1.12 1.13 1.14 Flag China RAD

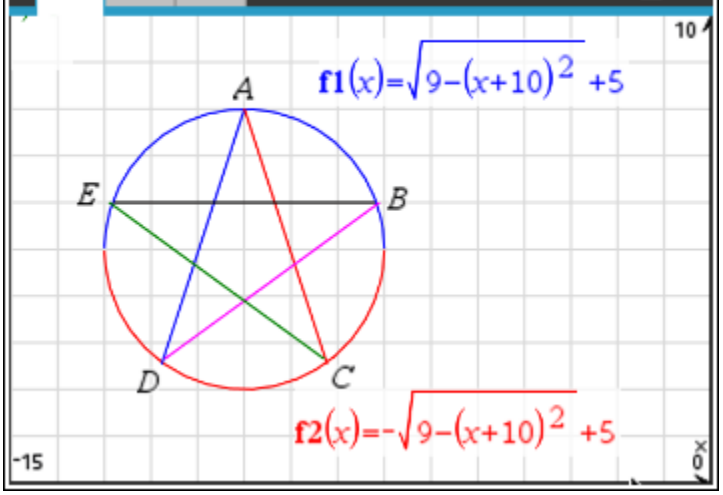
One method for constructing the national flag of China is to focus on the second quadrant that contains the stars. The large star is centered at (−10, 5) and is inscribed in a circle of radius 3. The circle can be described by equation $(x + 10)^2 + (y - 5)^2 = 9$ or the functional equations $y1 = \sqrt{9 - (x + 10)^2}$ and $y2 = \sqrt{9 - (x + 10)^2}$.

1.12 1.13 1.14 Flag China RAD

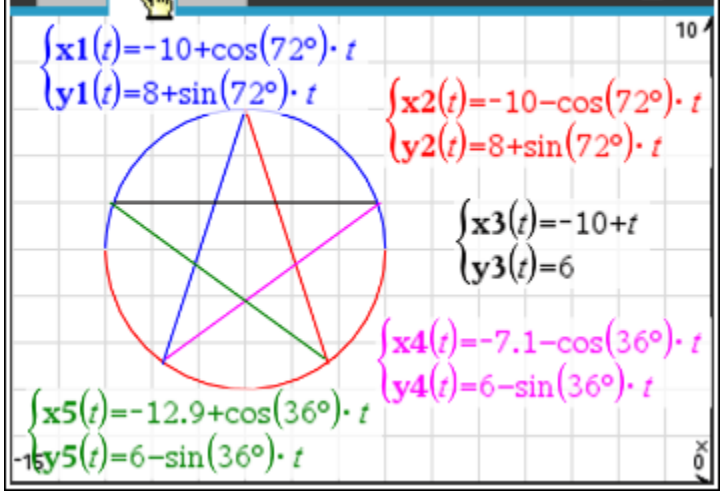
Each arc between consecutive vertices of the star measures 72° so each angle of the star measures 36°. Side AD makes an angle of 72° with the horizontal so its slope is tan 72°. Using A(−10, 8) as the starting point the parametric equations for side AD are:

x1 = −10 + cos(72°)t and y1 = 8 + sin(72°)t, with −5.75 ≤ t ≤ 0 to go from A to D.

1.1 1.2 1.3 Flag China RAD



1.1 1.2 1.3 Flag China RAD



1.15 1.16 1.17 Flag China RAD

Angle ACD is also 72° so side AC makes an angle of 108° with the horizontal so its slope is tan 108° = −tan 72°. Using A(−10, 8) as the starting point the parametric equations for side AC are:

x2 = −10 − cos(72°)t and y2 = 8 + sin(72°)t, with −5.75 ≤ t ≤ 0 to go from A to C.

