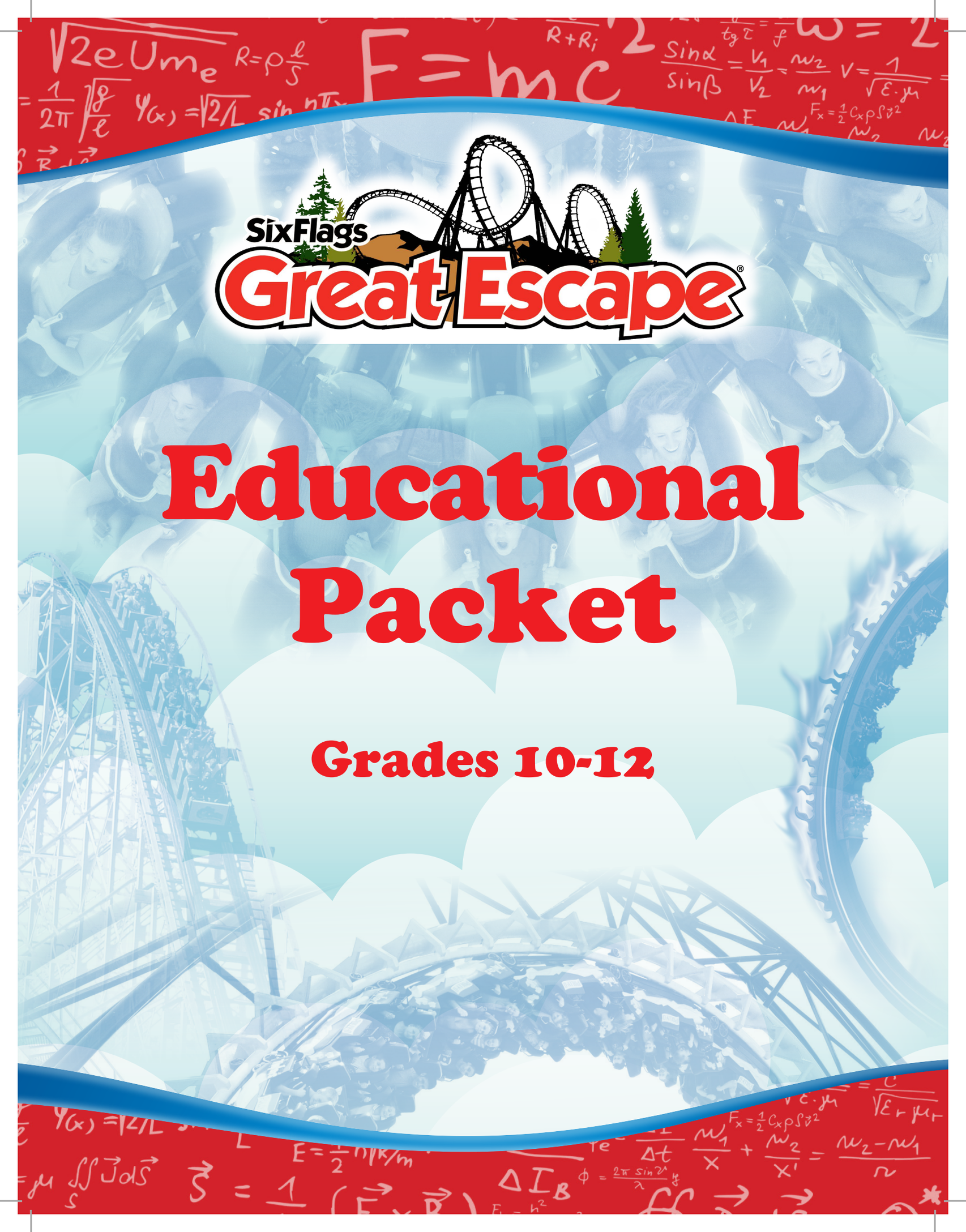

Educational Packet

Grades 10-12

89 SIX FLAGS DRIVE, QUEENSBURY, NY 12804

WWW.SIXFLAGS.COM

The Comet

1. If the first hill on The Comet is 25.9 meters (85 feet). If the cars each have a mass of 450 kg (about 1000 pounds) and six people with average weights of 670 Newtons (about 150 pounds), how many Joules of work must be done to get the car to the top? (assume the acceleration due to gravity is 10 m/s2)

2. If the drop from the top of the first hill on The Comet is 25.9 meters (85 feet), and the mass of the car and passengers is 860 kg (1900 pounds), ignoring friction, how fast is the car going at the bottom of the hill? (assume the acceleration due to gravity is 10 m/s2)

3. At the top of the first hill, the cars and passengers on The Comet have potential energy. However, not all of this energy is converted into kinetic energy. Where does this "lost" energy go?

4. If the "bunny hills" on The Comet cause the passengers to experience a force of -0.5g. What does the radius of the curve of the hill need to be if the car's speed at the top is 20 m/s?

