A PocketLab Experimental Analysis of a Yo-yo

Answers to Discussion Question for Teachers

1. ***What is the yo-yo doing at the points labeled with green dots?*** The yo-yo is reaching the bottom of its swing having a maximum magnitude for angular velocity. It is rotating rapidly and due to the fact that the string is tightly bound to the axle, it begins wrapping in the opposite direction around the axle.
2. ***What is the yo-yo doing at the points labeled with red dots?*** It has come to rest at the top of its swing, having lost all of its kinetic energy of rotation and translation while gaining gravitational potential energy. With each swing down and then up again, it rises less due to frictional losses of energy. Upon stopping at the top of its swing, its angular velocity changes sign, rotating in the opposite direction.
3. ***In contrast to the green dots, what has caused the horizontal lines which have been labeled with the letter A?*** You notice first that all of the lines labeled A are horizontal and have angular velocities of ±2000 °/s. It seems strange that the yo-yo would suddenly max out at 2000 °/s, and keep that angular velocity for the remainder of its fall. If you check out the PocketLab Specifications at http://www.thepocketlab.com/specs.html, you will notice that the gyroscope range is stated as ±2000 °/s. The gyroscope has simply maxed out! This clearly shows that students must be familiar with the allowed range for the sensors if they are going to avoid flawed analyses of data from PocketLab.
4. ***What is the yo-yo doing on the lines labeled with the letter B?*** The yo-yo is falling under the influence of gravity, with increasing magnitude of angular velocity and kinetic energy of translation, while its gravitational potential energy decreases.
5. ***What is the yo-yo doing on the lines labeled with the letter C***? The yo-yo is rising, with decreasing magnitude of angular velocity and kinetic energy of translation until it stops, while it gravitational potential energy increases.
6. ***Can you think of a way to determine the actual maximum angular velocities where you see the horizontal lines labeled A***? Using a linear regression model, extrapolate the lines B and C to the point at which they intersect. This point should allow determining the actual maximum angular velocity.