

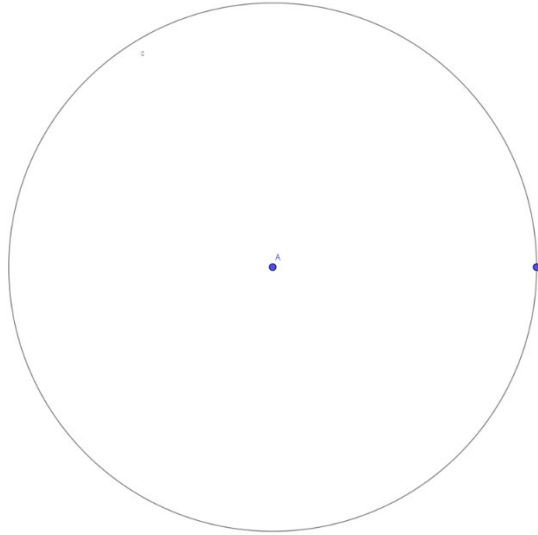
## 10-fold Islamic Rosette Pattern

Sarah Gelsinger Brewer

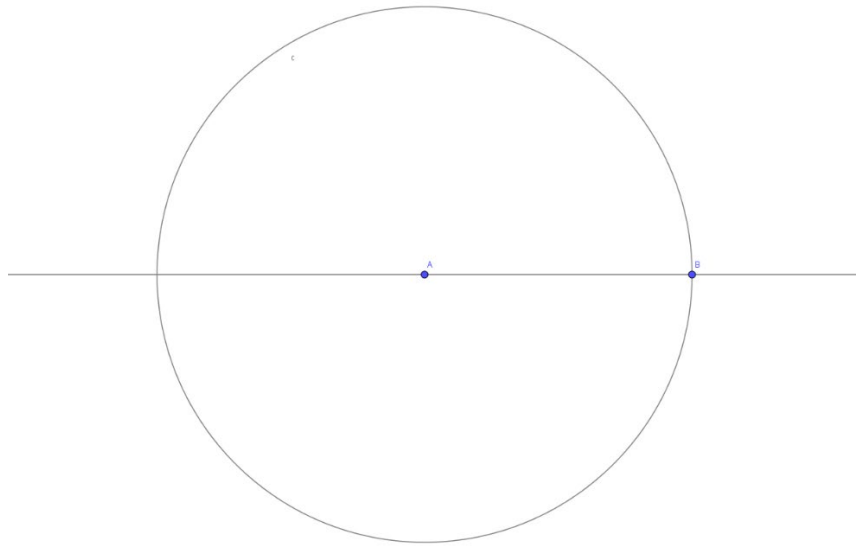
@mathemartiste

mathemartiste.com

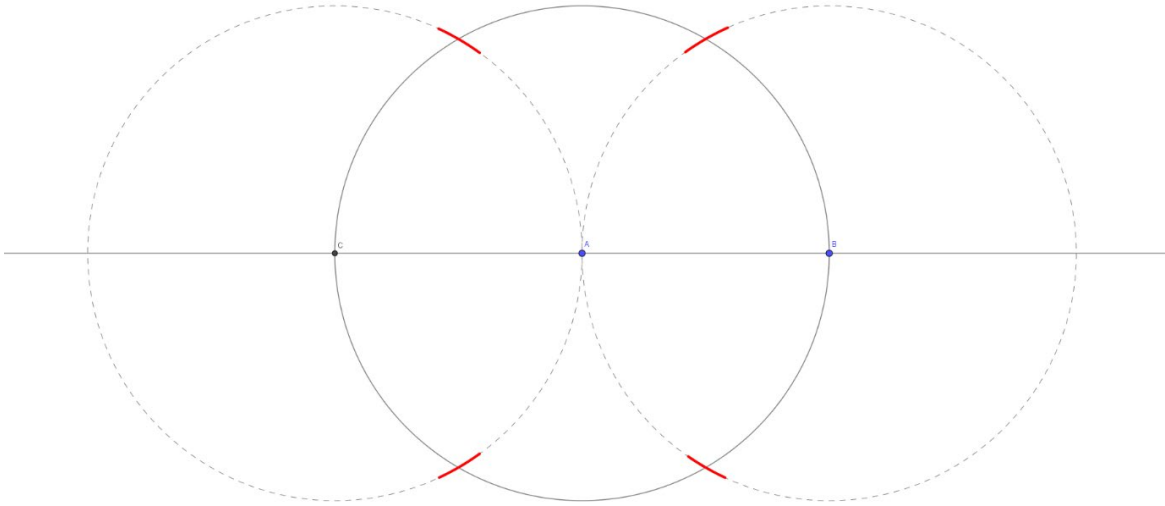
2021



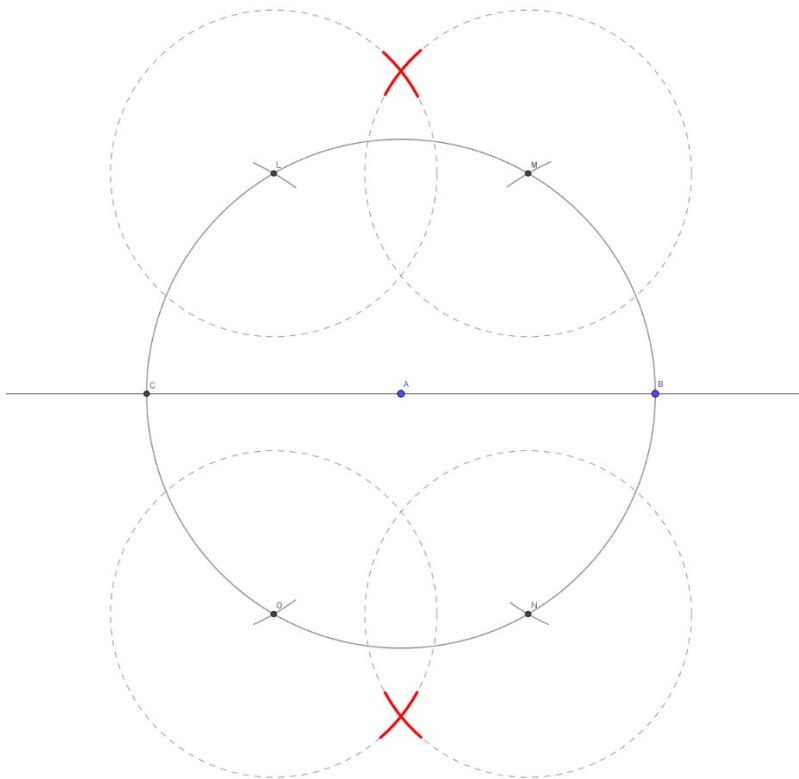
Start by drawing a circle. Your entire motif will fit inside this circle, so make it large.



Placing your pencil point in the center of your circle and bringing your ruler to your pencil, draw a horizontal line.

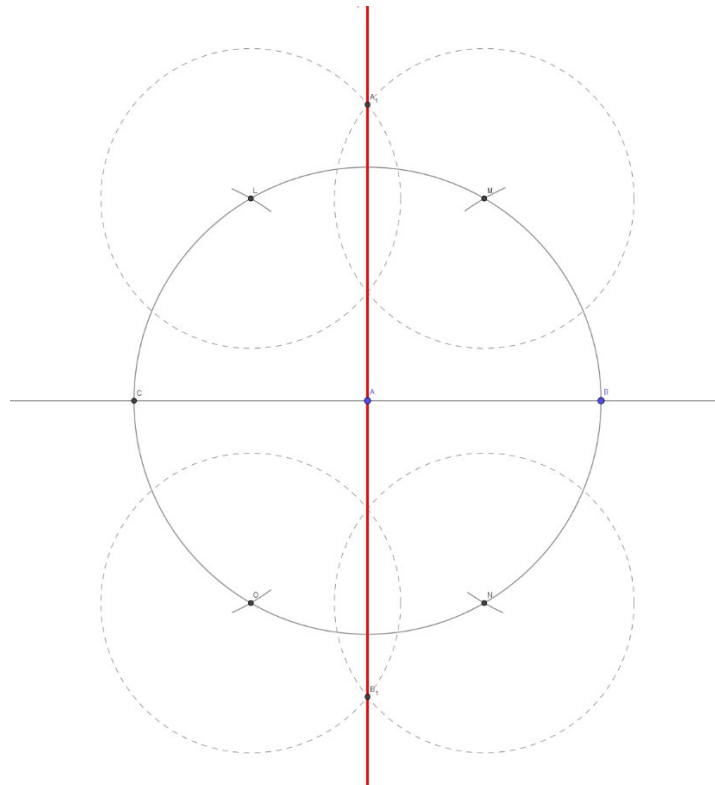


Keeping your radius the same as before, place your compass at the intersections of your original circle and horizontal line, and mark the four indicated intersections. Note that these four points, along with the right and left points on the original circle, determine a regular hexagon.

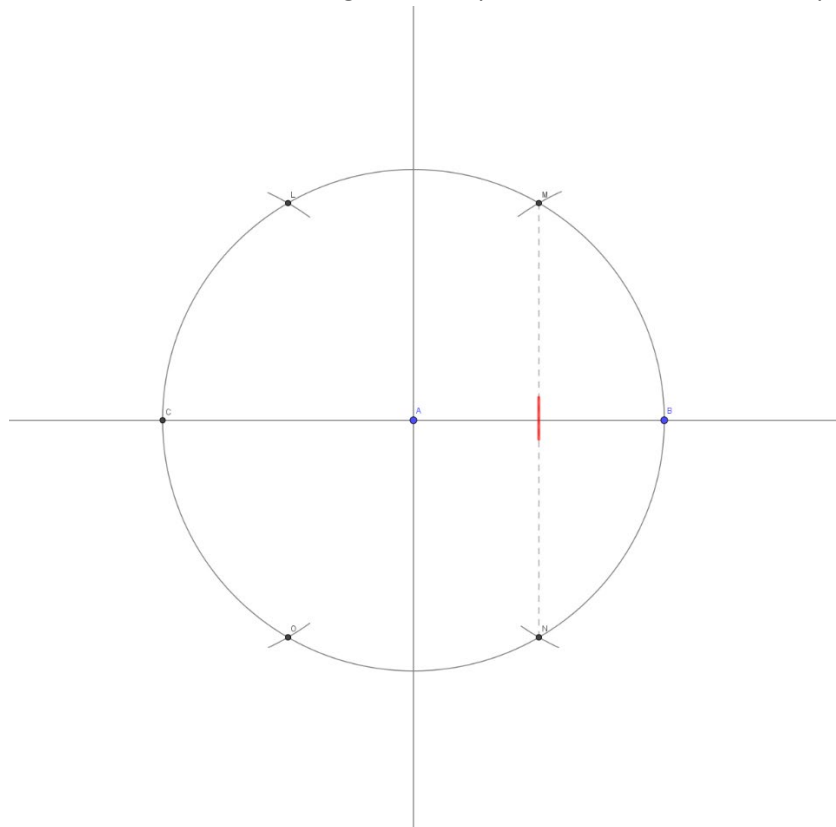


Decrease your compass radius to a little more than half the distance between the top two hexagonal intersections. By drawing intersecting arcs of the same radius from each of the four hexagonal intersections, we find two points that determine the perpendicular bisector of our horizontal diameter.

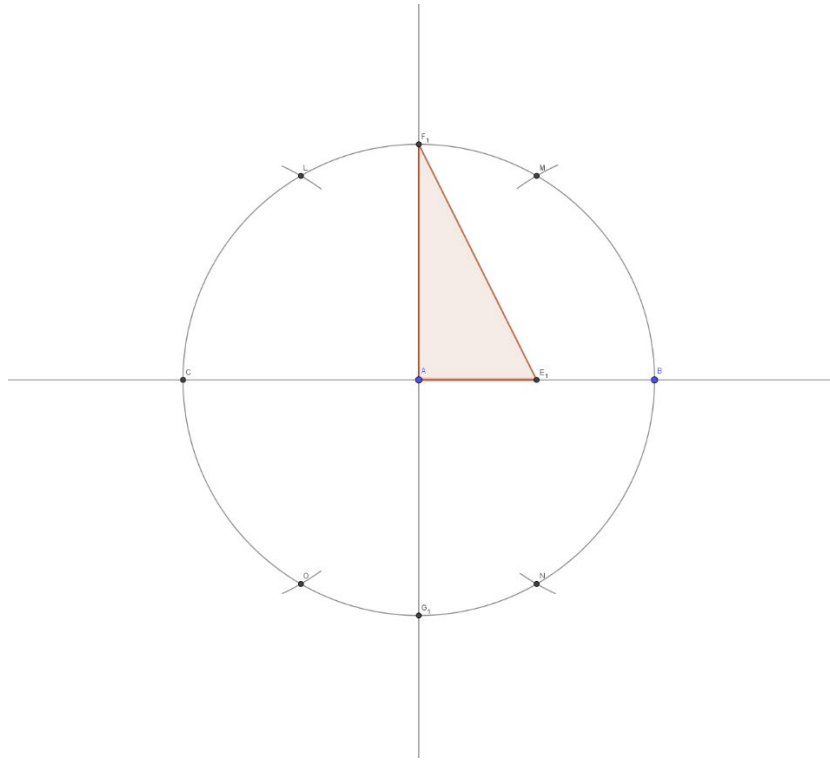
3



Draw the vertical line through the two points defined in the last step.

