Meccano pentagons gallery

https://github.com/heptagons/meccano/penta

Abstract

We show constructions of small meccano pentagons from side 12 to 3. We restrict all internal strips remain internal and do not overlap.

1 Pentagons of size 12

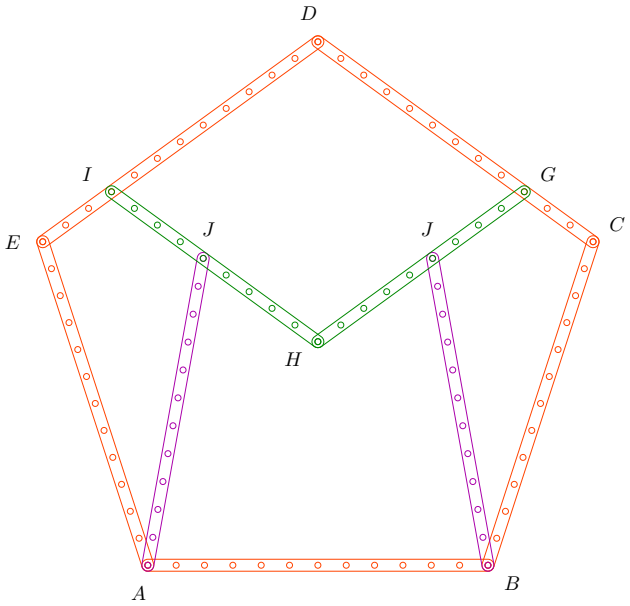

Figure 1: Pentagon size 12.

From figure 1 supose we have a regular pentagon of side 12 A, B, C, D, E and a rhombus D, I, H, G of side 9. Assume vertice A is at coordinates $(0, 0)$ and calculate relative coordinates of vertice J. First we calculate the abscissas going through vertices A, E, I, J substracting when we move to the left and adding when we move to the right:

$$AJ_x = AE_x + EI_x + IJ_x \tag{1}$$

$$= -\overline{AE}\cos\left(\frac{2\pi}{5}\right) + \overline{EI}\cos\left(\frac{\pi}{5}\right) + \overline{IJ}\cos\left(\frac{\pi}{5}\right)$$

$$= -12\left(\frac{\sqrt{5}-1}{4}\right) + 3\left(\frac{1+\sqrt{5}}{4}\right) + 4\left(\frac{1+\sqrt{5}}{4}\right) = \frac{19-5\sqrt{5}}{4} \tag{2}$$

Then we calculate the ordinates going to the same order of vertices adding when we go up and substracting when we go down:

$$\begin{aligned} AJ_y &= AE_y + EI_y + IJ_y && (3)\\ &= \overline{AE}\sin\left(\frac{2\pi}{5}\right) + \overline{EI}\sin\left(\frac{\pi}{5}\right) - \overline{IJ}\sin\left(\frac{\pi}{5}\right)\\ &= 12\left(\frac{\sqrt{10+2\sqrt{5}}}{4}\right) + 3\left(\frac{\sqrt{10-2\sqrt{5}}}{4}\right) - 4\left(\frac{\sqrt{10-2\sqrt{5}}}{4}\right)\\ &= \frac{12\sqrt{10+2\sqrt{5}} - \sqrt{10-2\sqrt{5}}}{4} = \frac{\sqrt{1450+190\sqrt{5}}}{4} && (4) \end{aligned}$$

Finally we calculate the distance $\overline{AJ}$ wich coincides with strip size 11:

$$\begin{aligned} \overline{AJ} &= \sqrt{(AJ_x)^2 + (AJ_y)^2} && (5)\\ &= \sqrt{\left(\frac{19-5\sqrt{5}}{4}\right)^2 + \frac{1450+190\sqrt{5}}{16}}\\ &= \sqrt{\frac{486-190\sqrt{5}}{16} + \frac{1450+190\sqrt{5}}{16}} = \sqrt{121} = 11 && (6) \end{aligned}$$