1.14 1.15 1.16 Flag China RAD

Plotting B and E on the circle, 72° on either side of A, we see that the y coordinate of B and E are extremely close to 2. Their x coordinates are very close to 2.9 units to the left and right of −10 (Point A's x coordinate). The parametric equations for side BE are:

x3 = −10 + t, y3 = 6, with −2.9 ≤ t ≤ 2.9

1.17 1.18 1.19 Flag China RAD

Angle BDC is 36° so the slope BD is tan 36°. Using B(−7.1, 6) as the starting point the parametric equations for side BD are:

x4 = −7.1 − cos(36°)t and y4 = 6 − sin(36°)t, with 0 ≤ t ≤ 5.8 to go from B to D.

1.19 1.20 1.21 Flag China RAD

Angle ECD is 36° so side EC makes an angle of 142° with the horizontal so its slope is tan 142° = −tan 36°. Using E(−12.9, 6) as the starting point the parametric equations for side EC are:

x5 = −12.9 − cos(36°)t and y5 = 6 − sin(36°)t, with 0 ≤ t ≤ 5.8 to go from E to C.

1.18 1.19 1.20 Flag China RAD

To construct the four smaller stars it is useful to plot the centers of the five stars. Using the description of the flag, the center of the large star is at F(−10, 5). The centers of the four small stars are at G(−5, 8), H(−3, 6), I(−3, 3), and J(−5, 1).

1.18 1.19 1.20 Flag China RAD

The segments connecting the center of the large star to the centers of the smaller stars can be describe using parametric equations:

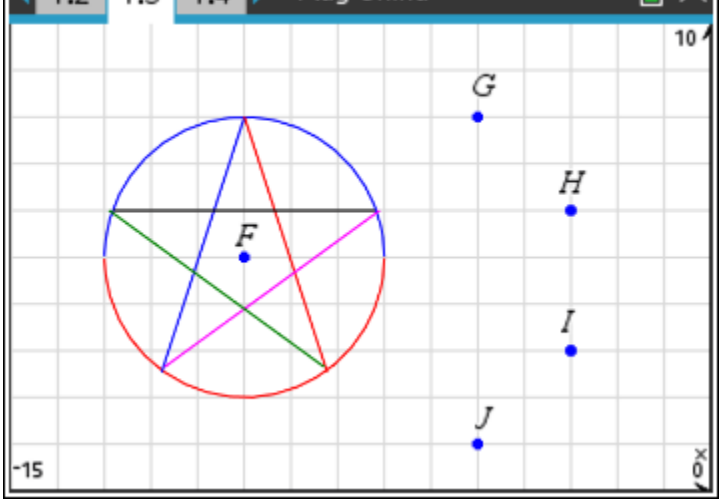
FG: x10 = −10 + 5t, y10 = 5 + 3t, 0 ≤ t ≤ 1

FH: x11 = −10 + 7t, y11 = 5 + 1t, 0 ≤ t ≤ 1

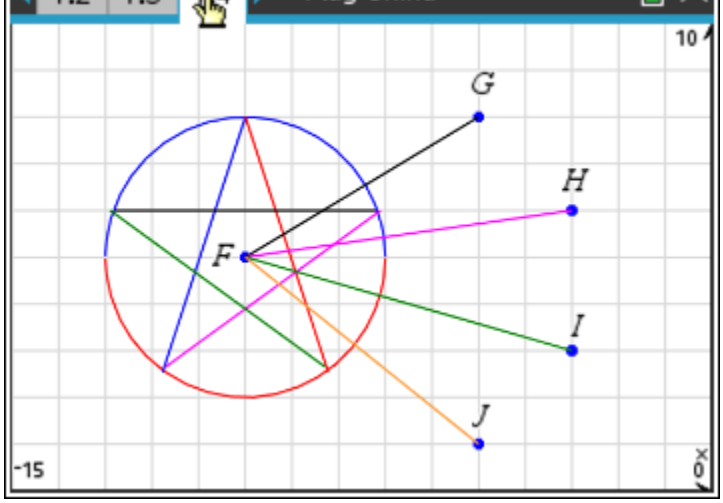
FI: x12 = −10 + 7t, y12 = 5 + −2t, 0 ≤ t ≤ 1

FJ: x13 = −10 + 5t, y13 = 5 + −4t, 0 ≤ t ≤ 1

1.2 1.3 1.4 Flag China RAD



1.2 1.3 1.4 *Flag China RAD



1.18 1.19 1.20 *Flag China RAD

Next we can construct the four small circles that circumscribe the four small stars.

