The King of the Spiders

10 April 2025

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This is a nice logic problem[1] from MathsJam Shout for April 2025.

The king of the spiders has four servants, and the servants have either 6, 7, or 8 legs. Servants with 7 legs always lie, and servants with 6 or 8 legs always tell the truth.

The king asks 'How many legs do you four have in total?', and the four spider servants (who are standing behind a table, so you can't see their legs) answer 25, 26, 27, and 28, respectively.

Who is telling the truth?

Solution

Like so many of these problems it seems difficult to get a handle on it at first. So consider some extreme cases. If all the spiders were telling the truth, there should be only one answer. So there must be some liars present. If all the spiders were lying, then the true answer would be $4 \times 7 = 28$ legs. But that would mean one spider gives the true answer 28, and that would mean not all the spiders were lying. If more than one spider were telling the truth, then they would agree on the true answer and there would be less than 4 distinct answers.

So *only one* spider must be telling the truth. Therefore 3 spiders are lying and they have 21 legs total. The truth-telling spider has 6 or 8 legs. But $21 + 8 = 29$, and that is not among the answers. But $21 + 6 = 27$ is. So there is one 6-legged spider telling the truth and the others are lying.

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[1] https://mathsjam.com/shout/MJShout.pdf (This is a general link. There is no link for the MJShout for a specific month.)