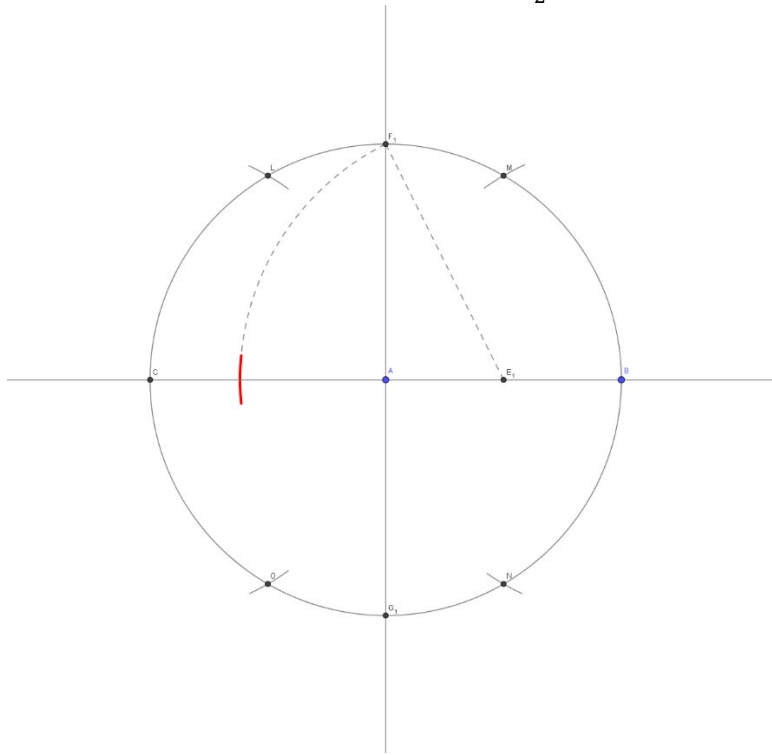


The right two hexagonal intersections determine the midpoint of the radius.

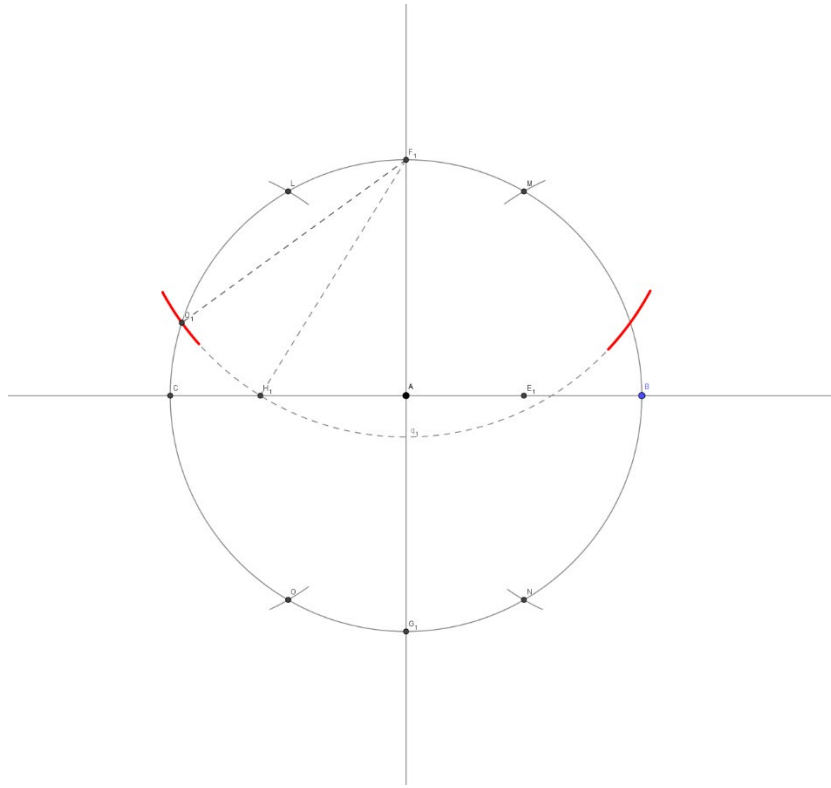


Set your radius to the distance between the “north” point on your circle and the radius midpoint determined in the last step. Note that if we consider our original circle radius (the height of the highlighted triangle) to be 1, the base of the highlighted triangle is  $\frac{1}{2}$  and the hypotenuse of this right triangle (and what we are now setting our radius to) is the

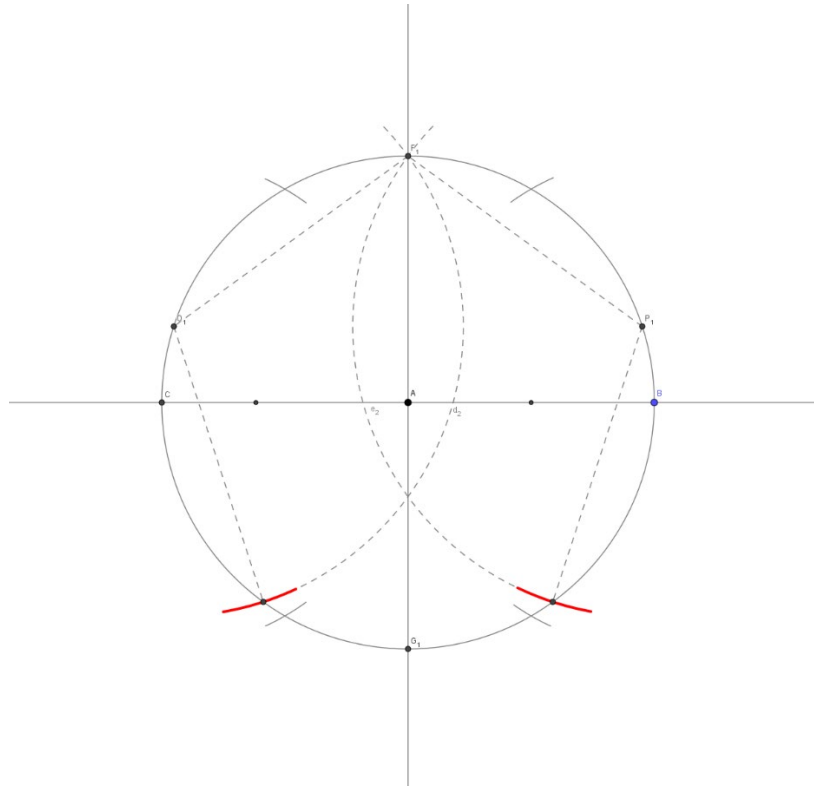
$$\text{“golden ratio” phi: } \varphi = \frac{1+\sqrt{5}}{2}$$



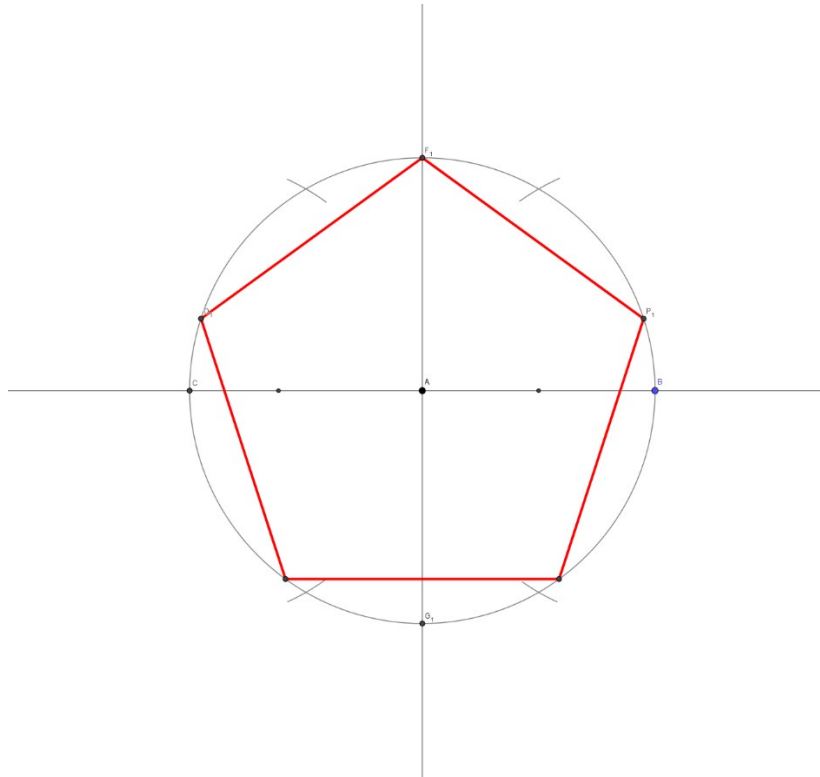
Centering your compass at the radius midpoint as if to draw an arc that passes through the “north” point on the circle, mark the intersection of that arc with the horizontal line.



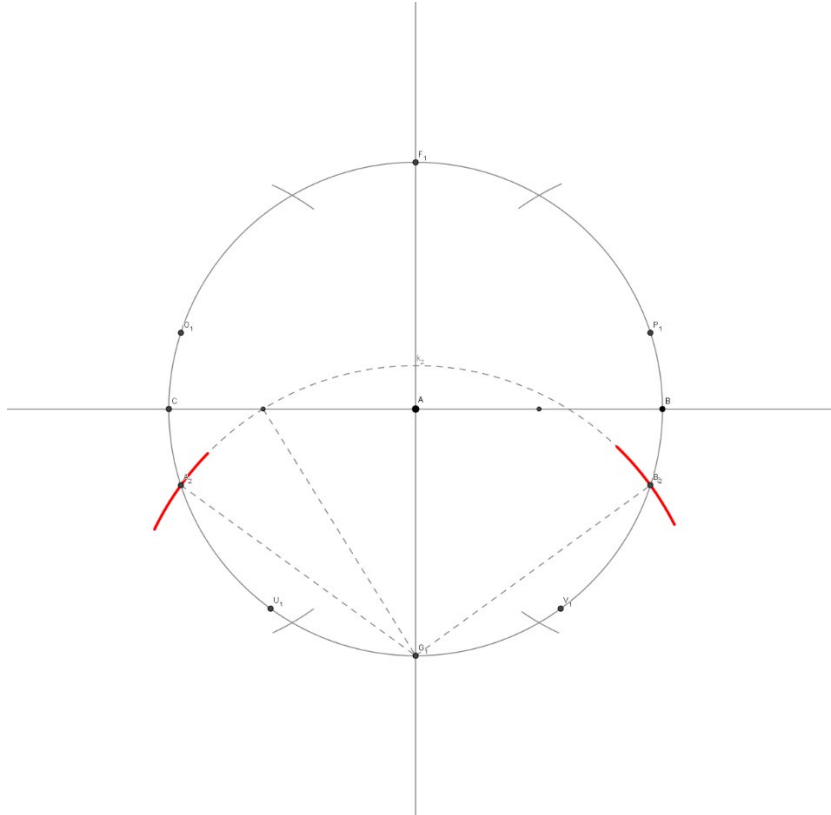
Centering the compass at “north” with a radius determined by the intersection with the horizontal determined in the last step, mark the intersections of this arc with the original circle. These two points, along with “north,” determine two sides of a regular pentagon.



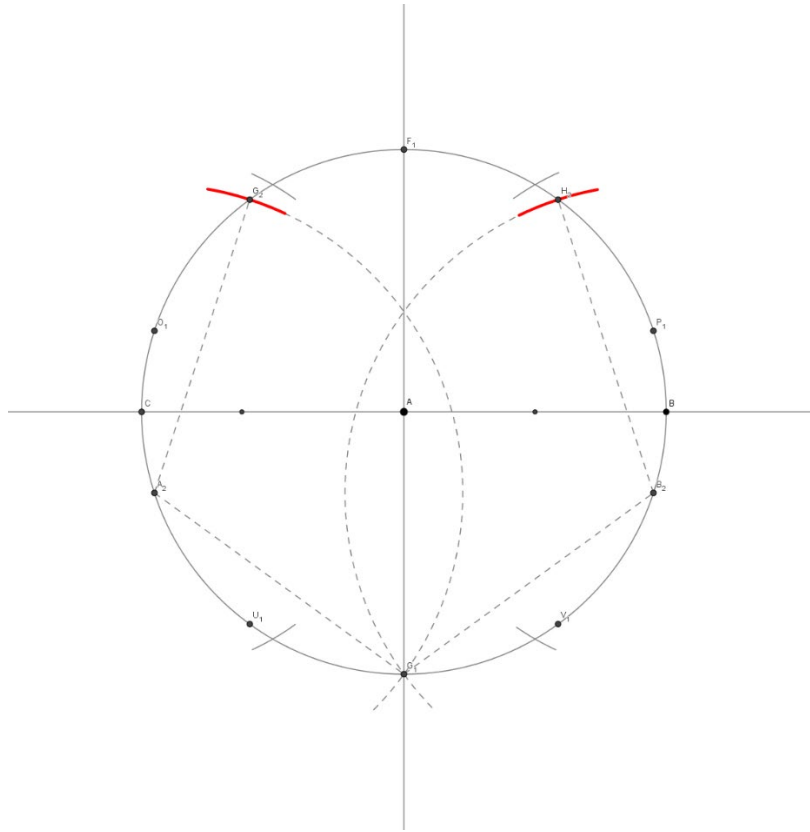
Walk the radius used in the last step around to determine the last two vertices of the regular pentagon.



