Physics of carousel essay sample

Science, Physics

I. Introduction

Physics is the natural science that involves the study of matter and its motion through space and time, along with related concepts such as energy and force. More broadly, it is the general analysis of nature, conducted in order to understand how the universe behaves. Physics is one of the oldest academic disciplines, perhaps the oldest through its inclusion of astronomy. Over the last two millennia, physics was a part of natural philosophy along with chemistry, certain branches of mathematics, and biology, but during the Scientific Revolution in the 17th century, the natural sciences emerged as unique research programs in their own right. Physics intersects with many interdisciplinary areas of research, such as biophysics and quantum chemistry, and the boundaries of physics are not rigidly defined.

New ideas in physics often explain the fundamental mechanisms of other sciences, while opening new avenues of research in areas such as mathematics and philosophy. Physics also makes significant contributions through advances in new technologies that arise from theoretical breakthroughs. For example, advances in the understanding of electromagnetism or nuclear physics led directly to the development of new products which have dramatically transformed modern-day society, such as television, computers, domestic appliances, and nuclear weapons; advances in thermodynamics led to the development of industrialization; and advances in mechanics inspired the development of calculus

II. Background the study

i. History of Carousel

The carousel originated in Europe, but reached its greatest fame in America in the 1900’s. The first carousels featured gondolas, carts, menagerie animals, and horses. The French developed many variations of the carousel. In one variation, the riders tried to spear gold rings with lances while the carousel rotated at full speed. This undoubtedly led to the phrase, “ catching the brass ring” on later carousels.

Broad Billed Jumper Brown

In the mid of 16th century, grand tournaments were held in France. Saddle makers, tailors, jewelers, and wig makers created extravagant costumes for both horse and rider for these occasions. Inspiration for later carousel carvers apparently originated from these events. During the late 1800’s, many skilled European carvers immigrated to the United States to produce carousels. The carvings of these immigrants were a great improvement over the first efforts of unskilled carvers. Usually the side of the carousel horse facing the audience, the “ Romance” side, was adorned with carved decorations, while the inner side received little attention. ii. Evolution of Carousel

The earliest known depiction of a carousel is in a Byzantine bas-relief dating to around 500 A. D., which depicts riders in baskets suspended from a central pole. The word carousel originates from the Italian garosello and Spanish carosella (“ little battle”) used by crusaders to describe a combat preparation exercise and game played by Turkish and Arabian horsemen in the 12th century. In a sense this early device could be considered a cavalry

training mechanism; it prepared and strengthened the riders for actual combat as they wielded their swords at the mock enemies. European Crusaders discovered this device and brought the idea back to their own lands. A carousel was also a training device for the ring-tilt, consisting of wooden horses suspended from arms branching from a central pole. Riders aimed to spear rings situated around the circumference as the carousel was moved by a man, horse, or mule.

Carousel was also the term for large “ horse ballet” or Musical Ride spectacles mounted as part of the court festivities for special occasions such as royal weddings or state visits from the mid-16th century onwards, which gradually replaced serious jousting, although non-combat competitions such as the ring-tilt lasted until the 18th century. They were developed in Italy, especially by the Medici Grand Dukes in Florence, and the first French example was in Paris in 1605. These usually took place in squares or large courtyards, and consisted of elaborately costumed riders and horses (usually from the cavalry) performing choreographed routines such as forming shapes together, riding in lines criss-cross against each other. They often took place at night, with riders carrying torches, and were accompanied by music. From the 17th century large decorated floats with allegorical figures were often included. The Place du Carrousel in Paris was so named from 1662, when it was used for such a display by Louis XIV. In 1620 the English traveller Peter Munday described a carousel ride he saw in modern Bulgaria, then part of the Ottoman Empire. By the early 18th century carousels were being built and operated at various fairs and gatherings in central Europe and England.

For example, by 1745 AD, wagon-maker Michael Dentzel had converted his wagon-making business in what is now southern Germany to a carousel-making enterprise. Animals and mechanisms would be crafted during the winter months and the family and workers would go touring in their wagon train through the region, operating their large menagerie carousel at various venues. Other makers such as Heyn in Germany and Bayol in France were also beginning to make carousels at this time. In its own unique style, England was also rapidly developing a carousel-making tradition. Early carousels had no platforms: the animals would hang on poles or chains and fly out from the centrifugal force of the spinning mechanism; these are called “ flying horses” carousels. They were often powered by animals walking in a circle or people pulling a rope or cranking. By the mid-19th century the platform carousel was developed where the animals and chariots would travel around in a circle sitting on a suspended circular floor which was hanging from the centre pole.

The first known recorded steam-powered carousel was created by Thomas Hurst and shown at Bolton (Lancashire, England) New Year Fair in 1861. Eventually, with the technological advances of the industrial revolution, bevel gears and offset cranks were installed on these platform carousels, thus giving the animals their well-known up-and-down motion as they travelled around the centre pole. The platform served as a position guide for the bottom of the pole and as a place for people to walk or other stationary animals or chariots to be placed. Fairground organs (band organs) were often present (if not built in) when these machines operated. Eventually electric motors were installed and electric lights added, giving the carousel

its classic look. Although the carousel developed gradually in European countries such as Germany, France, England, and Italy, it did not reach its full-scale development until it went into its American phase.

