



AMUSEMENT PARK SCIENCE



1. Match the following science terms with their corresponding definitions.

- ___ Acceleration
 - ___ Apparent Weight
 - ___ Force
 - ___ Gravitational Potential Energy
 - ___ Kinetic Energy
 - ___ Speed
 - ___ Velocity
 - ___ Weight
- a. A measurement of how fast an object is moving; calculated by taking distance traveled and dividing by the time it takes.
 - b. The sensation a body feels when it is experiencing a force of gravity that is not being balanced by another force.
 - c. The speed that an object moves and the direction that object moves.
 - d. The force of gravity acting on an object.
 - e. The rate at which an object changes its speed or direction.
 - f. A push or a pull acting on an object.
 - g. Energy possessed by an object because of its motion.
 - h. Energy possessed by an object because of its height above the ground.

2. Based on the definitions in #1, answer the following questions.

a. For any ride, at what point do you experience the greatest kinetic energy? Why? _____

b. For any ride, at what point do you experience the greatest gravitational potential energy? Why? _____

c. When you are going around a curve, over a hill, or through a dip, are you accelerating? Why or why not? _____

d. What are the three ways that an object can accelerate and what are the three instruments in a car that can cause those accelerations? _____

e. On a roller coaster, at what point in the ride would you feel the least apparent weight? Why? _____

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3. Read the following information about “g forces” and answer the questions.

Accelerometers are instruments designed by scientists to measure the “g force” felt by a passenger on a ride or an astronaut in a rocket. Accelerometers are calibrated in g’s. A reading of 1 g equals an acceleration of 9.8 m/s^2 (9.8 meters per second per second), which is the acceleration due to the Earth’s gravitational pull. As you live on Earth, you normally experience 1 g of acceleration. Listed below are the sensations of various g forces. These are rough estimates, but may be helpful in estimating the sensations felt on the various rides at an amusement park.

Accelerometer Reading	Sensation
+3.0 g	Three times heavier than normal <i>(maximum g’s pulled by space shuttle)</i>
+2.0 g	Twice normal weight <i>(a very fast sports car getting to top speed in less than 2.5 seconds)</i>
+1.0 g	Normal weight
+0.5 g	$\frac{1}{2}$ normal weight <i>(you feel lighter)</i>
0.0 g	Weightlessness <i>(no force between passenger and seat; astronauts feel this in orbit)</i>
-0.5 g	$\frac{1}{2}$ normal weight <i>(but directed away from the passenger’s seat)</i>

Your apparent weight is determined by the g force you experience. The greater the g-force, the greater the apparent weight.

- a. When an elevator needs to go from the top floor to the bottom floor of a tall building, where do you experience the *largest* apparent weight (g force)? Put a check mark by the correct choice.
- At the top when it begins to move.
- On the way down.
- At the bottom when it begins to stop.

- b. When an elevator needs to go from the bottom floor to the top floor of a tall building, where do you experience the *least* apparent weight (g force)? Put a check mark by the correct choice.
- At the bottom when it begins to move.
- On the way up.
- At the top when it begins to stop.
- c. If you were to stand on a bathroom scale in a moving elevator, which of the following motions would give the *greatest* reading on the scale? Put a check mark by the correct choice.
- At the top when it begins to move downward.
- At the top when it begins to stop.
- At the bottom when it begins to move upward.
- On the way up as it moves at a constant speed.
- d. If an object is falling, how much apparent weight (g-force) does that object experience? Why?

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1. Visit an amusement park or local carnival / fair with at least one adult who can help you with this merit badge. Ride at least four of the following types of rides: a swinging pendulum ride, a circular motion ride, a rollercoaster without a vertical loop, a rollercoaster with a vertical loop, and a free fall ride.

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2. Answer the following questions about each of the four rides chosen.

Type of Ride _____

a. At what point of the ride did you have the most kinetic energy? Why? _____

b. At what point of the ride did you have the most gravitational potential energy? Why? _____

c. At what point of the ride did you experience the greatest g force? _____

d. At what point in the ride did you experience the least g force? Why? _____

Type of Ride _____

a. At what point of the ride did you have the most kinetic energy? Why? _____

b. At what point of the ride did you have the most gravitational potential energy? Why? _____

c. At what point of the ride did you experience the greatest g force? _____

d. At what point in the ride did you experience the least g force? Why? _____

Type of Ride _____

a. At what point of the ride did you have the most kinetic energy? Why? _____

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d. At what point in the ride did you experience the least g force? Why? _____

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3. Choose one of the following topics to research. Write a one-page paper that summarizes the answers to the questions being asked.
- a. Who was Isaac Newton and what are his three laws of motion?
 - b. What is air-time on a roller coaster and how is it created?
 - c. What are wind resistance and friction? How do they affect rollercoasters?
 - d. How is a circular loop different from a clothoid loop? Why is the clothoid loop the preferred design for rollercoasters with vertical loops?

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