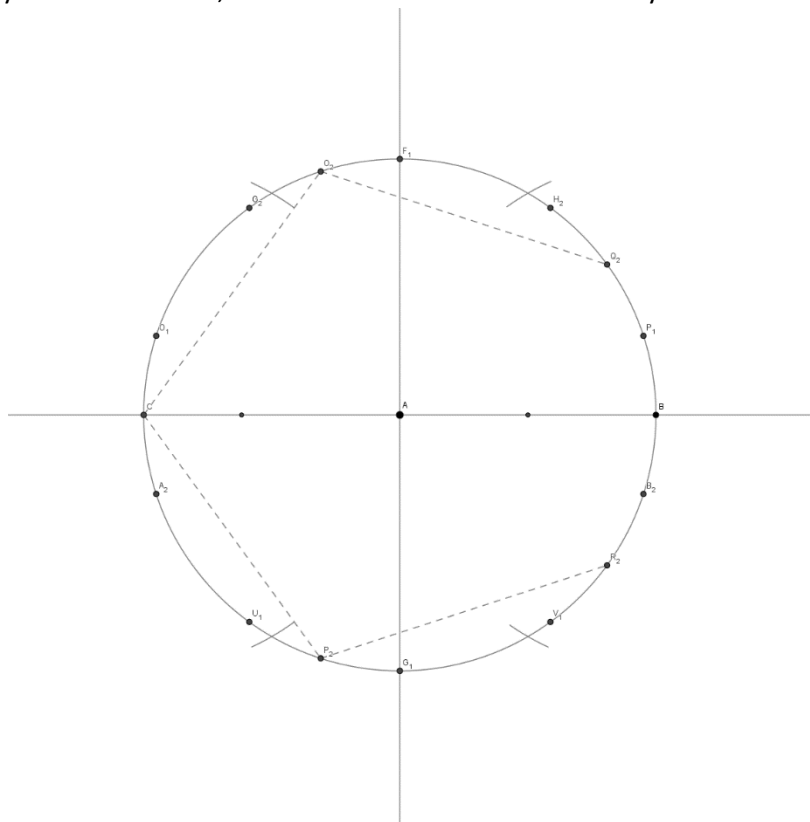
You don't need to draw in this pentagon. It is merely highlighted here to show the construction. In the next few steps we will keep the same radius and basically repeat this pentagonal construction three more times (with vertex at south, west, and east) to give us a total of  $5 \times 4 = 20$  radial divisions of our circle.



Starting from the "south" point on your circle and with the same radius, mark the nearest two pentagonal vertices.

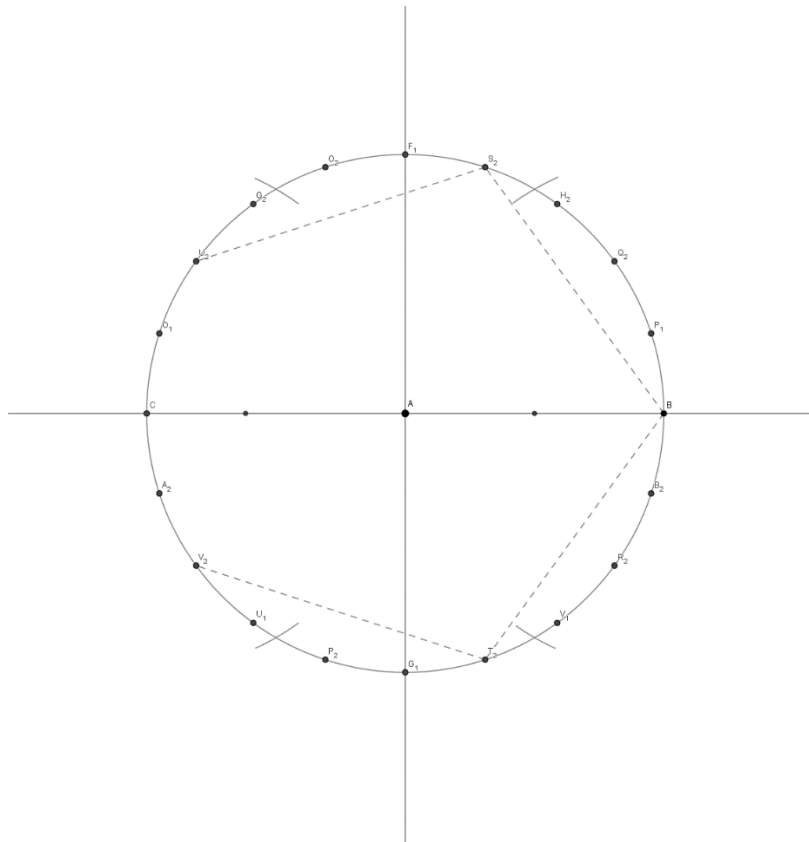


Walk your compass around to mark the last two pentagonal vertices. Being careful to omit the “east” and “west” points, as well as the early six-fold divisions, we now have the vertices necessary to construct a regular decagon.

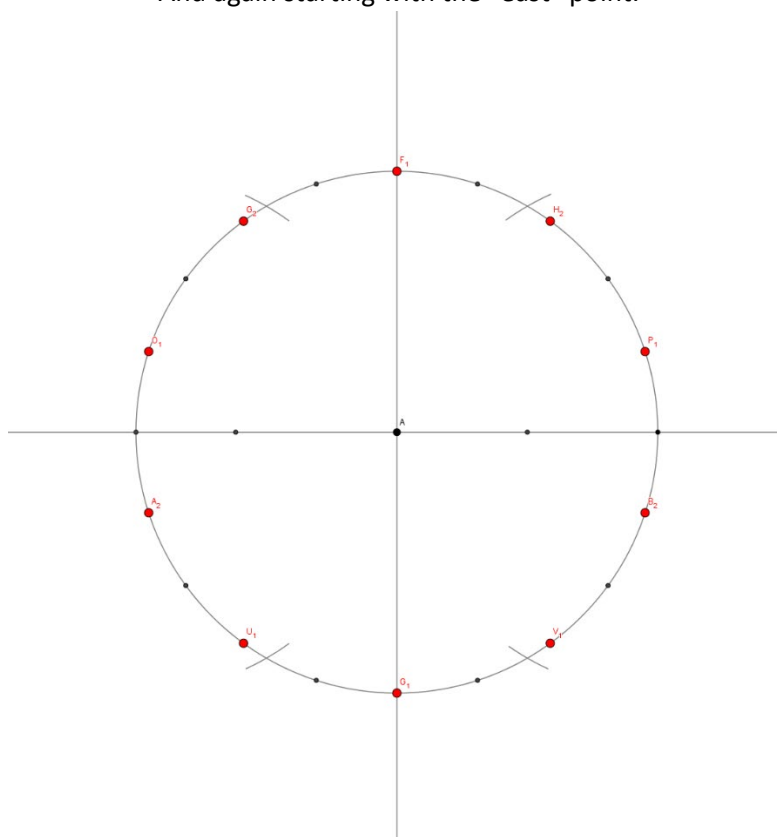


Repeat this same process starting from the “west” point.

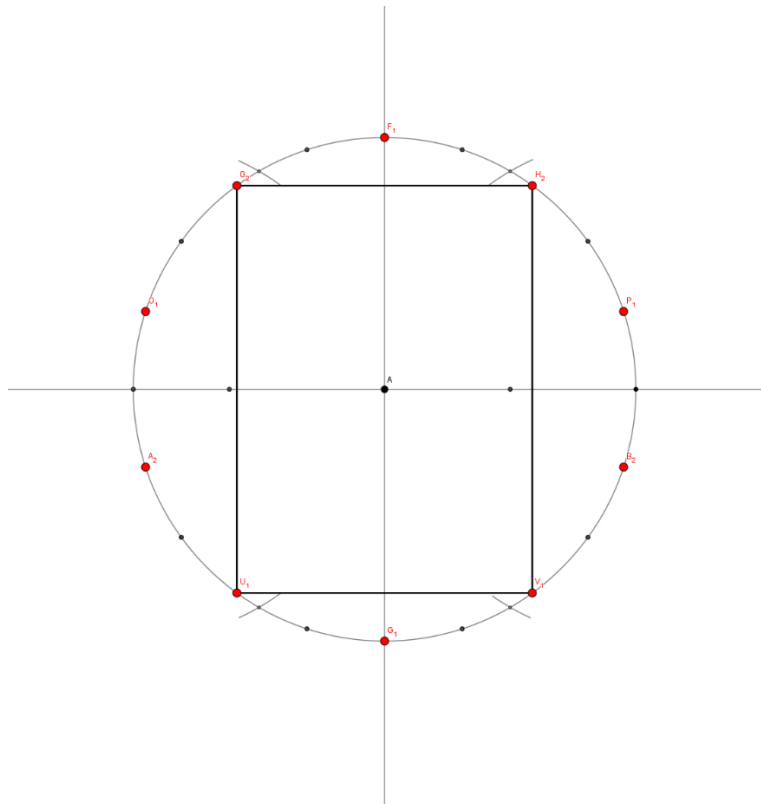




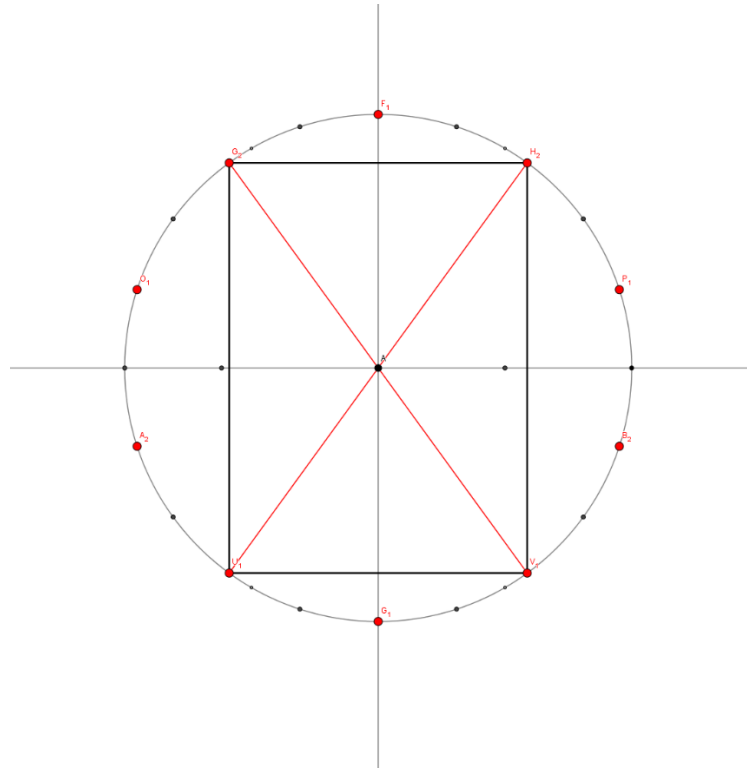
And again starting with the “east” point.



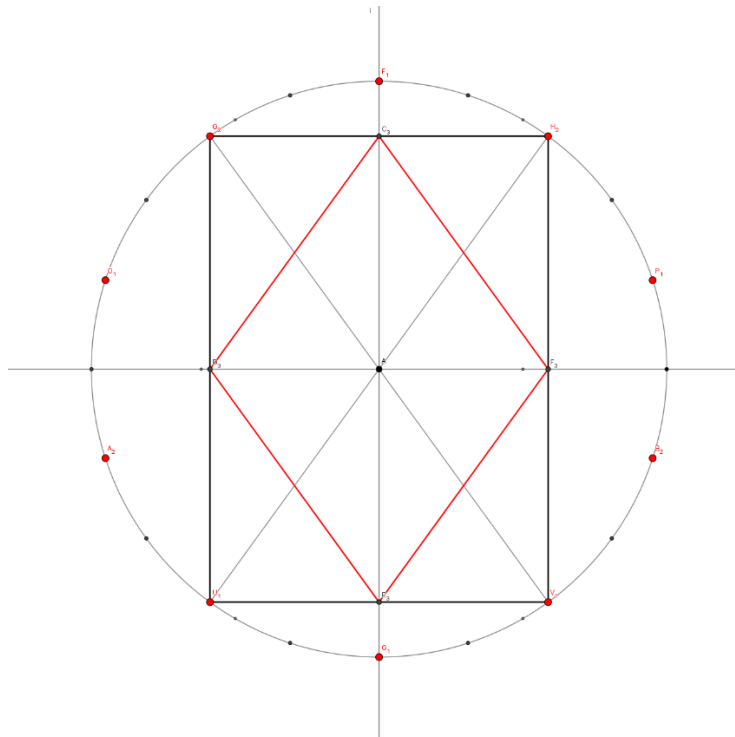
While the twenty-fold divisions could be found later, I find them helpful for ensuring accuracy in my construction.  
So as to not get confused in the coming steps, take a moment to circle the vertices highlighted here in red.



