Short Performance Assessment: **HS-PS2-1**

Grade Level: **High School**

Adapted from SNAP[1]

Title	**Newton's 2nd Law NGSS Assessment**		
Designed by	**Brian Mellon - Saigon South International School**	Course(s)	**Physics**

Performance Expectation	**HS-PS2-1**: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. **Clarification Statement**: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force. **Assessment Boundary**: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.
Science and Engineering Practice	**Analyzing and Interpreting Data** • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
Disciplinary Core Ideas	**PS2.A: Forces and Motion** • Newton's second law accurately predicts changes in the motion of macroscopic objects.
Crosscutting Concept	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
Student Performance	1. Organizing data 2. Identifying relationships 3. Interpreting data

[1] The Short Performance Assessment (SPA) and the Assessment Rubric adapted from the Stanford NGSS Assessment Project http://snapgse.stanford.edu/

Name_____

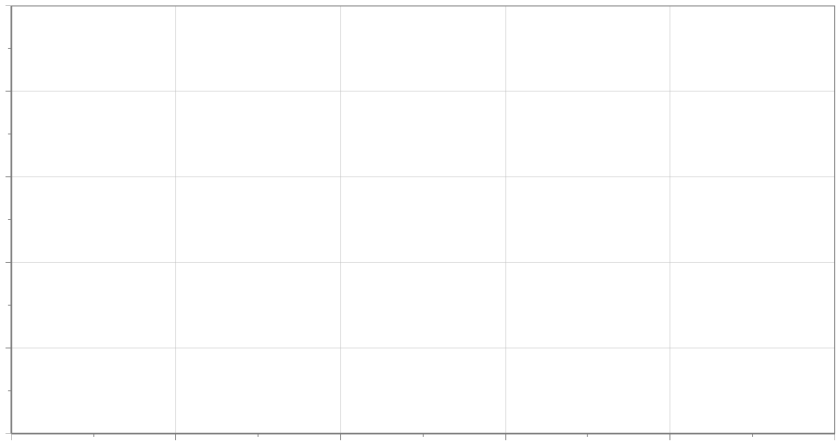
Newton's 2nd Law Assessment

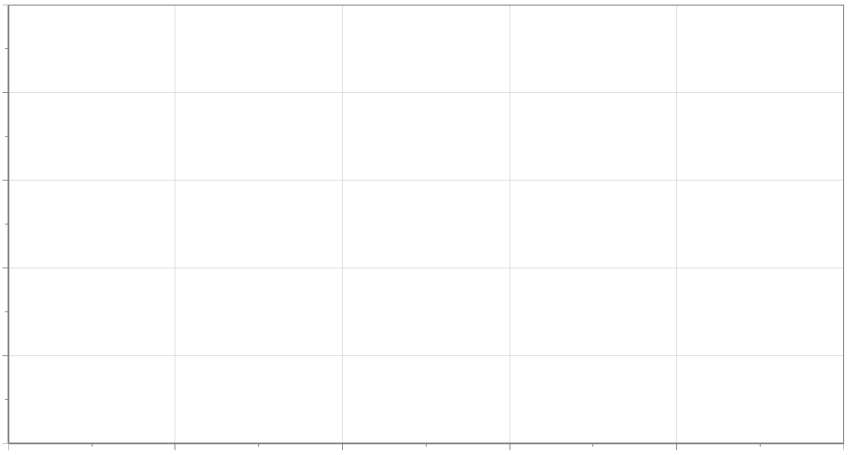
Two spheres are dropped from an initial height in an environment of negligible air resistance. Sphere A has a mass of 20.0 g and sphere B has a mass of 100.0 g. Video tracking software is used to determine the position of the spheres as a function of time.

Sphere A Trial 1		Sphere B Trial 1	
Time (s)	Position (m)	Time (s)	Position (m)
0	0.114	0	0.011
0.100	0.168	0.100	0.065
0.200	0.317	0.200	0.211
0.300	0.587	0.300	0.452
0.400	0.898	0.400	0.795
0.500	1.354	0.500	1.331
0.600	1.878	0.600	1.775
0.700	2.521	0.700	2.411
0.800	3.311	0.800	3.147
0.900	4.083	0.900	3.911