Raging River

5. The rafts for Raging River can carry a total weight of 2,200 pounds. What is the volume of water that the boats displace? (The density of water is about 62 lb/ft3)

6. If approximately 850 people can ride Raging River every hour, and 8 people fit in each boat, and there are 8 boats, what is the length of the ride in minutes?

7. The boats for Raging River have compartments that each hold only about 2 gallons of water, which drain very quickly. Why does the water have to drain out?

8. If the boats in Raging River have a diameter of 4 meters, and they are spinning at 8 revolutions every minute, what is the centripetal acceleration on the passengers?

Sasquatch

9. If we were to compose a conservation of energy test on this ride, why would it appear that energy is not conserved?

10. Measure the length of the first drop (in seconds) on Tower A. Calculate the free-fall velocity.

11. Determine the time (in seconds) it takes for the ride to get to the top of Tower C (space shot). Assume the total mass of the 12 riders is 680kg. If the final speed of the ride is 17.88 meters per second, what is the force (in Newtons) needed to overcome just the mass of the riders?

12. According to Newton's Law of Gravitation, will the force of gravity acting on the ride change when it is raised to its maximum height of 200 ft?

Flying Trapeze

13. If the ride's outside path is approximately 75m and a ride is typically 15 revolutions, what is the rider's distance traveled and displacement?

14. Although there are 4 chains on each swing, only 3 bear the weight. If a rider exerts 600N of force, how much tension force is on each chain?

15. Compare a rider on the inside path of the ride to a rider on the outside path. Which has a greater linear speed? Which has a greater rotational speed?

16. Calculate the centripetal force on a rider on the outside path. Assume the rider has a mass of 60kg. The diameter of the ride is 24m. The path of travel is approximately 75m/revolution; time the ride (in seconds) so you can calculate speed.

Answer Key

1. A: 220,668 Joules
   Work = Force × Distance
   Force = total weight = (450 kg)(10 m/s2) + (6)(670 N) =8520 N
   Work = (8520 N)(25.9 m) = 220,668J
   Some students that understand the concept of significant figures will come up with an answer of 221,000 J
2. 22.8 meters/second
   P.E.=mgh
   K.E.=1/2 mv^2
   P.E. = K.E.
   mgh=1/2 mv^2
   gh=1/2 v^2
   v=√2gh = √(2)(10 m/s2)(25.9 m) = 22.8 meters/second
   Some students that understand the concept of significant figures will come up with an answer of 221,000 J
3. Energy is primarily lost to friction forces opposing the motion of the coaster.
4. 26.7 meters
   Since there is an upward “thrust” occurring on the rider, a force greater than that of gravity must be pulling down on the rider as they round the hill (specifically 1.5 x the force of gravity)
   a=1.5*10 m/s^2=15 m/s^2
   r=v^2/a=〖(20 m/s)〗^2/〖10 m/s〗^2 =26.7 m
   A student that understands significant figures may give a result of 30 meters which is also acceptable.
5. 35 cubic feet of water Volume = weight/density = 2200lbs/(62ft^3)= 35ft3
6. 0.56 minutes per ride (1 hour / 850 people) * (60 minutes / 1 hour) * (8 people / 1 ride) = 0.56 minutes / ride
7. The added water would add weight to the boat causing it to sink and/or tip over
8. 1.4 m/s2
   Angular Velocity = (8 rev / 1 min) * (1 min / 60 s) * [2 * (2m) / rev] = 1.68 m/s
   a=v^2/r= (1.68 m/s)2 / (2 m) = 1.4 m/s2
9. The friction creates heat energy so energy is lost from the system. This energy given off would be hard to detect and can go “un-measured”.
10. Free-fall velocity = acceleration due to gravity * time in seconds
    10m/s2 *_____ = free-fall velocity in meters per second
    e.g. if first drop occurs over 2 seconds, then free-fall velocity = 20 m/s
11. Force = mass * acceleration = 680kg * acceleration
    Acceleration = (17.88 m/s) / (launch duration in seconds)
    e.g. if the time taken is 2 seconds, then F = 680kg * (17.88 m/s) / (2s) = 6079 Newtons.
12. Law of gravitation states that gravity is inversely proportional to square of distance between objects. Therefore the force of gravity acting on the riders will be reduced at the top of the ride.

Answer Key

13. distance = 75m * 15 revolutions = 1125m Displacement = 0; it is a circular path and you end where you started. Some students may state that their starting position on the ride may not be their finishing position, so their displacement is some value less than 75 meters. Therefore that is an acceptable answer.
14. 600N/3 = 200N This is a classic example of weight distribution.
15. The outer circle has a greater linear speed. It covers a greater distance in the same amount of time as a rider on the inside path. The inner and outer path riders have the same rotational speed. They are completing the same number of rotations in the same time period.
16. force (Fc) =mass (v^2/r)
    Fc = 60kg (75m/time of ride in seconds)^2/ 12m