Work and Energy
Roller Coaster Lab

Name _____

Teacher _____

Period _____

Overview – Analyze the motion, energy and forces of a roller coaster at **five** points of interest: top of the lift hill, bottom of a loop, top of a loop, top of a hill and braking zone.

Directions
Open the Rollercoaster Lab Excel spreadsheet on GravityKills.net. Select your group's assigned TRACK NUMBER. As a lab group, calculate and input the requested information highlighted in yellow.

Let g = 10 m/s^2 for ALL CALCUALTIONS
Use ROUNDED values on ALL subsequent calculations.

Roller Coaster – Sketch your roller coaster and identify the five points of interest.

Calculations – Copy and complete the chart below in your notes. In each box include the equation used and the work to complete each calculation. Use a full page of paper to complete the chart.

	Top of Lift Hill	Bottom of Loop	Top of Loop	Top of Hill	Braking Zone
Mass of Coaster and Occupants					
Weight of Coaster and Occupants					
Height above Ground					
Potential Energy					
Kinetic Energy					
Velocity					
Radius					
Braking Distance					
Acceleration					
The calculations below may be OPTIONAL. Check with your teacher.					
FBD					
G-Factor (see explanation on next page)					

Calculating G-Factor

G-Factor:
The G-factor (G), mistakenly referred to as the "g-force," is a measure of the effect an acceleration has on a person's perception of the force of gravity. It's a ratio of the accelerations of forces in a given direction to the acceleration due to gravity or the weight of a person. Because of the vertical nature of the gravitational force, the way in which the G-factor is calculated for vertical accelerations differs from the way in which the G-factor is calculated for horizontal or lateral accelerations.

- Vertical analysis
  Draw the FBD for each scenario and calculate the magnitude of the normal force as a multiple of the force of gravity. Calculate the G-factor for the rider's vertical motion using the equation to the right.

$$G_Y = \frac{F_N}{F_g}$$

  A positive G-factor means the rider will remain within the safety of the coaster's car.

  A negative G-factor means the rider is unsafe.

- Horizontal analysis
  Draw the FBD for each scenario and calculate the magnitude of the acceleration as a multiple of the acceleration due to gravity. Calculate the G-factor for the rider's horizontal motion using the equation to the right.

$$G_X = \frac{a_x}{g}$$

Post Lab Questions - Copy and complete the questions below in your notes.

1. Can any hill be taller than the top of the lift hill along the roller coaster? Explain.
2. When is energy converted from potential energy to kinetic energy?
3. When is energy converted from kinetic energy to potential energy?
4. How much work is done to lift the coaster and riders to the top of the lift hill?
5. The roller coaster ride ends with the coaster and riders coming to a complete stop. How do you account for the lose of the initial mechanical energy of the coaster?
6. How does the mass of the coaster affect: potential energy, kinetic energy, velocity and acceleration?
7. An object is drop from rest from a 100 m high cliff. Complete the chart below

Height	Potential Energy	Kinetic Energy	Total Energy
100			1000 J
75			
50			
25			
0			