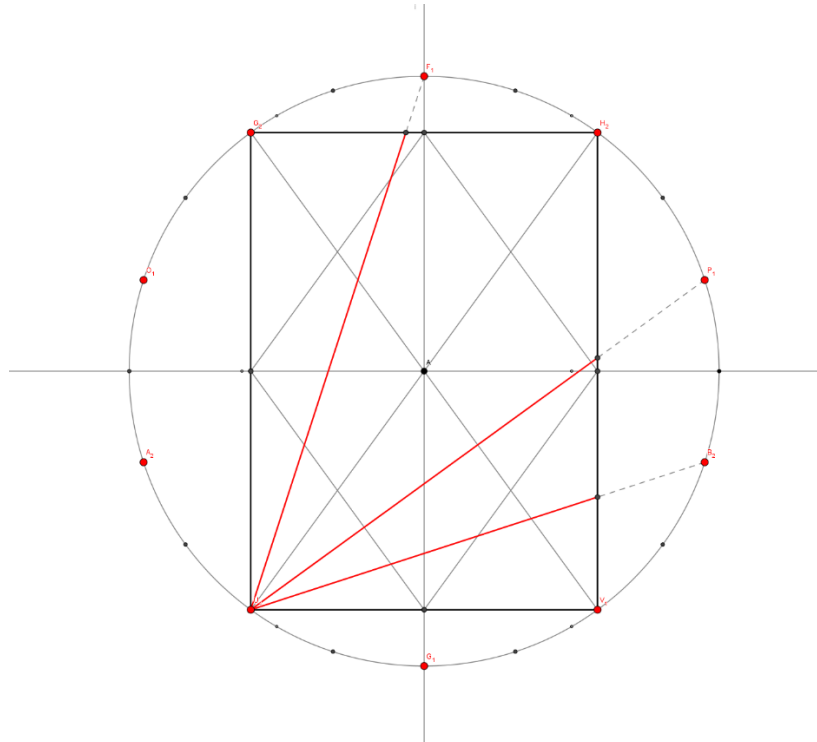
Connect the indicated vertices. This rectangle will contain our design, and can be used to tile the plane. Now that we have this rectangle drawn in, those initial hexagonal intersections will be reduced to small vertices in the remaining steps of this tutorial.



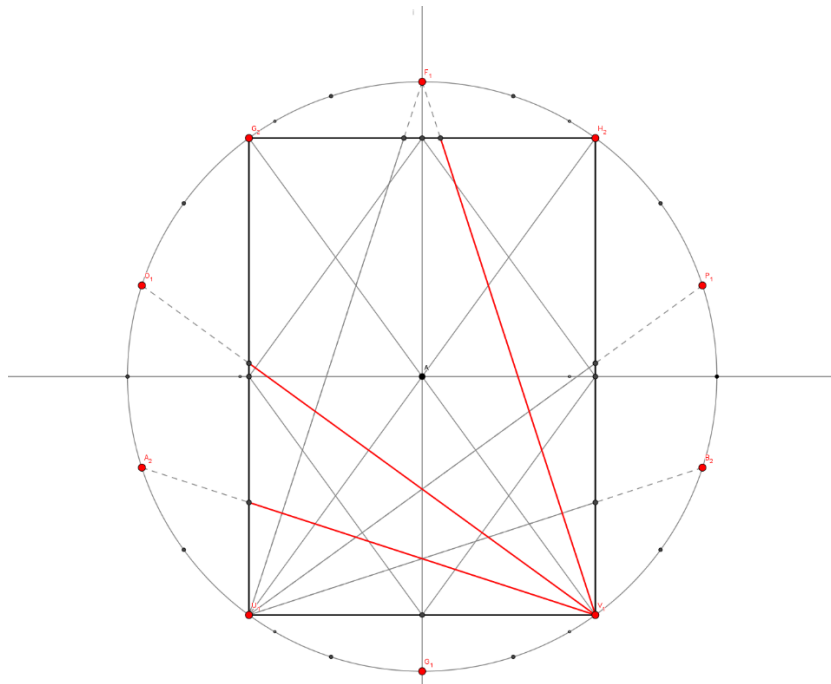
Draw in the two diagonals of the rectangle.



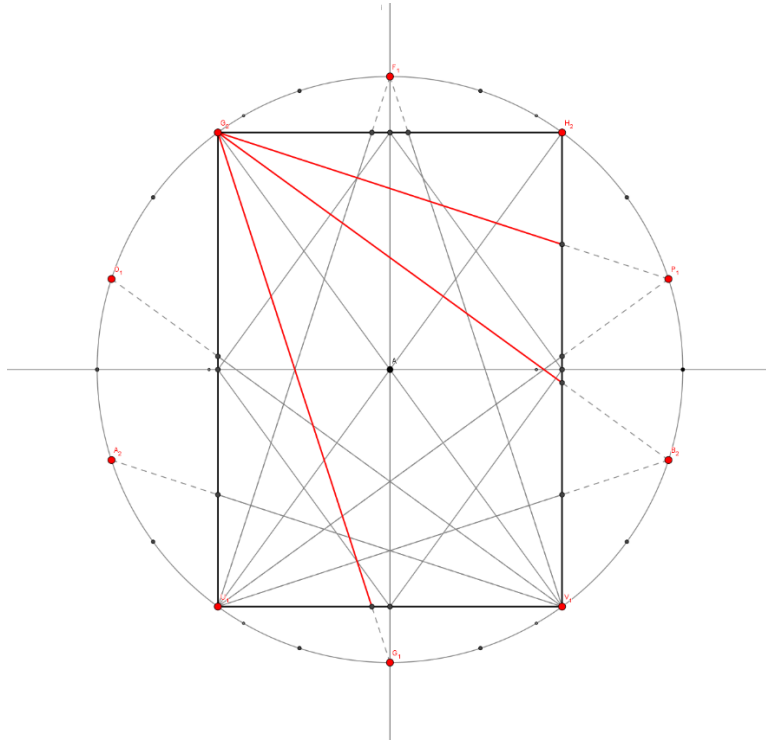
Draw in the four line segments connecting the midpoints of each side of the rectangle.  
 Note that this rhombus can also be used to tile this pattern across the plane.



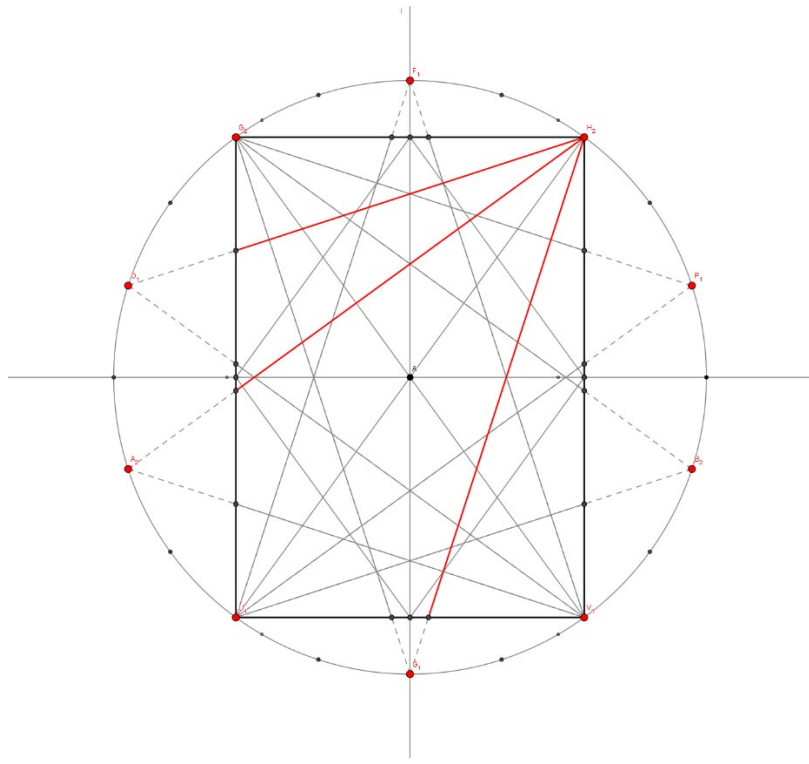
The next few steps serve to fill in the missing twenty-fold radial divisions at each corner of the rectangle. We achieve this by drawing chords to each of the ten-fold divisions of our original circle. This results in twenty-fold divisions at the corner because we are forming inscribed angles, each of which is half the measure of the intercepted arc. The same arc is equal to a central angle (vertex at the center of our original circle) that intercepts it. Hence, a ten-fold division from the center results in a twenty-fold division at the corner.



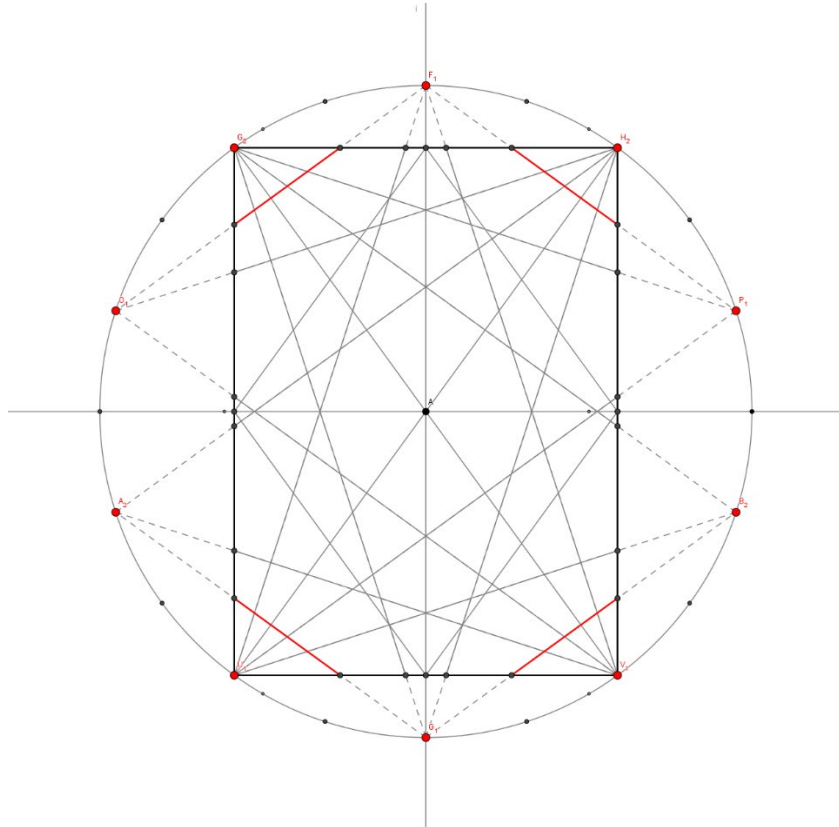
Add the missing three radial divisions at the bottom right.



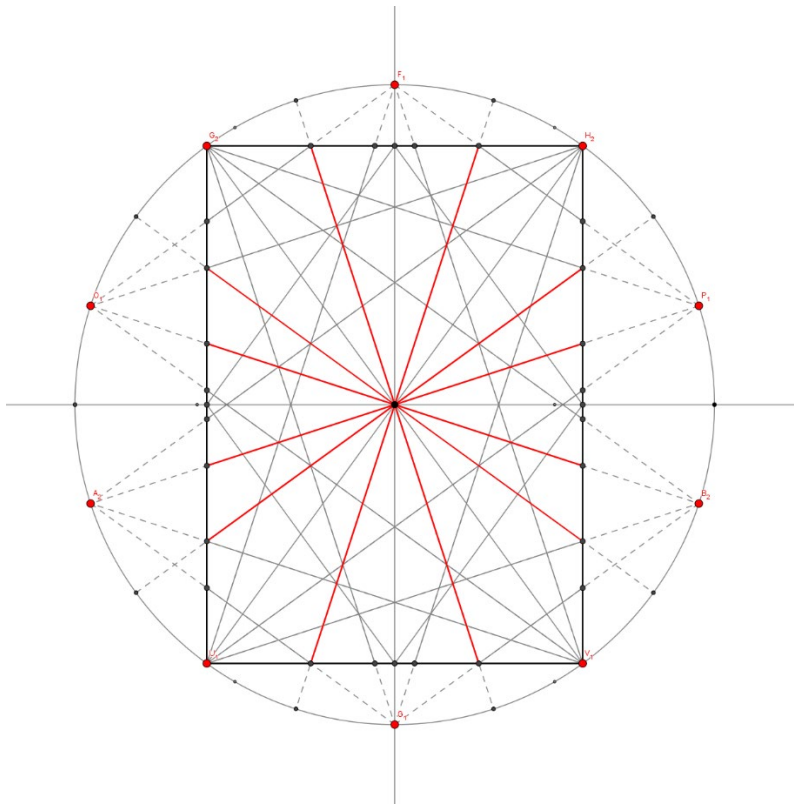
Add the missing three radial divisions at the upper left.



