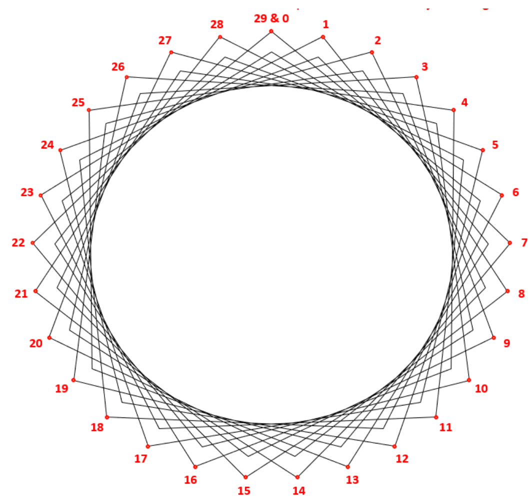
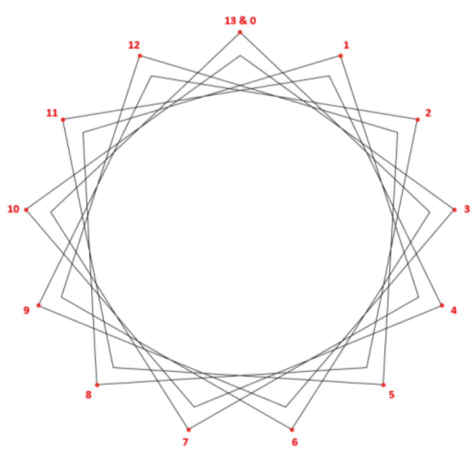
Rotational Symmetry

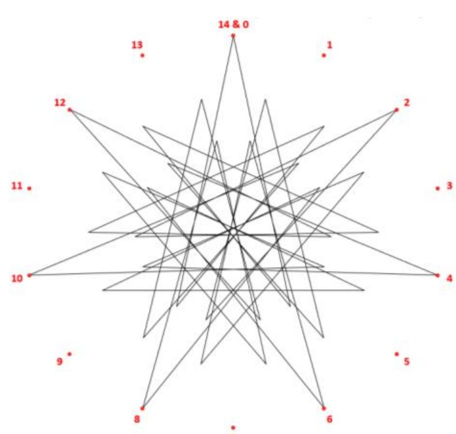
Any image has **rotational symmetry** if, after the image has been turned about its center, it matches the original image. Put another way, an image will have rotational symmetry if it looks the same after its apex vertex at ***n&0*** has been turned to some different vertex. An images' ***degree of rotational symmetry*** is *the number of different vertices it can be rotated to for which it matches the original.*

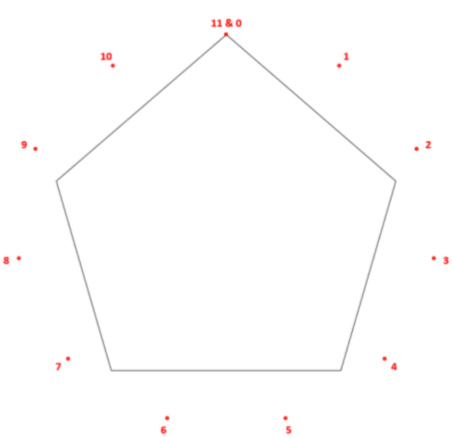
For example, it may be noticed fairly quickly that the image where ***S***, ***P***, ***J***, ***n*** = 2, 3, 4, 29 (below) has rotational symmetry. Interestingly, this image's degree of rotational symmetry is 29, or ***n***. This is to say that the image has rotational symmetry for any vertex to which it is turned.



The image made by ***S***, ***P***, ***J***, ***n*** = 2, 3, 2, 13 (at left below) also has a degree of rotational symmetry equal to ***n*** (13). However, images can be created that have lesser degrees of rotational symmetry than ***n***, such as the bottom middle image made by ***S***, ***P***, ***J***, ***n*** = 5, 8, 5, 14. This image's degree of rotational symmetry is 7, or $\frac{n}{2}$. Lastly, some images may be made which have no rotational symmetry, such as ***S***, ***P***, ***J***, ***n*** = 5, 22, 2, 11, a pentagon shown at the bottom right. This image has a degree of rotational symmetry of 1. Had the 11 vertices used to create this image not been labeled, it may have been mistaken for a regular pentagon with equal angles of 108° and 5 degrees of rotational symmetry. With labeled vertices, we recognize this pentagon does not have rotational symmetry because it cannot be rotated to any of the other 10 vertices and match the original image.







All images in *File 2* are created so that their degree of rotational symmetry is equivalent to their number of attached vertices. Each attached vertex also forms a line of symmetry through the center of the ***n***-gon.