

## Area of Vertex Frame in Double Jump model Challenge Questions

The three double jump ( $n, S, P, J_1, J_2$ ) images to the right appear to be rectangles.

1. Provide a rationale for why they are, in fact, rectangles.

**FACT:** Assuming these are drawn on a unit circle (so that top and bottom vertices are  $(0,1)$  and  $(0,-1)$ ), we can calculate the areas of these images without resorting to trigonometry.

For reference, the unit circle that contains each of these four points has area  $\pi = 3.14$ . Refer to the images by  $n = 6, 8, \text{ or } 12$ .

You need not provide numerical answers to Questions 2, 3 and 4, educated guesses are sufficient here. Question 5 asks you to calculate exact areas (some of which involve square roots). Once you have these values you can check on your educated guesses from 2, 3, and 4.

2. Which image is closest to half as large as the circumscribed circle? Is the image more or less than half the size of the circle?

3. Which image is closest to one third as large as the circumscribed circle. Is the image more or less than one third the size of the circle?

**Fact:** One of these images is only 3.1% larger than the other (to the nearest 0.1%).

4. Which is 3.1% larger than the other?

5. What are the areas of each of the three rectangles (to the nearest 0.01)?

