 point circle is a star.

The aim of this project is to figure out what increments result in a regular polygon; what increments results in a star and when it is a star, when does it use all 24 points and when does it only use some points? And of course, why?

In this investigation, we have 4 variables:

1. The number of points on the circumference of the circle. Let's use $N$ to represent this number.
2. The increment we use to draw the chords. Let's use $n$ to represent this number.
3. The number of chords we need to draw to return to the starting point. Let's use $c$ to represent this number.
4. The value of the final point, if we keep counting in our increment as we go around and around the circle. Let's use $v$ to represent this number.

| To get started, draw chords using an increment of 3. | On this circle, draw chords using an increment of 5. |
|---|---|
|  |  |
| $N = 12;\quad n = 3;\quad c =$ and $v =$ | $N = 12;\quad n = 5;\quad c =$ and $v = 60$ |

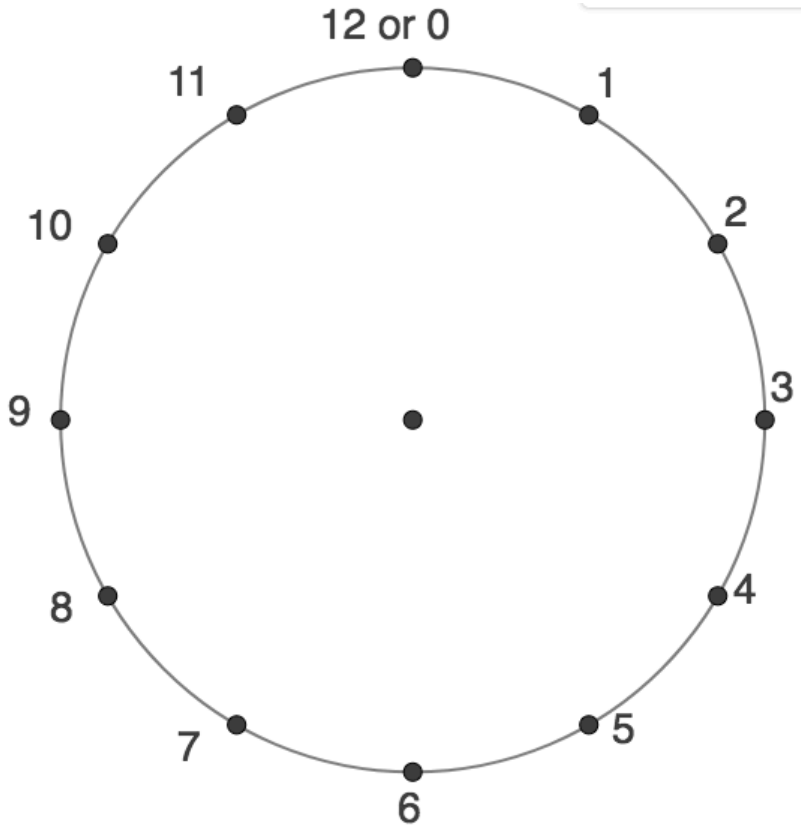
Use the applets at https://ggbm.at/epewd6aw to draw all other increments, and record results on the pages that follow.

## Star Drawings Record Sheet

**12 Point Star**

| Increment $n$ | Polygon (what kind?) or Star? | Chords $c$ | End Value $v$ |
|---|---|---|---|
| 1 | | | |
| 2 | Hexagon | 6 | 12 |
| 3 | | | |
| 4 | | | |
| 5 | Star | | 60 |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |

Example using an increment of ……..

