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A SYSTEMIC INITIATIVE FOR MODELING INVESTIGATIONS & OPPORTUNITIES WITH DIFFERENTIAL EQUATIONS

# TEACHER VERSION
# Time Up Vs Time Down

Brian Winkel
Director, SIMIODE
Chardon OH 44024 USA
BrianWinkel@simiode.org

**Abstract:** We seek to compare for the time a projectile takes to go vertically up with the time it takes to return to its starting position. Do this in the following three cases. Case I: There is no resistance due to air. Case II: Resistance to the motion due to air is proportional to velocity. Case III: Resistance to the motion due to air is proportional to velocity squared.

## SCENARIO DESCRIPTION

How do the times compare for the time a projectile takes to go vertically up with the time it takes to return to its starting position?

Do this in the following three cases.

- Case I: There is no resistance due to air.
- Case II: Resistance to the motion due to air is proportional to velocity.
- Case III: Resistance to the motion due to air is proportional to velocity squared.

## NOTES FOR TEACHERS

We enclose a Mathematica notebook 3-033-Mma-T-TimeupTimeDown-TeacherVersion and a pdf version for those who do not use Mathematica in which we address all three cases.

An extension of this project is to consider the case where the resistance to the motion due to air is proportional to velocity to some power $r$, which is not $r = 1$ or $r = 2$.

An activity in which students could engage is to actually take some projectiles into the field and through measurements determine which case is applicable for describing flight and whether or not this modeling is valid. For example, use various projectiles: shuttlecock, baseball, Steel ball, balloon, golf ball, whiffle ball, table tennis ball.