AS91522 - Physics 3.2

Circular Motion of a Stunt Glider

Nathan Tasker

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Contents

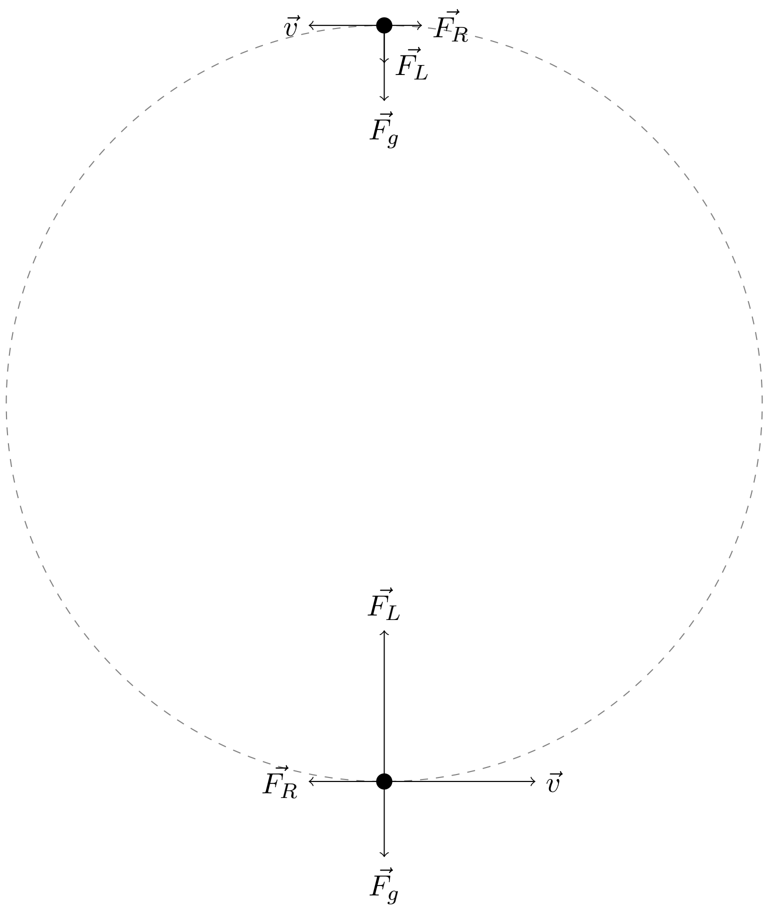
1 Vertical Circle: Loop the loop including Dip and Arch

1.1 Achieved

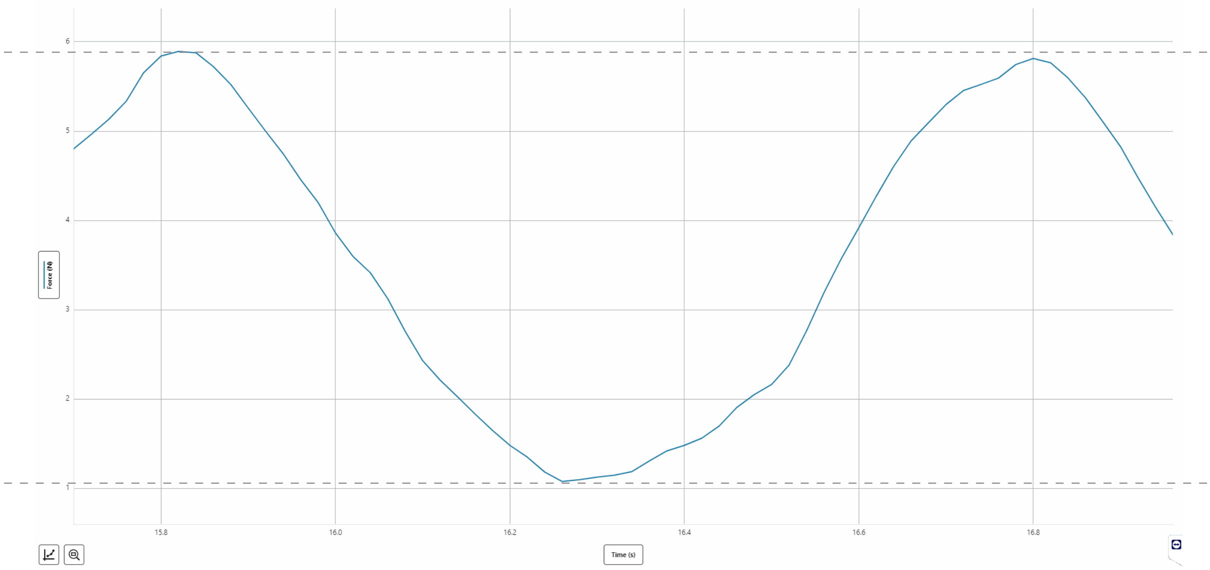
During motion, 3 forces are acting on the stunt glider:

1. Gravity ($\vec{F_g}$) (i.e. Weight) always vertically downwards (i.e. toward center of Earth).
2. Lift ($\vec{F_L}$) perpendicular to direction of velocity, toward the center of the circular path.
3. Air Resistance ($\vec{F_R}$) (i.e. Friction, Drag) opposite to direction of velocity.

Please note that vector arrow lengths are not perfectly proportionally accurate.



The force of gravity is always constant in both magnitude and direction regardless of the glider's velocity or position in the loop (top, bottom, and anywhere else). This is because $|\vec{F_g}| = mg$ where mass (m) and the acceleration of gravity (g) are constants.
Conversely, the force of lift varies in both direction and magnitude as the glider performs the loop the loop.
Lift's magnitude ($|\vec{F_L}|$) is greatest at the bottom, $\because |\vec{F_L}| = \frac{1}{2}pv^2AC_L$, $\therefore |\vec{F_L}| \propto v^2$. Because velocity is greatest at bottom, lift force is as well. To maintain circular motion the centripetal force ($|\vec{F_c}| = |\vec{F_L}| - |\vec{F_g}|$) towards the center of the circular path must have a magnitude value great enough to provide necessary centripetal acceleration for the circular path radius, meaning the lift force upwards must at least be greater than the gravity force downwards ($|\vec{F_L}| > |\vec{F_g}|$ in order for $|\vec{F_c}| > 0$).
Lift's magnitude ($|\vec{F_L}|$) is least at the top, because the direction of gravity force is toward the center of the circular path. This means ($|\vec{F_c}| = |\vec{F_L}| + |\vec{F_g}|$).



At the bottom of the vertical circle, the tension force (emulating the lift force, $\vec{F_L}$) is greatest, which occurs at 15.82 seconds with 5.89N.
Once the force meter (emulating motion of glider) reaches the top of the verticle circle, the tension force is at its least, which - when smoothing the curve of data and reducing random variation/noise - occurs at
Check if sine model helps then return to this section.
During the loop the loop, as the glider ascends, its kinetic energy (E_K) is converted into gravitational potential energy (E_p). As the glider descends, its gravitational potential energy (E_p) is converted back into kinetic energy (E_K).

1.2 Merit

1.3 Excellence

2 Banked Corner

2.1 Achieved

2.2 Merit

2.3 Excellence

3 Additional Info

3.1 Comprehensive Version History

Access to all prior versions of this document during process of creation is publicly available at:
`https://github.com/NathanTaskerPersonal/AS91522`

3.2 Graphical Analysis Files

Access to all graphical analysis files are publically available at:
middletonschoolnz-my.sharepoint.com/...

3.3 Bibliography