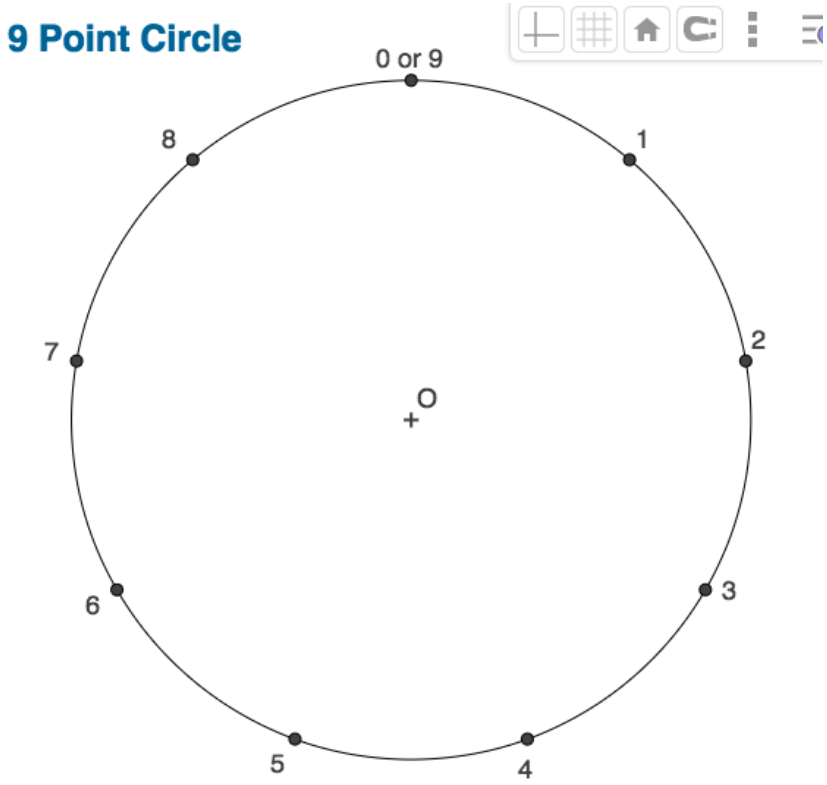



If the radius of the circle is 5 cm, calculate the length of one chord.

**9 Point Star**

| Increment $n$ | Polygon (what kind?) or star? | Chords $c$ | End Value $v$ |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |

Example using an increment of ……..

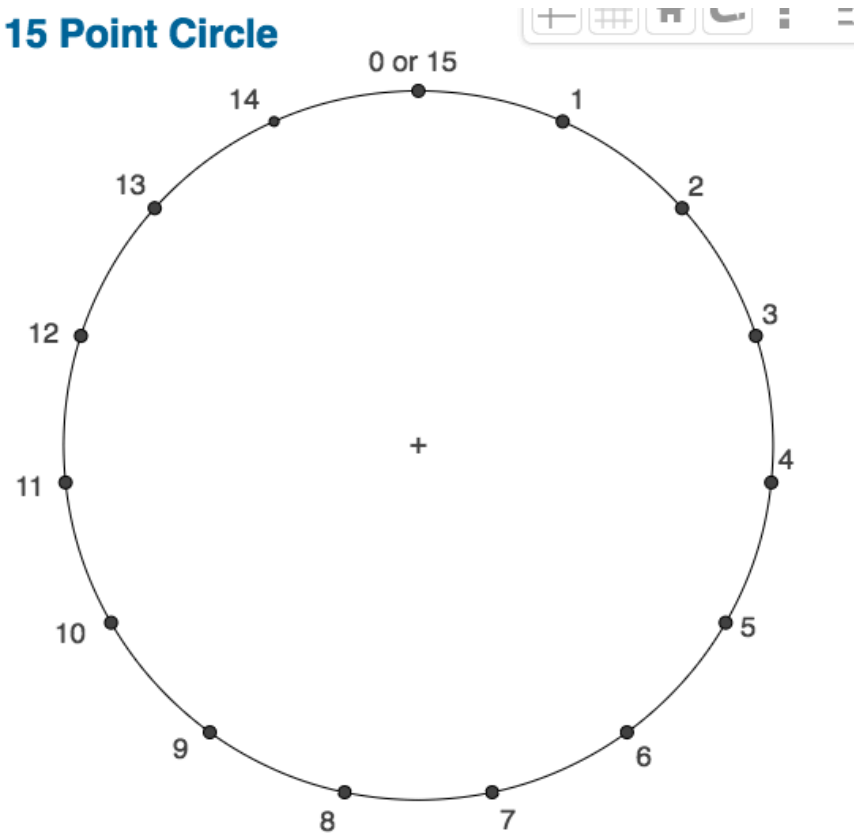



If the radius of the circle is 5 cm, calculate the length of one chord.

**15 Point Star**

| Increment $n$ | Polygon (what kind?) or Star? | Chords $c$ | End Value $v$ |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |

Example using an increment of ……..




If the radius of the circle is 5 cm, calculate the length of one chord.