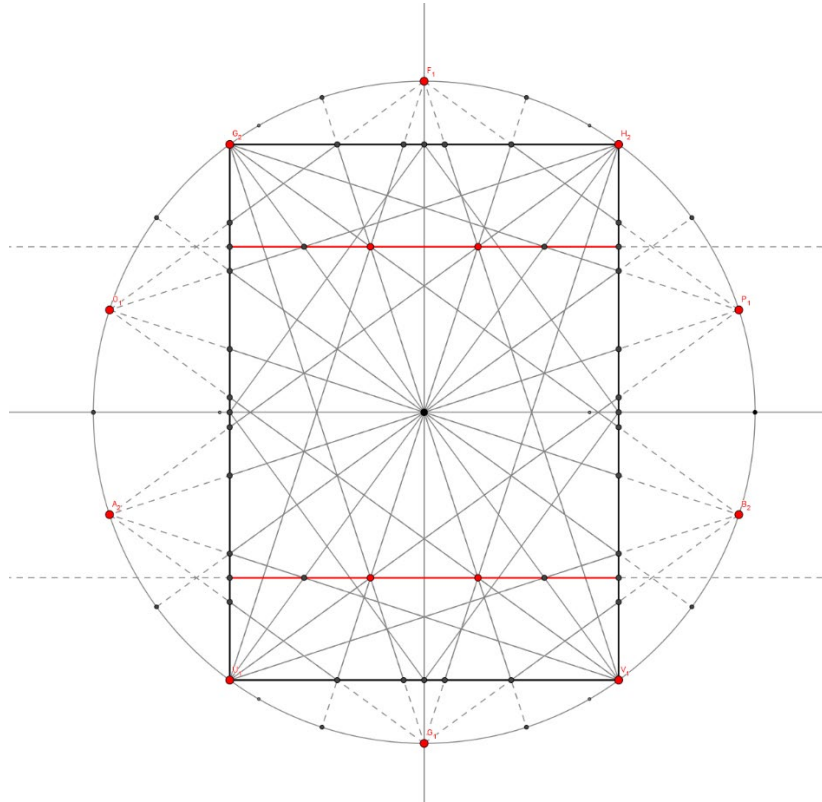
Add the missing three radial divisions at the upper right.



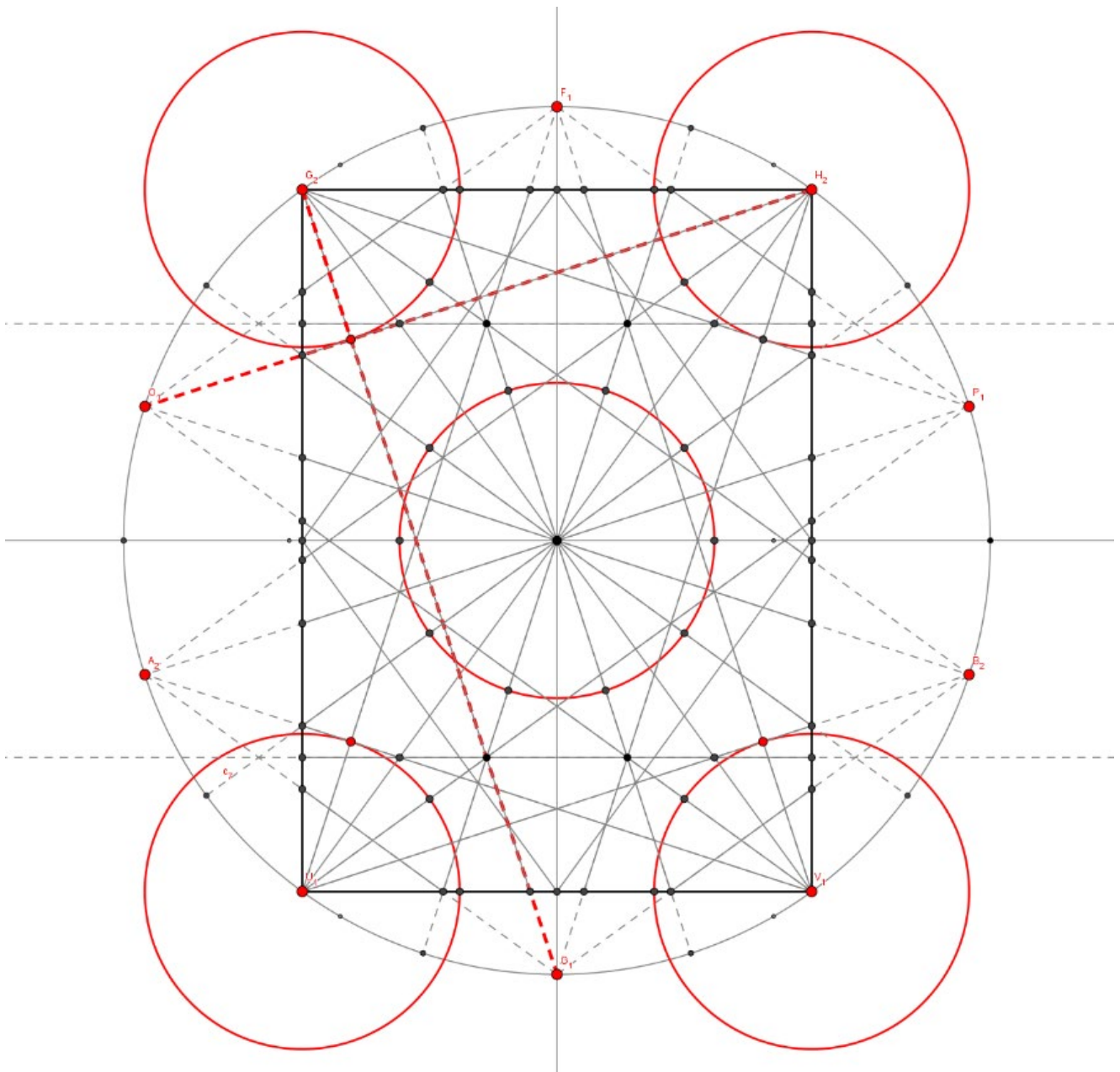
We won't need these line segments for a while, but before things get too busy, let's go ahead and draw in the four line segments at the corners, by connecting the "north" point ( $\pi/2$ ) to the points at  $\pi/10$  and  $9\pi/10$  (measuring counter-clockwise from the "east" point).



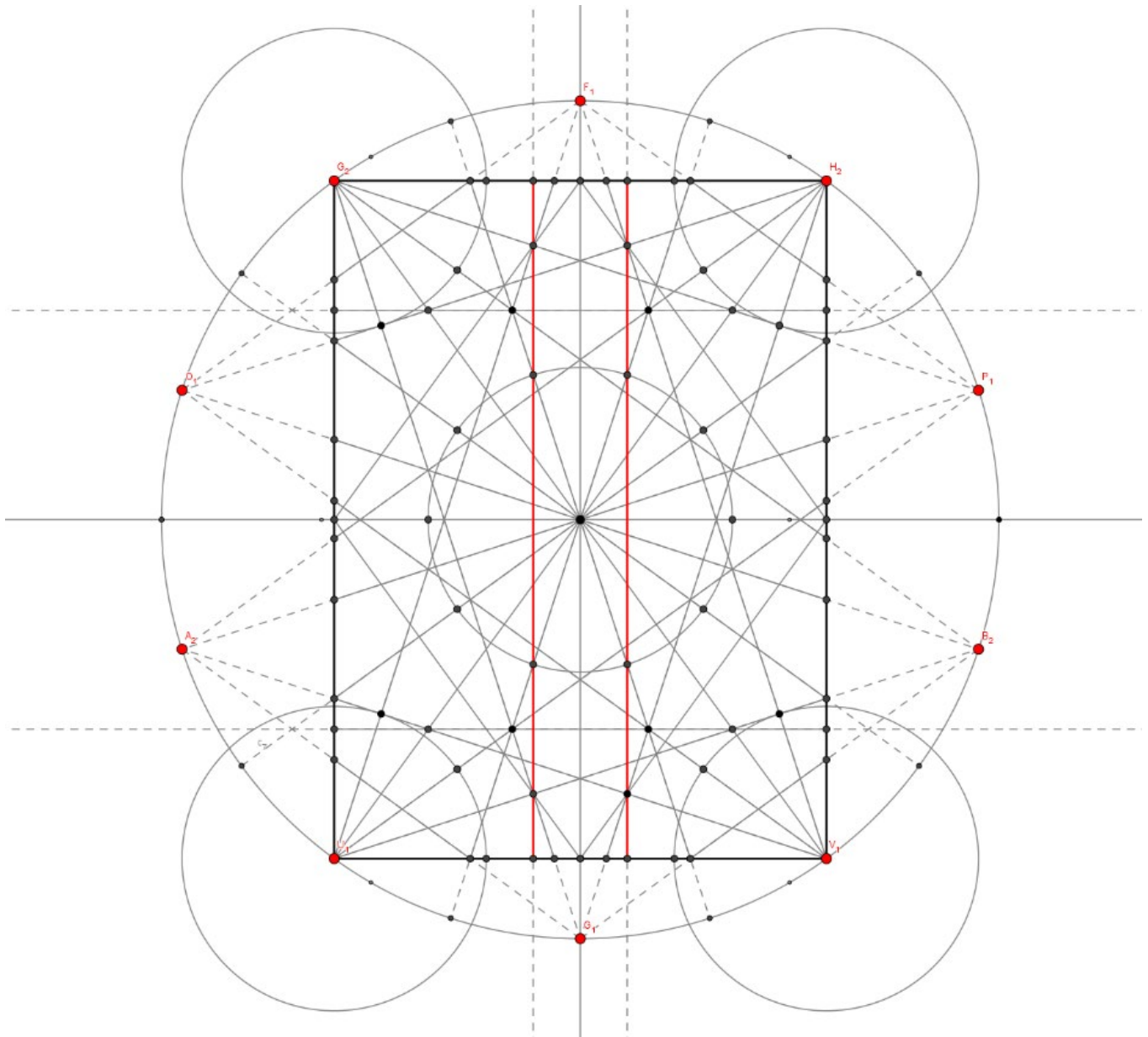
Draw the indicated six lines to complete the twenty-fold divisions at the center.



Locate the intersections highlighted in red, and draw the two indicated horizontal lines. Note that you should have four total intersections to help you line up each one accurately.

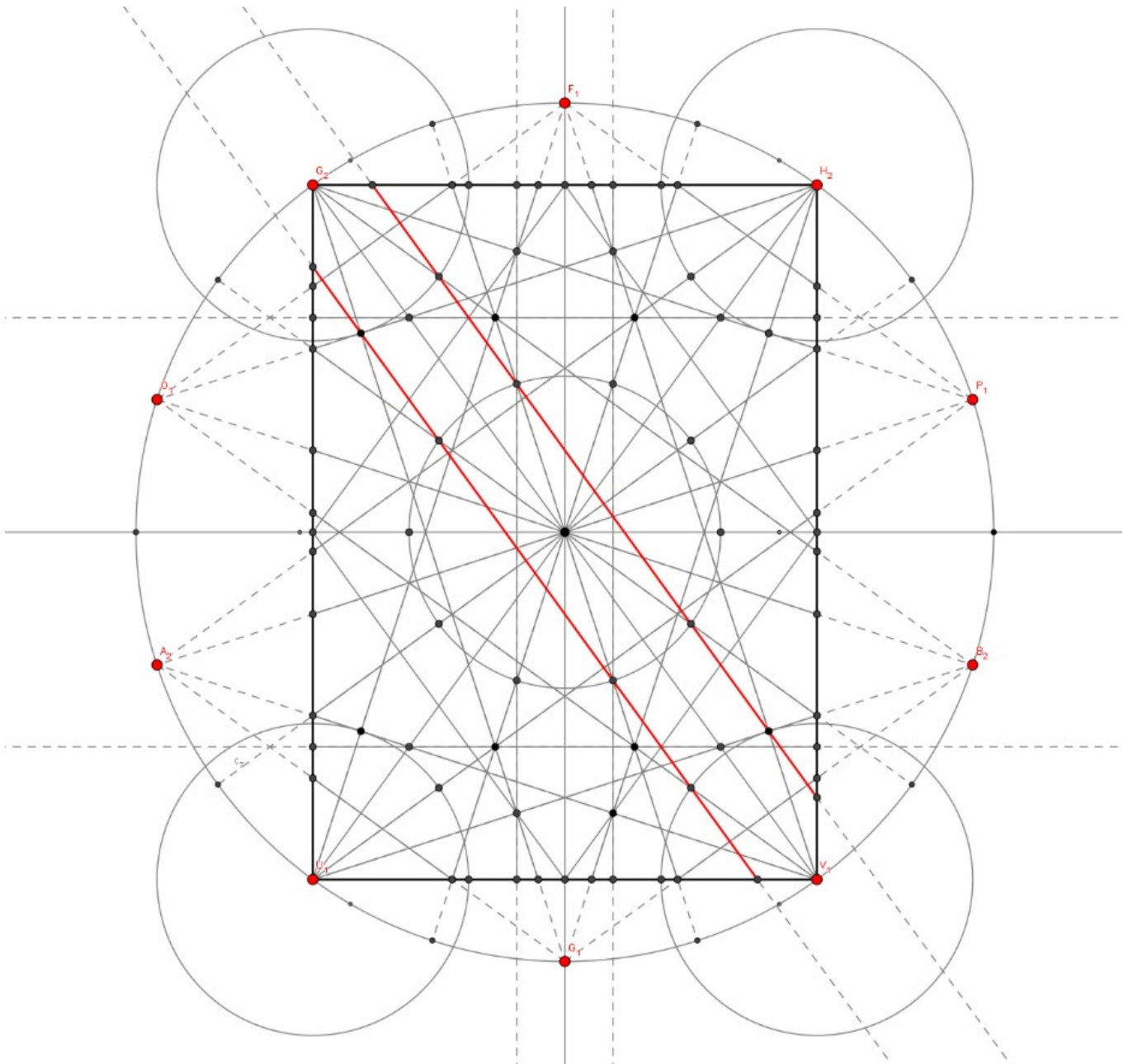


Find the intersection of the two radial lines highlighted with red dotted lines. Centering your compass at the top left corner of the rectangle, use this intersection point to set your radius. You can check it against similar intersections in the other three corners before drawing circles at each corner and the center, all with this same radius. Note the points along each red circle that indicate intersections with radial lines. You may want to circle these to help you keep track of the next few steps.

