

# MathsJam Shout

August 2023

Guildford MathsJam

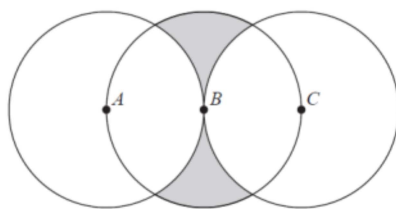
'Circular Reasoning' - celebrating the recent mathematical holiday 22/7

## Puzzle Circles in a line

This was a 5-mark GCSE question, so it should only take you 5 minutes!

The diagram shows three circles, each of radius 4 cm.

The centres of the circles are  $A$ ,  $B$  and  $C$  such that  $ABC$  is a straight line and  $AB = BC = 4$  cm.



Work out the total area of the two shaded regions.  
Give your answer in terms of  $\pi$

## Puzzle On The Ball

Five points are placed on the surface of a sphere. Prove that some four of them must be contained in some closed hemisphere.

From a selection at [bit.ly/pi-day-geom](https://bit.ly/pi-day-geom)

## Puzzle In The Ring

100 people numbered from 1 to 100 stand in a circle, in order. No. 1 has a sword, kills No. 2 and passes the sword to No. 3, who kills No. 4 and passes the sword on. This is repeated until only one person remains. Which number does this person have? Can you find a general way to solve this for any number of people without explicitly working through all the eliminations?

## Calculate $\pi$ approximations

**Madhava-Gregory-Leibniz series:** ([jstor.org/stable/2690896](https://jstor.org/stable/2690896))

$$\frac{\pi}{4} = \arctan 1 = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots$$

**Nilakantha series:**

$$\frac{\pi - 3}{4} = \frac{1}{2 \times 3 \times 4} - \frac{1}{4 \times 5 \times 6} + \frac{1}{6 \times 7 \times 8} \dots$$

**Ramanujan-Sato series:**

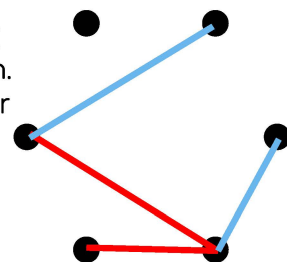
$$\frac{1}{\pi} = \frac{2\sqrt{2}}{99^2} \sum_{k=0}^{\infty} \frac{(4k)!}{k!^4} \frac{26390k + 1103}{396^{4k}}$$

Calculate some terms for each series and see how close to  $\pi$  you get. Which converges fastest? Which is easiest to calculate? Do you know any others?

## Play No Triangles

Draw six dots in a hexagon. Two players take turns drawing line segments between a pair of dots in their own color pen. The object of the game is to avoid drawing a triangle in your own colour.

Expand to higher order polygons (approximating a circle). Is there a winning strategy? Can the game end in a draw?



**MathsJam Shout** is a monthly sheet of ideas for activities to do at a MathsJam night. It's created using suggestions from a different MathsJam each month, and if you'd like to submit suggestions for a month in the future, email [katie@mathsjam.com](mailto:katie@mathsjam.com) for details.

MathsJam is a monthly opportunity for like-minded self-confessed maths enthusiasts to get together in a pub and share stuff they like. Puzzles, games, problems, or just anything they think is cool or interesting. Monthly MathsJam nights happen in over 70 locations around the world, on the second-to-last Tuesday of each month. To find your nearest MathsJam, visit the website at [www.mathsjam.com](http://www.mathsjam.com).