**Hypothesis**

When joining $N$ points on a circumference using an increment of $n$, one of three shapes occurs:

1. A regular polygon
2. A star that uses all $N$ points
3. A star that uses only some of the points but not all.

| A regular polygon occurs when | An $N$ point star occurs when | A star that has less than $N$ points occurs when |
|---|---|---|
| | | |

**Prediction for a 24 point circle**

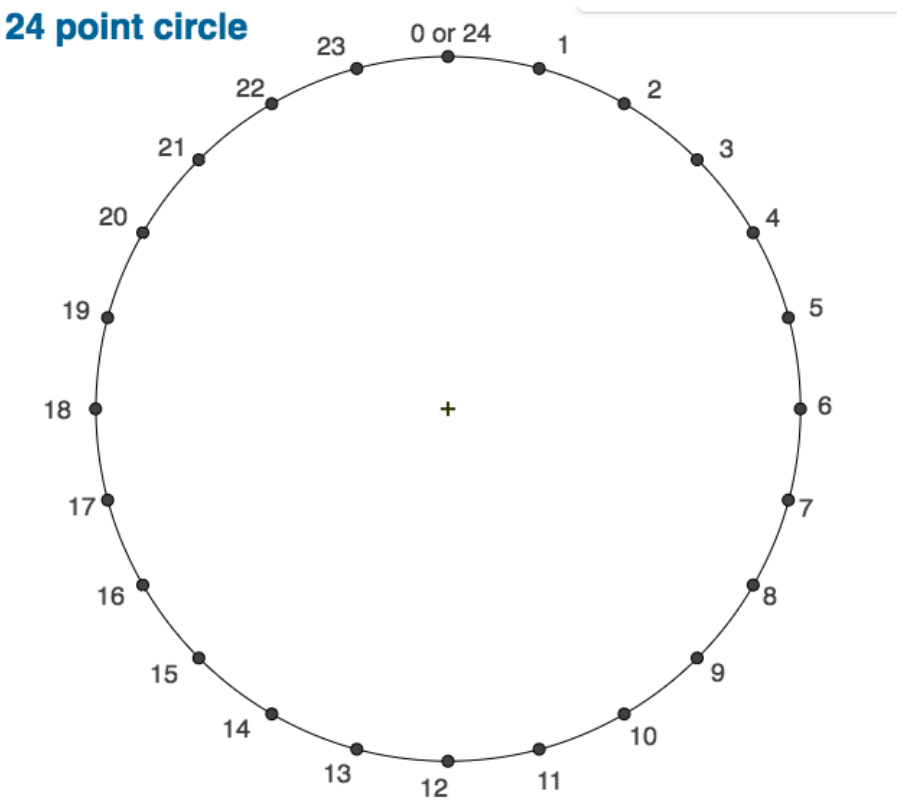
| Suppose $N = 24$. The following increments will yield regular polygons (state the kind of polygon for each): | Suppose $N = 24$. The following increments will yield a 24 point star (state the end value for each increment): | Suppose $N = 24$. The following increments will yield a star that has less than 24 points (state the end value for each increment): |
|---|---|---|
| | | |

Test your prediction on the 24 point circle https://ggbm.at/mpnPshPh and record your results on the following page.

**24 Point Circle**

| Increment $n$ | Polygon (what kind?) or Star? | Chords $c$ | End Value $v$ |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |

Example using an increment of ……..




If the radius of the circle is 5 cm, calculate the length of one chord.

## Conclusions:

There are 23 possible increments for a 24 point star. For which increments was your prediction correct?

Write down any formula that you have created that relate any two or more of the values $N, n, c, v$.

Now choose your own value $N$, between 10 and 100. Choose an increment that will give you one of the following, and state the values required:

| $N =$ | | |
|---|---|---|
| Regular Polygon.<br><br>Let $n =$<br><br>This will yield a regular polygon with ……. sides.<br><br>The number of chords $c =$<br><br>The end value $v =$ | $N$ point star.<br><br>Let $n =$<br><br>This will yield an $N$ point star.<br><br>The number of chords $c =$<br><br>The end value $v =$ | Star, less than $N$ points.<br><br>Let $n =$<br><br>This will yield a star with ……. points.<br><br>The number of chords $c =$<br><br>The end value $v =$ |

Confirm your answers with the 'star drawings' applet: https://ggbm.at/srwmxtwt

**Finally:**

Suppose there are $N$ points on the circle, and you use an increment of $n$ and the radius of the circle is 5cm. How long is one chord, in terms of $N$ and $n$?