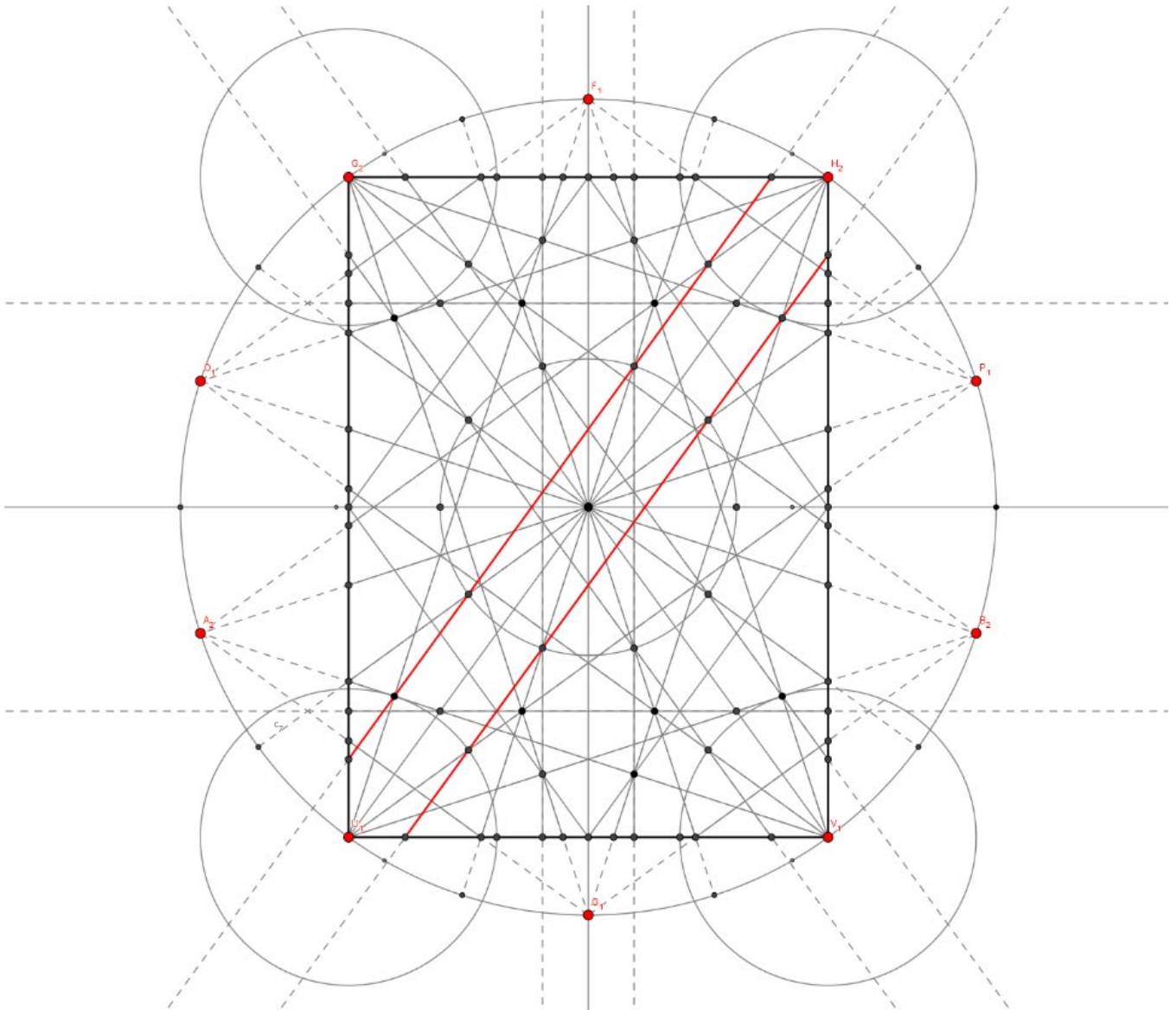


Locate the intersections at  $4\pi/10$ ,  $6\pi/10$ ,  $14\pi/10$  and  $16\pi/10$  on the central circle. Draw the indicated verticals parallel to the original vertical. You should notice a couple other intersections that will help you line these up properly.

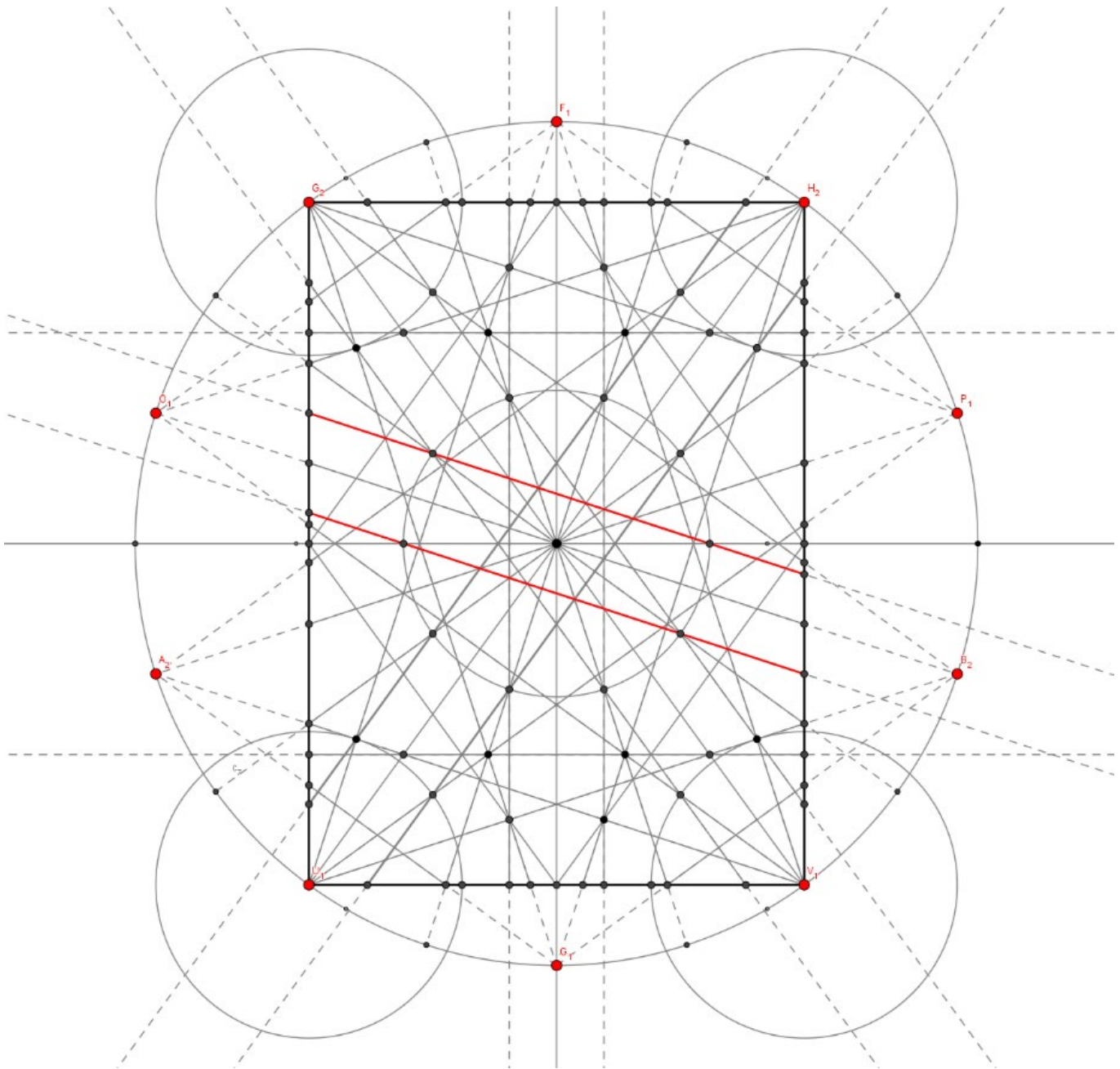




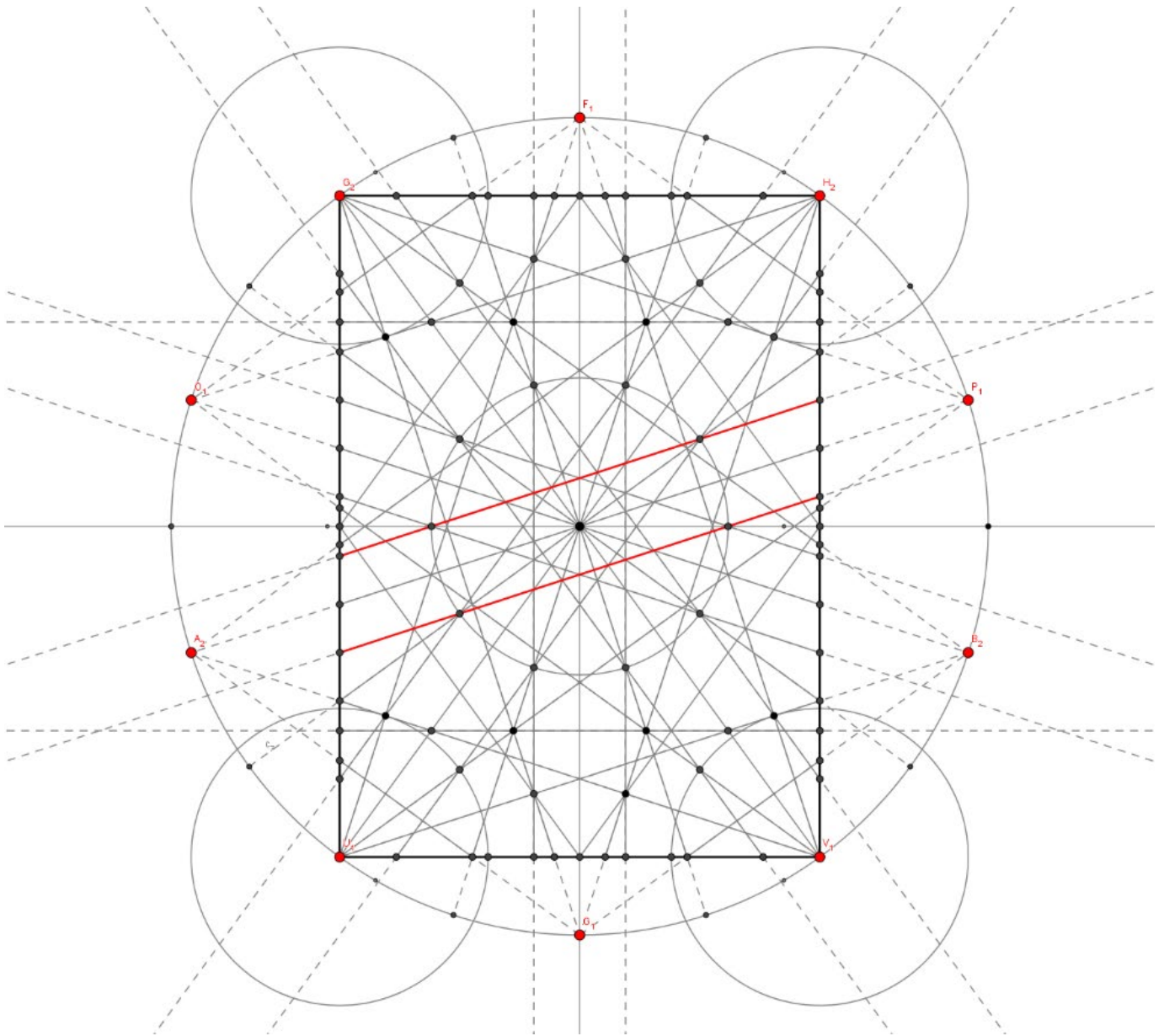
We are going to draw similar pairs of parallels all the way around. These two are on either side of the diagonal. Take care to make sure you are lining up the correct intersections.