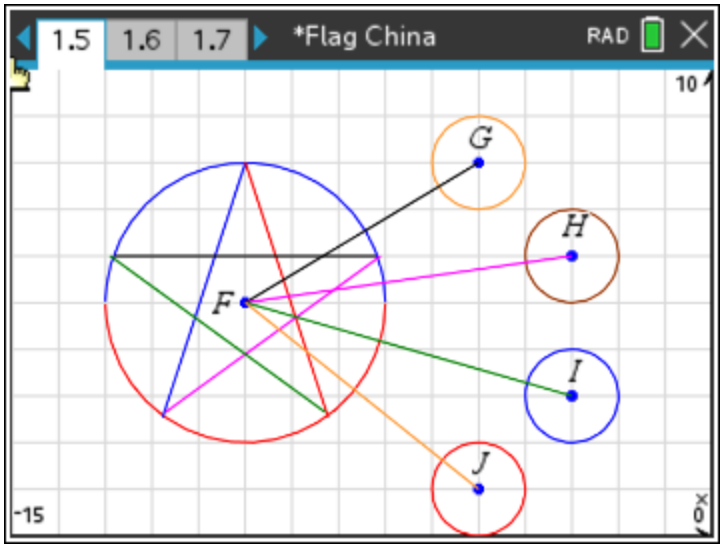
Circle G: x6 = −5 + cos(t), y6 = 8 + cos(t)

Circle H: x7 = −3 + cos(t), y7 = 6 + cos(t)

Circle I: x8 = −3 + cos(t), y8 = 3 + cos(t)

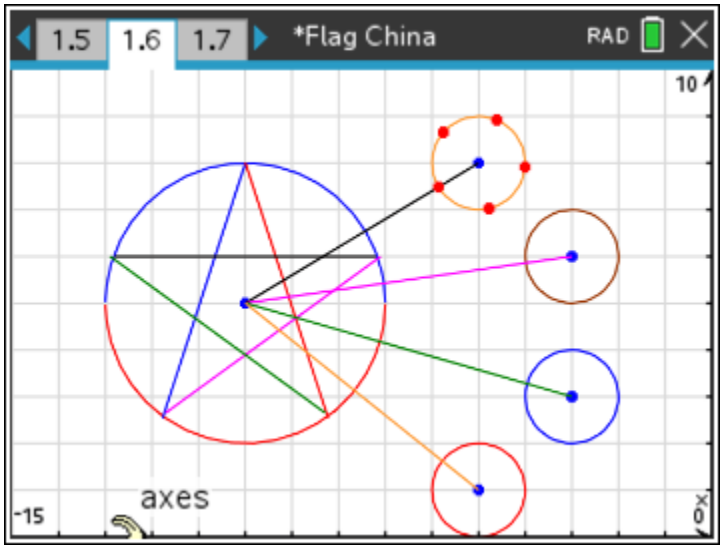
Circle J: x9 = −5 + cos(t), y9 = 1 + cos(t)

with 0 ≤ t ≤ 2π.



1.20 1.21 1.22 *Flag China RAD

Next we determine the point on each small circle where the line segment from the center of the large circle intersects the small circle. The slope of FG is 3 / 5 so the angle of elevation of FG is $\tan^{-1}(3/5) = a°$. Line segment FG intersects circle G at a point whose angle measure is 180 + a°. Subtracting 72° will generate other star vertex points on circle G.



