FLINN SCIENTIFIC

Name_____

PSworks Carriage and Ramp Worksheet

Part 1. Mechanical Advantage

Distance between "start line" and "finish line": _____

Mass of carriage: _____

Additional mass added to carriage (if necessary): _____

Data Table

Ramp Angle	Height of Start Line	Height of Finish Line	Minimum Mass Needed to Raise the Carriage

Results Table

Ramp Angle	Force Needed to Raise the Carriage	Actual Mechanical Advantage	Ideal Mechanical Advantage	Energy Required	Ideal Energy Required

Calculations and Post-Lab Questions (Use a separate sheet of paper to answer the following questions.)

1. For each Ramp Angle, calculate the Force Needed to Raise the Carriage. Multiply the *Minimum Mass Needed to Raise Carriage* (in kilograms) by the acceleration due to gravity constant, 9.81 m/s^2. The resulting force will have units known as newtons (*N*). Enter the results, as well as the units, in the results table.
2. Multiply the mass of the carriage plus any additional mass (in kilograms) by the acceleration due to gravity constant to determine the weight of the carriage.
3. Use Equation 1 to calculate the "actual" mechanical advantage for each experimental Ramp Angle. Record these results in the results table.
4. Use Equation 2 to calculate the "ideal" mechanical advantage for each experimental Ramp Angle. Record these results in the results table.
5. Calculate the amount of energy that was needed to raise the carriage for each Ramp Angle. Multiply the force needed to raise the carriage at a specific angle by how far the carriage traveled along the ramp (in meters). The resulting energy will have units known as joules (*J*). Record these results, including units, in the results table.
6. Calculate the "ideal" energy required to raise the carriage from the "start line" height to the "finish line" height by multiplying the total weight of the carriage by total height the carriage raised. Record this in the results table.
7. What angle of the ramp required the least amount of effort (force) to raise the carriage?
8. How does the mechanical advantage compare to the ease of raising the carriage?
9. What is an advantage of an inclined plane? What is a disadvantage of an inclined plane? Briefly describe the principles of a simple machine.
10. Explain why the energy required in each case is similar to the "ideal" energy even though the needed force was less than the weight of the carriage. If any "extra" energy was needed to raise the carriage up the ramp, compared to the ideal case, why was it needed?

PSWORKS Carriage and Ramp Worksheet, continued

Part 2. Forces and Gravity

Length of the carriage wing: _____

Ramp Angle	Trial No.	Transit Time between Photogates 1 and 2	Transit Time of Photogate 1	Transit Time of Photogate 2
	1			
	2			
	3			
	4			
	5			
	Average			
	1			
	2			
	3			
	4			
	5			
	Average			
	1			
	2			
	3			
	4			
	5			
	Average			

Calculations and Post-Lab Questions (Use a separate sheet of paper to answer the following questions.)

1. Calculate the average values for the Transit Time between Photogates 1 and 2 for each Ramp Angle. Record these results in the data table.
2. Calculate the average speed of the carriage as it passes through each photogate by dividing the length of the wing (in cm) by the average Transit Time (in seconds) through the individual photogate. Calculate the average speeds (in cm/s) through Photogates 1 and 2 for each Ramp Angle.
3. Calculate the average acceleration of the carriage as it travels down the ramp. Subtract the average (calculated) speed at Photogate 2 by the average (calculated) speed at Photogate 1, and then divide this value by the average Transit Time between Photogates 1 and 2. Calculate the average acceleration (in cm/s^2) for each Ramp Angle.
4. How does the Ramp Angle affect the acceleration of the carriage? Explain.
5. On graph paper, plot the acceleration on the *y*-axis, and the *sin* θ on the *x*-axis for each angle of the ramp. Draw a straight best-fit line through the data points, including the origin (0,0). Then, calculate the slope of the best-fit line by dividing the "rise" by the "run."
6. Since the carriage rolls down the ramp, instead of sliding, a small correction factor is needed to account for the rotation of the wheels. Multiply the calculated slope of the best-fit line by 1.2. This new value is the experimentally determined value for the acceleration due to gravity. How does the value compare to the "true" value of 981 $cm/s^{2.}$