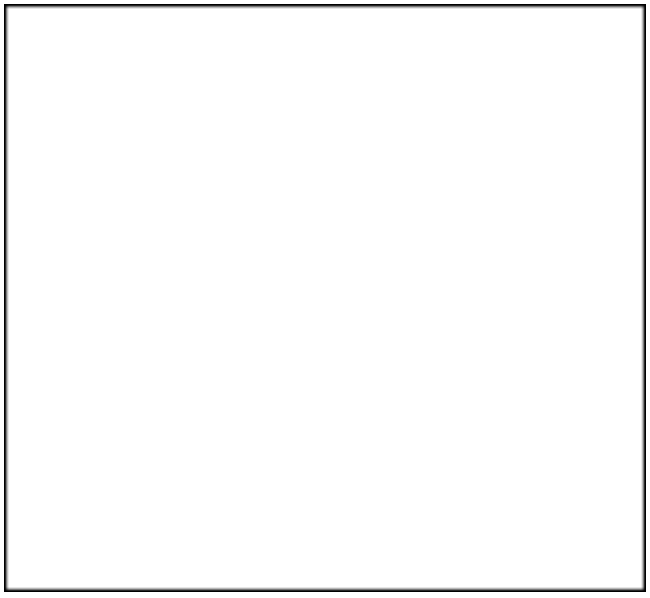
Prove that the acceleration of both objects are the same. Your answer must include:

- A definition of system being studied. (2)
- One or more graphs that organize the data. (5)
- Evidence from the graph(s) in support of the acceleration of both objects being the same. (1)
- One or more free body diagrams. (4)
- Use of the free body diagram(s) in support of the acceleration of both objects being the same. (2)





Free Body Diagram(s)



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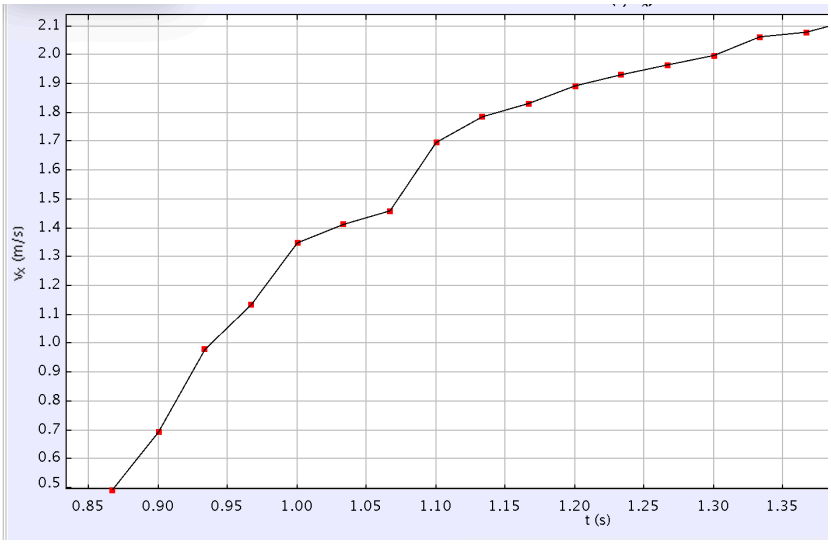
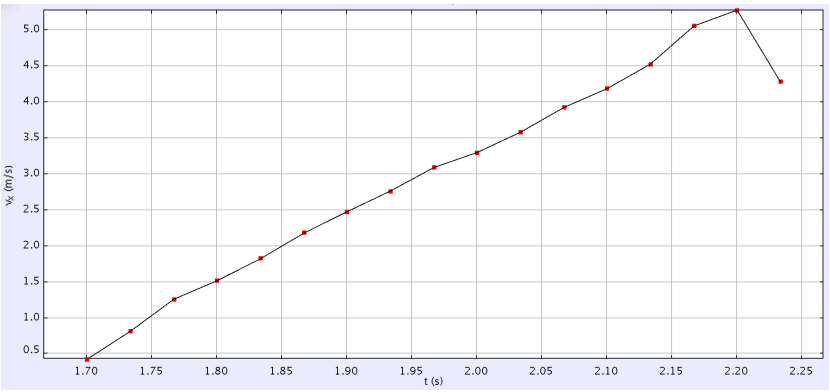
A second trial is conducted using the same two spheres. Below are the velocity vs. time graphs for spheres A and B.

Sphere A Trial 2 Velocity vs. Time



Sphere B Trial 2 Velocity vs. Time



Hypothesize what was different about trials 1 and 2 that caused different results. Your answer must include:

- A description of the acceleration of spheres A and B.(2)
- A cause and effect explanation of the difference between the motion of spheres A and B in trial 2. (2)
- A hypothesis explaining what was different about trials 1 and 2 causing different results in the form of CLAIM, EVIDENCE, REASONING. (3)
- Hypotheses for what may have caused irregularities in data for sphere A at t = 1.07 s and for sphere B at 2.20 s. (2)

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Assessment Rubric* - Question 1				
	Emerging	Developing	Approaching Proficiency	Excelling
Description of performance				
Sample student responses				

Assessment Rubric* - Question 2				
	Emerging	Developing	Approaching Proficiency	Excelling
Description of performance				
Sample student responses				

Insert additional Assessment Rubrics (if needed) here.