1.29 1.30 1.31 *Flag China RAD

$\tan^{-1}\left(\frac{3}{5}\right)$	0.54042
$\frac{0.54041950027058 \cdot 180}{\pi} \rightarrow a$	30.9638
$\tan^{-1}\left(\frac{1}{7}\right)$	0.141897
$\frac{0.14189705460416 \cdot 180}{\pi} \rightarrow b$	8.1301

1.31 1.32 1.33 *Flag China RAD

$-5+\cos((180+a)°) \rightarrow e$	-5.85749
$-5+\cos((108+a)°) \rightarrow g$	-5.75429
$-5+\cos((36+a)°) \rightarrow i$	-4.60869
$8+\sin((180+a)°) \rightarrow f$	7.4855
$8+\sin((108+a)°) \rightarrow h$	8.65654
$8+\sin((36+a)°) \rightarrow j$	8.92026

1.33 1.34 1.35 *Flag China RAD

$-5+\cos((-36+a)°)\rightarrow k$	-4.00386
$-5+\cos((-108+a)°)\rightarrow m$	-4.77567
$8+\sin((-36+a)°)\rightarrow l$	7.91221
$8+\sin((-108+a)°)\rightarrow n$	7.02549

$\{e,g,i,k,m\}\rightarrow o$

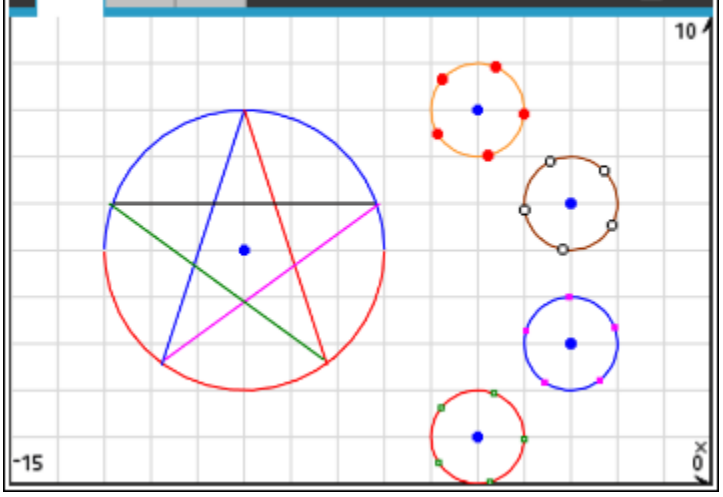
$\{-5.85749,-5.75429,-4.60869,-4.00386,-4.$

$\{f,h,j,l,n\}\rightarrow p$

1.22 1.23 1.24 *Flag China RAD

The slope of FH is 1 / 7 so the angle of elevation of FH is $\tan^{-1}(1/7)$ = b°. Line segment FH intersects circle H at a point whose angle measure is 180 + b°. Subtracting 72° four times from this angle will generate the other star vertex points on circle H.

1.8 1.9 1.10 *Flag China RAD



1.22 1.23 1.24 *Flag China RAD

The slope of FI is −2 / 7 so the angle of depresion of FI is $\tan^{-1}(-2/7)$ = c° < 0. Line segment FI intersects circle I at a point whose angle measure is 180 + c°.Subtracting 72° four times from this angle will generate the other star vertex points on circle I.

1.23 1.24 1.25 *Flag China RAD

The slope of FJ is −4 / 7 so the angle of depresstion of FJ is $\tan^{-1}(-4/7)$ = d° < 0. Line segment FJ intersects circle J at a point whose angle measure is 180 + d°.Subtracting 72° four times to this angle will generate the other star vertex points on circle J.

