Name 1: _____

Name 2: _____

Date: _____

Challenge #9: SUMO

Overview

Up to **two** students can work on this challenge. Remember each team member must contribute to at least one the completion of one of the physics components for one challenge and the completion of one of the engineering components for another challenge. This challenge is primarily about **forces**. You will be asked to do the following:

1. Collaborate with an opposing team to create a force diagram of your rover and the forces it experiences

2. Determine how long it should take to win or lose

3. Reflect on accuracy of your calculations

Creating a Force Diagram

To create a force diagram, you and another team need to collaborate to capture a video of your rovers pushing against each other, with one rover having a lower speed compared to the other. Once you have captured the video, you will be able to determine the acceleration of the two rovers together. Please write down the acceleration below.

Net Acceleration (a_{net}): _____

Remember Newton's second law is as follows:

$$F_{net} = ma_{net}$$

Using the law above, determine the net force acting on your rover.

Net Force (F_{net}): _____

In the space below, draw a force diagram. Please include a calculated value for the vertical forces and your net force. You are not required to include calculated values for horizontal forces, but do make sure to label them.

Theoretical Time to Win or Lose

Exceeding Proficiency*: If you determine the experimental time to lose for the following part on your own, and it is correct or reasonable, you will receive exceeding proficiency.*

Rewrite your calculated acceleration from Vernier Video Analysis below. Remember that you will be starting from rest and measure the distance from the back of the losing rover to the edge of the ring.

Acceleration (a): _____

Initial Velocity (v_0): _____

Distance to Edge of Ring (Δx): _____

Using a kinematic equation, determine the time you would expect for the losing rover to reach the edge of the ring. Include your work in the space below.

Time to Win or Lose (t): _____

Experimental Time to Win or Lose

Now, starting from the same place, experimentally measure – four times – the time to win or lose and complete the table below.

Trial	Time(s)
Average Time:	

How does the experimental time compare to the theoretical time from the previous section?

_____

_____

What might be some sources of error that would lead to a difference between the two times?

_____

_____

_____

_____

Point System (TEACHER ONLY - CIRCLE ONE)

Not Yet (0pts) (50%)	Approaching Proficiency (10pts) (60%)	Somewhat Proficient (20pts) (70%)	Proficient (30pts) (85%)	Exceeding Proficiency (40pts) (100%)
You have not correctly completed any of the elements of this challenge component.	You have correctly completed at least one element of this challenge component.	You have correctly completed half of the elements of this challenge component.	You have correctly completed all of the elements of this challenge component.	You have additionally and correctly completed the independent element of this challenge component.
Comments:				