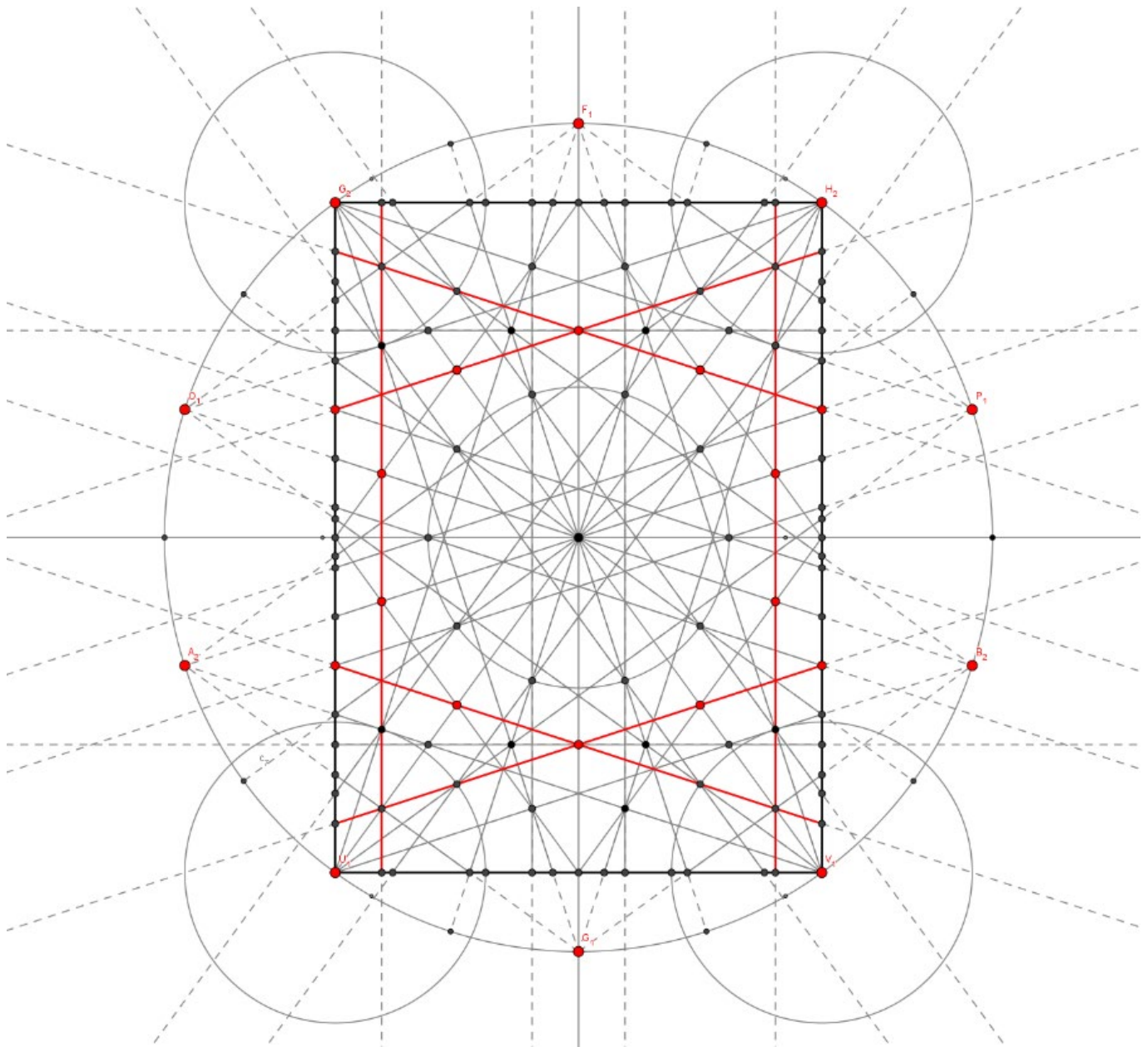
Draw two more parallels along the other diagonal.



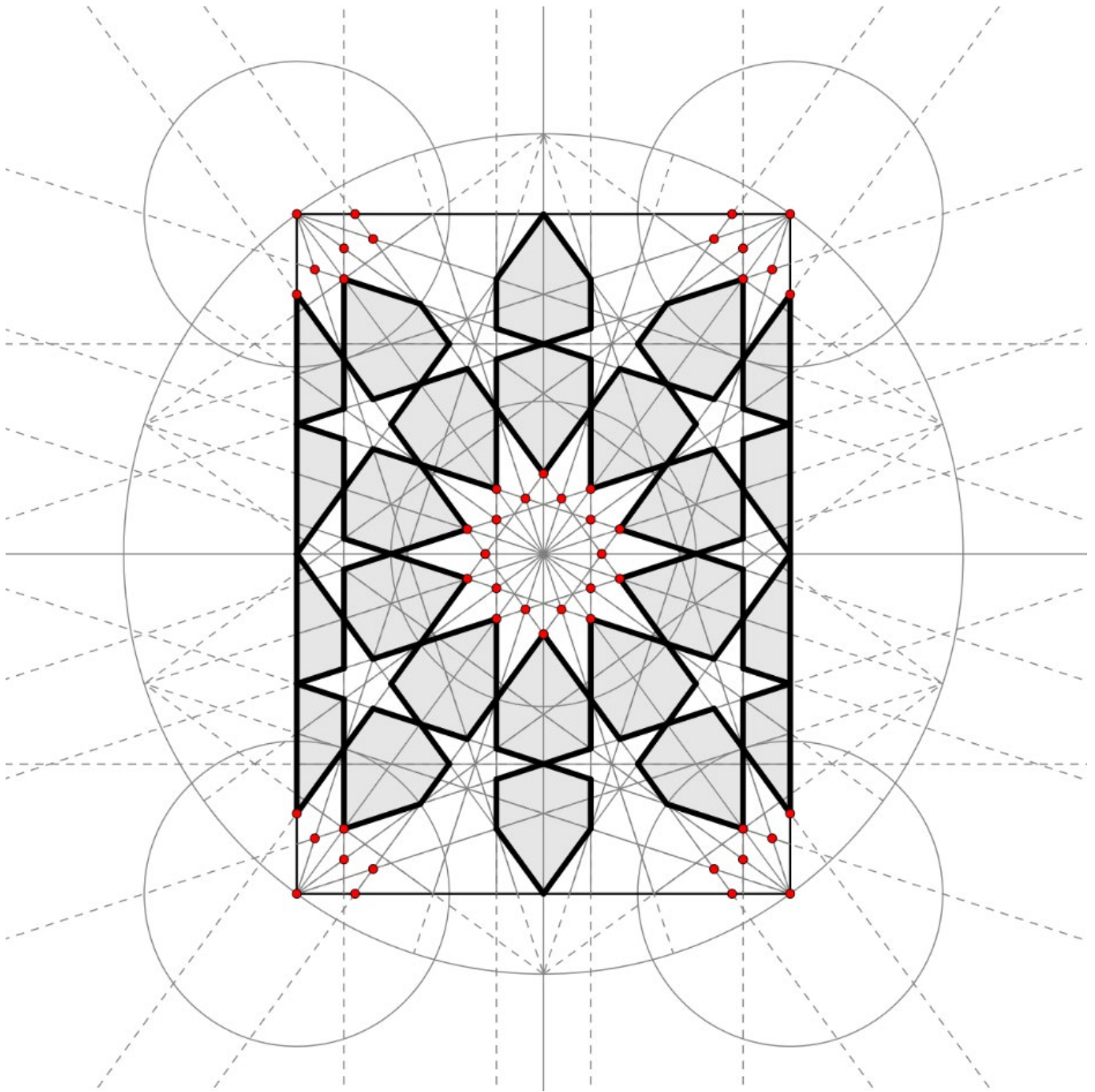
Two more parallels, connecting  $8\pi/10$  to  $0$  and  $10\pi/10$  ( $\pi$ ) to  $18\pi/10$ .



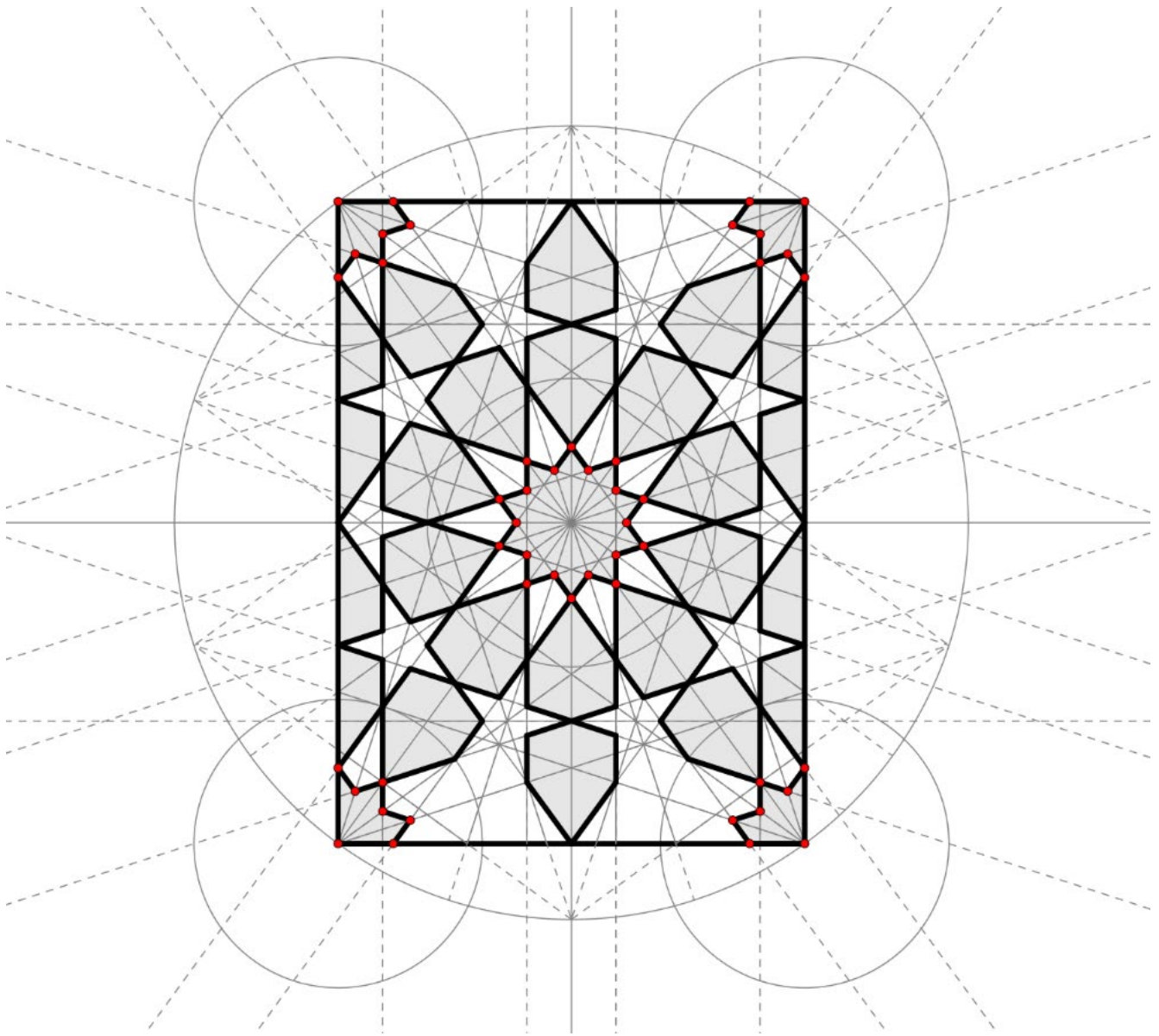
The last pair connect  $10\pi/10$  to  $2\pi/10$  and  $12\pi/10$  to  $0$ .