1.25 1.26 1.27 *Flag China RAD

To generate the sides of the small stars we can use five parametric equations to the nonadjacent vertices. In circle G, the vertex points are $(-5+\cos(180+\mathbf{a})°, 8+\cos(180+\mathbf{a}°))$ = (e, f). Similary, the other points are:

$(-5+\cos(108+\mathbf{a})°, 8+\cos(108+\mathbf{a}°))$ = (g, h)

$(-5+\cos(36+\mathbf{a})°, 8+\cos(36+\mathbf{a}°))$ = (i, j)

$(-5+\cos(-36+\mathbf{a})°, 8+\cos(-36+\mathbf{a}°))$ = (k, l)

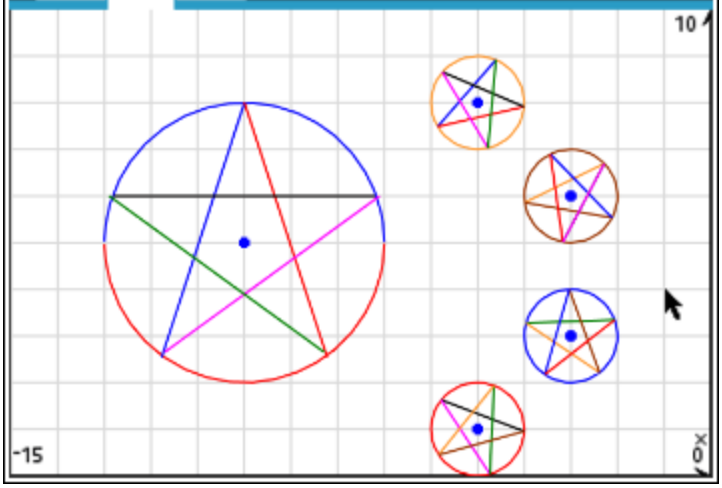
1.26 1.27 1.28 Flag China RAD

$(-5+\cos(-36+a)°, 8+\cos(-36+a°)) = (k, l)$

$(-5+\cos(-108+a)°, 8+\cos(-108+a°)) = (m, n)$

A simple way to plot these points is to create list o = {e, g, i, k, m} and list p = {f, h, j, l, n} and plot list o and list p using a scatter plot. The star vertices for the other circles can be generated in a similar fashion.

1.8 1.9 1.10 *Flag China RAD



1.25 1.26 1.27 *Flag China RAD

The sides of the small star in circle G are the segments connecting (e,f) to (i, j), (e,f) to (k,l) (g, h) to (k, l), (g, h) to (m, n), (i, j) to (m, n).

$x15 = e + (i - e)t,\ y15(t) = f + (j - f)t,\ 0 \le t \le 1$

$x16 = e + (k - e)t,\ y16(t) = f + (l - f)t,\ 0 \le t \le 1$

$x17 = g + (k - g)t,\ y17(t) = h + (l - h)t,\ 0 \le t \le 1$

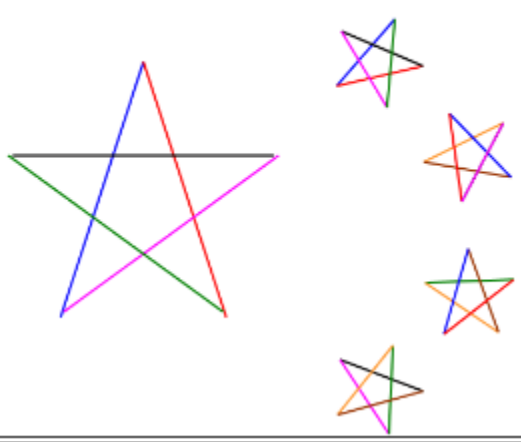
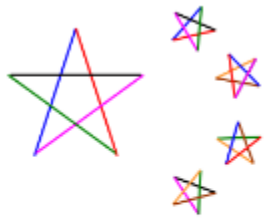
$x18 = g + (m - g)t,\ y18(t) = h + (n - h)t,\ 0 \le t \le 1$

$x19 = i + (m - i)t,\ y19(t) = j + (n - j)t,\ 0 \le t \le 1$

1.26 1.27 1.28 *Flag China RAD

The sides of the other small stars can be generated in a similar fashion. To view just the stars we turn off the equations for the circles, centers, segments connecting the centers, axes, and grid. To view the flag in proper portion, we adjust the window so that $-15 \le x \le 15$ and $-10 \le y \le 10$.

1.9 1.10 1.11 Flag China RAD



1.9 1.10 1.11 Flag China RAD