Name 1: ⎯⎯⎯⎯⎯⎯⎯⎯

Name 2: ⎯⎯⎯⎯⎯⎯⎯⎯

Date: ⎯⎯⎯⎯⎯⎯⎯⎯

Challenge #1: Hercules's Push

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 **kinematics**. You will be asked to do the following:

1. Program your rover so that it has a constant acceleration

2. Use a kinematic equation determine the push and net accelerations of your rover

3. After determining your accelerations, create a force diagram for the rock

4. Determine the drag or friction force on the rock

Programming

To create a program that has a constant acceleration, you must increase its speed at the same rate. To do this, please use the program template below; feel free to modify the "step" size of **100** and the time between steps of **0.5**.

*for i in range(100,900, +**100**):*

MD1.forwardMOT12(i)

MD2.forwardMOT34(i)

*sleep(**0.5**)*

MD1.stopMOT12()

MD2.stopMOT34()

Determining Push and Net Accelerations

The best way to determine the accelerations of your rover is by using Vernier Video Analysis. Make sure to get steady videos with a meter stick in front and that this is on the actual test surface. First, obtain a video **without** the challenge rock and then a video **with** the challenge rock. Fill out the corresponding sections.

Determining Push Acceleration (No Rock)

When you are analyzing the video on Vernier Video Analysis, look at your X Velocity (m/s) vs. Time (s) graph. If you need help to access this graph, please ask your teacher. Select two points that lie on a straight line and determine push acceleration. Make sure to write down:

Initial Velocity (v_0): _____

Final Velocity (v): _____

Time (t): _____

Acceleration (a_{push}): _____

Determining Net Acceleration (With Rock)

When you are analyzing the video on Vernier Video Analysis, look at your X Velocity (m/s) vs. Time (s) graph. If you need help to access this graph, please ask your teacher. Select two points that lie on a straight line and determine net acceleration. Make sure to write down:

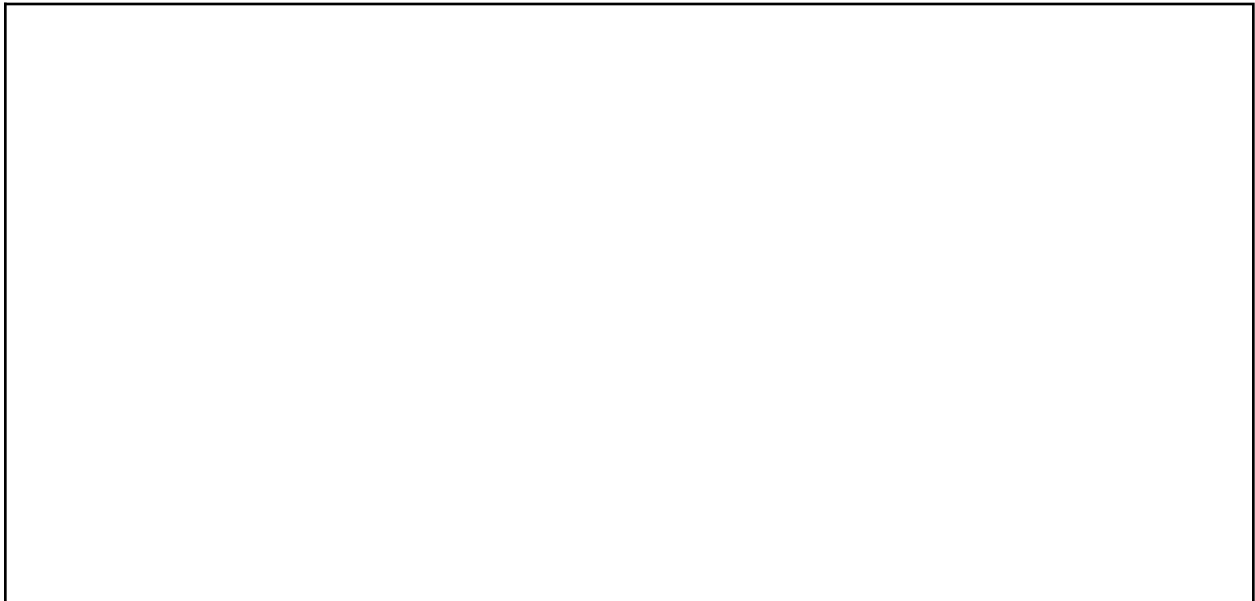**Initial Velocity (v_0)**: _____

Final Velocity (v): _____

Time (t): _____

Acceleration (a_{net}): _____

Force Diagram (or Free Body Diagram)

To create a force diagram, first write down all of the forces present below.

_____

_____

_____

_____

In the space provided draw your force diagram and make sure the magnitude of the forces are relative to each other. Please also include the net force in your force diagram.

Determining Drag or Friction Force

You can determine the force of the push using Newton's second law (with the mass of the rover). Remember that you know the net force on the rock as well, which means you can calculate the friction force or drag force on the rock (**hint**: $F_{net}=F_{applied}-F_f$). Use the space below to write down your calculations and write the final value for the friction force.

Exceeding Proficiency: If you, additionally, determine the coefficient of friction on your own,

and it is correct or reasonable, you will receive exceeding proficiency.

Friction Force (F_f): _____

Coefficient of Friction (μ): _____

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:				