Stable wheel

Aim: To show how a rolling bicycle wheel "organizes" its stability.

Subjects: 1Q60 (Rotational Stability)

Diagram:

Equipment:

- Small bicycle wheel; diam. = 40cm (or any other wheel or disc).

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Presentation:

- Place the wheel upright on the floor. On release it falls down immediately.
- Then the wheel is released while turning. It rolls over the floor and remains upright for a much longer time.
  The second observation made is that it will follow a curve when it starts falling down. Also notice that the curve it makes, is into the direction of the "falling-down" (see Figure1).

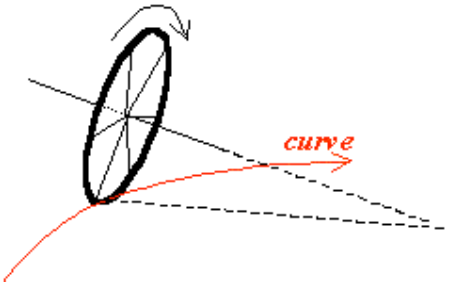

Figure 1

Explanation: Figure2A shows the wheel turning. The rotation is indicated by means of the vector $\underline{\omega}$. Due to some disturbance, the wheel inclines due to gravity: a torque ($\underline{\tau}$) is acting on the wheel (see Figure2B).

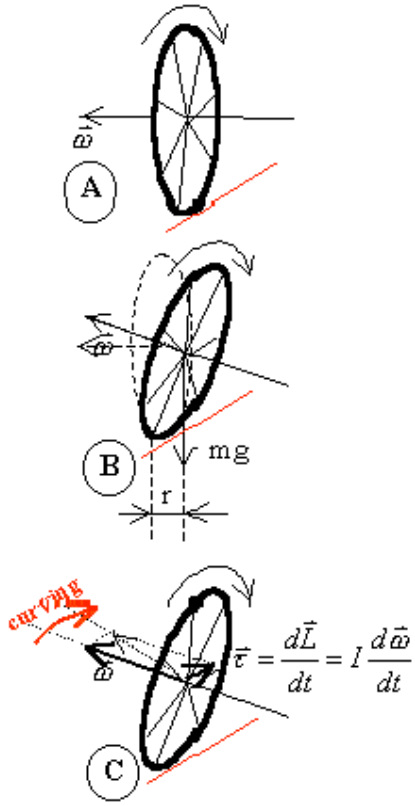

Figure 2

Due to this torque the direction of the vector $\underline{\omega}$ is changed: $\underline{\omega}$ is changed into the

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direction of $\underline{\tau}$ (see figure2C), so the wheel will make a curve while rolling. This continues because the vectors $\underline{\omega}$ and $\underline{\tau}$ remain perpendicular to each other.
Also can be seen now that the larger the inclination, the sharper the curve it will make since the vector $\underline{r}$ increases, making $\underline{\tau}$ larger.