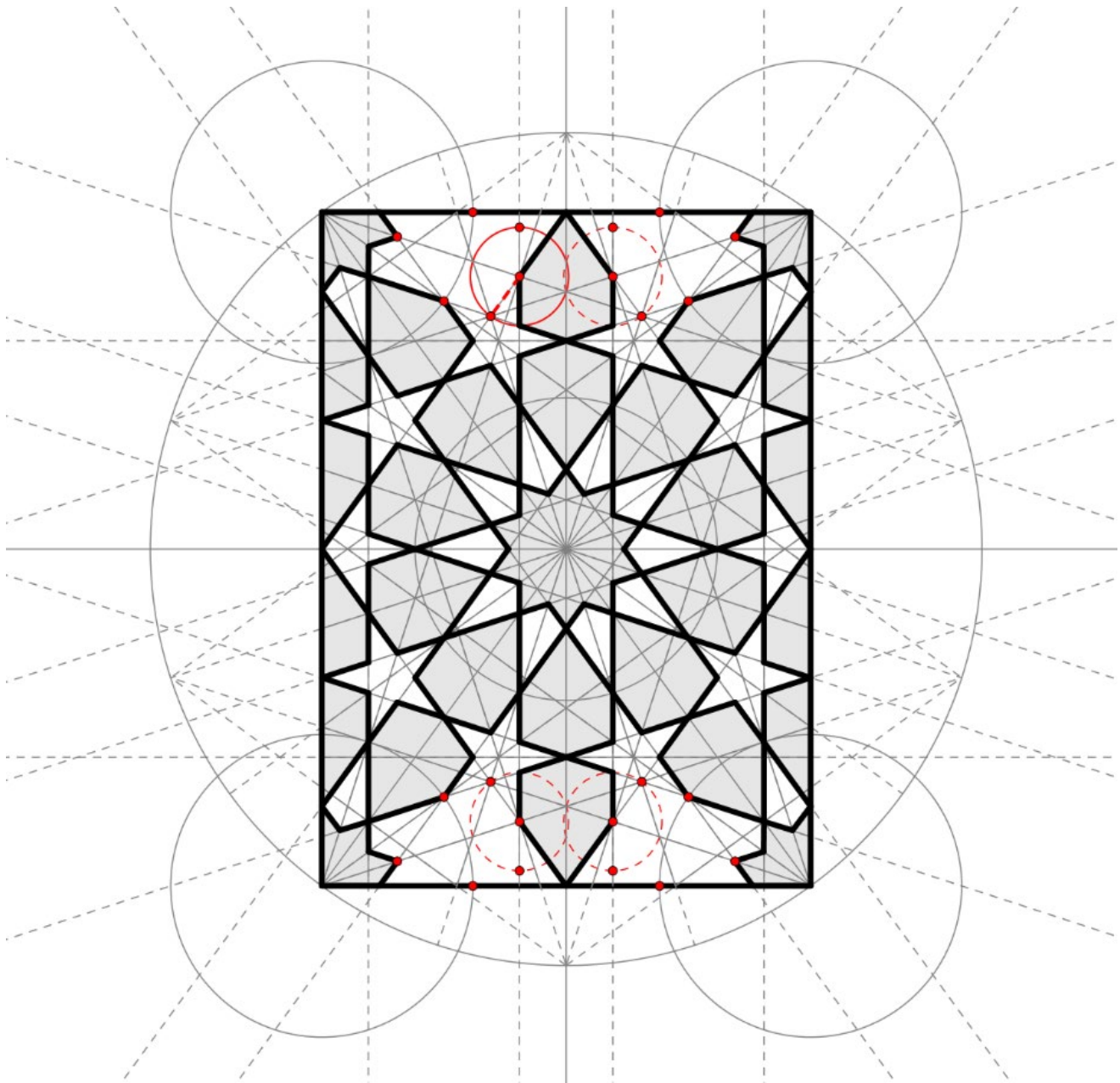
Locate these intersections along the rhombus edges, outer circles, and midpoints of those early horizontals that we drew. These six lines almost complete the pattern.



At this point, we can begin to pick out the pattern. Locate and outline the petals. The regular five-pointed stars should help guide you. Note that the sides of the petals follow the parallel lines we drew.

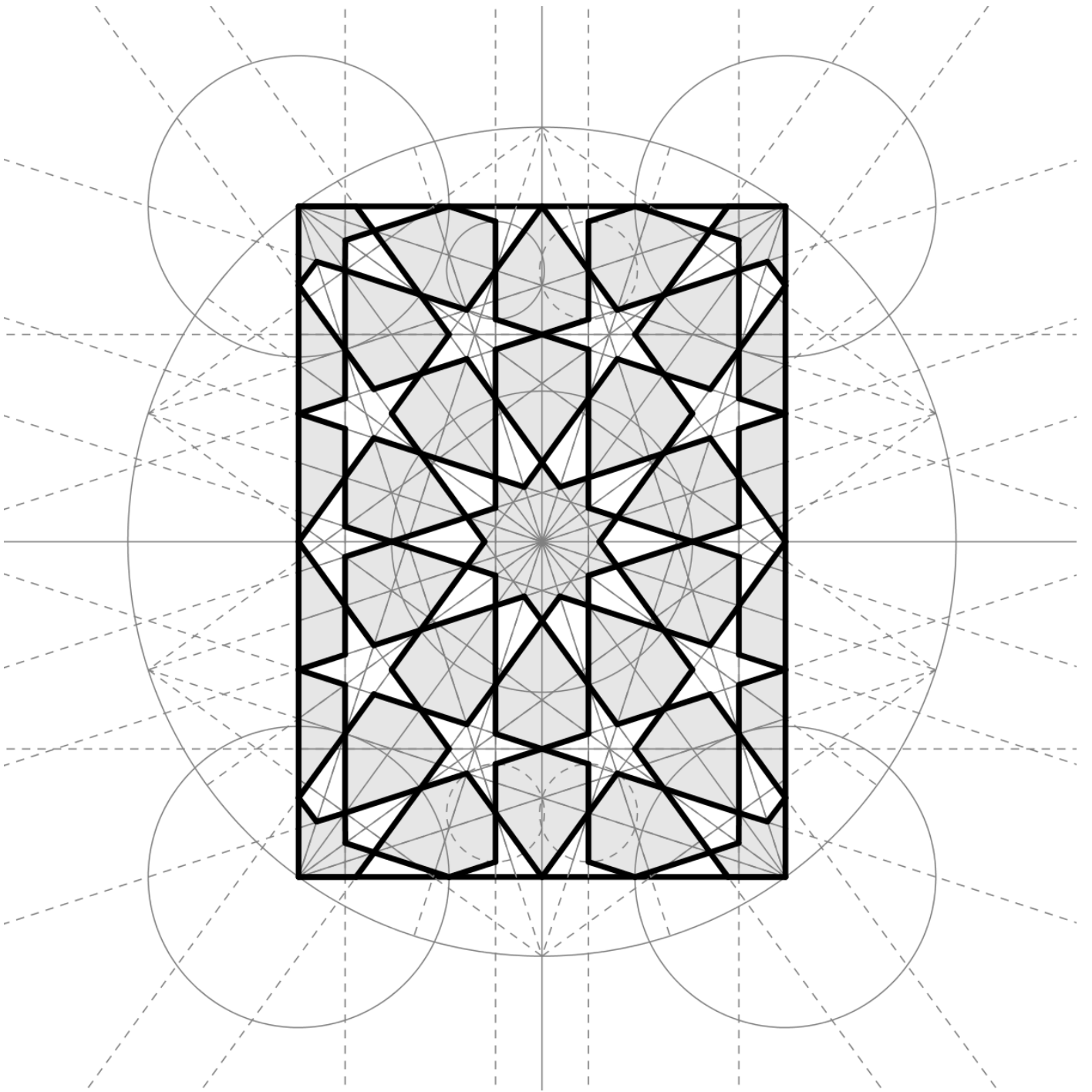


Locate and outline the central 10-pointed star and the quarter stars in the corners. There are a couple line segments at the corners that we didn't already have drawn in, but all of the vertices necessary to draw them in are there.



In order to fill in the last four petals, we need to find the indicated points on the pair of vertical parallels. One way to do this is to transfer the length of the edge of a star by centering the compass at the left vertex of the top center petal and setting the radius to the indicated inner star vertex. This radius can be transferred to the analogous points in the other three indicated locations.





Locate and outline the final four petals. You're done! 😊

## Supplies and Additional Resources

These are the supplies that I personally use most often in my drawing practice. I am not sponsored or compensated in any way for mentioning these products. I also make no claims that these are the best. Art supplies are very personal.

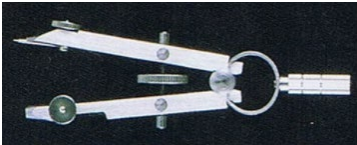
Compasses:

Keuffel and Esser bow compasses and beam compass (for drawing large circles with high precision)



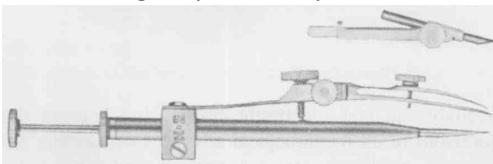
[Small \(79mm drafting radius\) Dorapasu compass](#)

(for drawing very small circles)



Keuffel and Esser drop bow compass

(for drawing very VERY tiny circles)



For my students and other beginners, I recommend the [Blick Masterbow](#), which is a sturdy little compass at a bargain



Rulers:

[Westcott 12-inch quilting ruler](#)

(this is especially helpful for ensuring lines are parallel)



[Alvin 18-inch scratch-resistant clear acrylic ruler](#)



[6-inch stainless steel ruler similar to this one](#)

(this is what I use in my tiny sketchbook)



[Alvin Lettering Guide](#)

(useful for thickening lines for weaving)



Pencils, etc.:

[Staedtler Mars Technico lead holder](#)



[Koh-I-Noor 2.0mm 6H leads](#)

(I use these in all of my compasses and my lead holder)



[Staedtler Mars Technico Lead Sharpener](#)



[Tombow MONO Zero eraser](#)



[Pentel Hi-Polymer Eraser](#)



Pens:

[Sakura Pigma Micron Graphic Pens in various sizes](#)



Paper:

[Springhill 67lb \(147GSM\) 11"x17" Vellum Bristol Cover](#)

[Arches hot press watercolor paper](#)

Colors:

[Winsor & Newton Cotman Sketcher's Pocket Box watercolor half pan set](#)



[Artify watercolor field sketch watercolor set](#)

(the brushes that came with this set are the ones I use most often)



[MozArt Komorebi metallic watercolor paint set](#)



[Zebra Midliners](#)



[Prismacolor art markers](#)

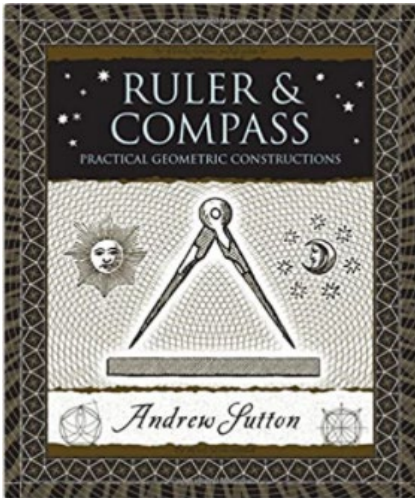


[Prismacolor colored pencils](#)

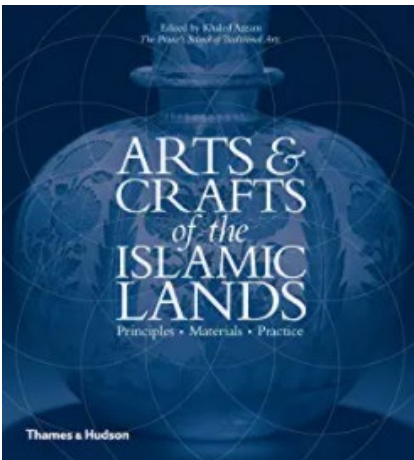


Books:

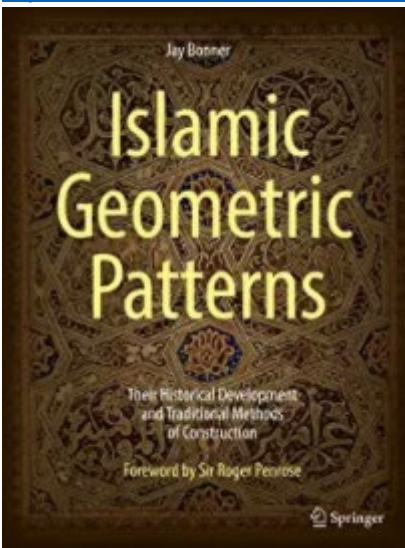
[Ruler & Compass by Andrew Sutton](#)



[Arts & Crafts of the Islamic Lands](#)



[Jay Bonner, Islamic Geometric Patterns](#)



[Designa: Technical Secrets of the Traditional Visual Arts](#)



YouTube channels:

[Samira Mian](#)

[Con Regla y Compás \(Manuel Martinez Vela\)](#)

[Mohamad Aljanabi](#)

[Kamikyodai \(Ricardo Hinojosa\)](#)

Facebook Groups with patterns and tutorials:

Alan Adams, [Drawing Islamic Geometric Designs](#)

Mohamad Aljanabi, [Geometric Pattern School](#)

Classes:

[Art of Islamic Pattern](#)

[Prince's School of Traditional Arts](#)

Misc:

[Pattern in Islamic Art](#) (David Wade's photo archive)

[Tilingsearch.org](#) (searchable pattern database)

A.J. Lee, [Islamic Star Patterns Notes](#)

[The Topkapi Scroll](#)

[Abu al-Wafa' Buzjani, A Book on Those Geometric Constructions Which Are Necessary for a Craftsman](#)