This began with several makers, primarily Gustav Dentzel, Michael Dentzel's son, of Germany, and Dare from England. Michael Dentzel sent all four of his sons over to America in the 1850s, one of them, Gustav, with a full and complete large carousel packed away on the steamship. In early 1860 Gustav set up his family's carousel in Philadelphia to test the American market. The saddles on these early wood carousel horses were made of fabric, silk with padding, and velvet with padding. These are very rare and it's doubtful that any still exist. If they do, the cost of such a horse with an original velvet saddle would be close to 20, 000. 00. He opened up a carousel and cabinet workshop in Germantown. This eventually became the headquarters for one of America's greatest carousel-making families. Shortly after this beginning other carousel makers from Europe began to arrive on American shores. Many fine woodcarvers and painters, classically trained in their European homeland, worked for these early American companies. The Dentzels, being of German origin, also employed other Germans such as the Muller brothers and also many Italians, such as Salvador Chernigliaro. The first carousel to be seen in the United States was created in Hessville, Ohio, approximately 25 miles (40 km) from Toledo, Ohio on U. S. Route 20during the 1840s by Franz Wiesenhoffer.

The first carousel patent was granted on 25 July 1871, to Willhelm Schneider of Davenport, IA. Several centers and styles for the construction of carousels

emerged in the United States: Coney Island style – characterized by elaborate, and sometimes faux-jeweled, saddles – with Charles I. D. Looff, Charles Carmel, Marcus Charles Illions, Soloman Stein and Harry Goldstein and Mangels; Philadelphia style – known for more realistically painted saddles – with Dentzel and the Philadelphia Toboggan Company; and Country Fair style – often with no saddles at all – with Allan Herschell and Edward Spillman of western New York, and Charles W. Parker of Kansas. Early on the Dentzels became known for their beautiful horses and lavish use of menagerie animals on their carousels. Their mechanisms were also considered among the very best for durability and reliability. Gustav's sons, William and Edward, operated the company until William's death in 1927 at which time the company was auctioned off. By this time many carousel companies had gone out of business or diversified into other rides because of the hardships of the Depression. Young Edward Dentzel, who was operating carousels in Southern California at the time decided to stay there and become a luxury housing contractor in Beverly Hills; he eventually became the Mayor of that city in the early 1950s. Many carousel connoisseurs consider the golden age of the carousel to be early 20th century America.

Very large machines were being built, elaborate animals, chariots, and decorations were superbly made by skilled old-world craftsmen taking advantage of their new freedoms in America. Large amounts of excellent and cheap carving wood were available such as Appalachian white pine, basswood, and yellow poplar. Whereas most European carousel figures are relatively static in posture, American figures are more representative of

active beasts – tossed manes, expressive eyes and postures of movement are their hallmarks. The first carousel at Coney Island, America’s first major amusement park, was built in 1876 by Charles I. D. Looff, a Danish woodcarver. Another style is a double-decker, in which there is a huge carousel stacked on top of another. An example is the Columbia. In the early 20th century, there were approximately 4, 000 carousels throughout the United States. By the 21st century, that number had been reduced to 150. In the 1920s another noted woodcarver of horses for US carousels was Frank Carretta of Philadelphia, Pennsylvania. Each year he carved an estimated 200 horses. William H. Dentzel of Port Townsend, Washington is the only descendant from a founding American carousel family of the United States still making wooden carousels. His carousels are similar to the oldest operating carousel in the United States in Watch Hill, R. I. (1893) built by the Dare company, a “ flying horses” machine.

The power sources for Dentzel’s contemporary carousels range from rope-pull to hand-crank to foot-pedal to AC 110 volt electric to DC solar power. The carousel at the Willows park in Salem, Ma was manufactured in 1866 and relocated to its current site around 1900, so may have claim to the oldest operating carousel in the United States. It was originally driven by a donkey that was hidden in the cellar below the ride and was ultimately converted to electricity. It is rumored to be the oldest and fastest ride of its kind in operation. The oldest functional carousel in Europe is in Prague(Letná Park), built in 1892 or 1893. In the USSR in the 1970s and 1980s the carousel was not just a ride of amusement parks, but also an integral part of the urban culture. Many playgrounds, which existed in every yard, were

equipped with a standard flower-shaped carousel, made of metallic bars with six wooden seats attached to them.

III. Discussion

The carousel is an excellent example of physics principles at work. Rotational motion, torque, lever arm, centripetal force, and gear ratios are some of the examples of physical principles associated with carousels. So what does rotational motion, torque, and the rest of these terms mean, and how are they part of the carousel equation? First we need to define some terms and equations. Terms and Equations:

i. Radian – Degree Conversion

1 rad = 180° /π ≈ 57. 3°

π (pi) = 3. 1415 is a mathematical constant. It is defined as the ratio of a circle’s circumference to its diameter. ω (omega) is defined as angular velocity. Its units are radians/sec. ii. Angular Velocity

θ (theta) is defined as the angular displacement. Its SI units are radians. α (alpha) is the angular acceleration. Its SI units are radians/sec2. m is the variable used to represent mass. Its SI unit is kg.

A. Rotational Inertia (Moment of Inertia)

Rotational Inertia ()

The rotational inertia, also called the “ moment of inertia,” is defined as the measure of a body’s resistance to angular acceleration. Inertia is the tendency of a body stay at rest or in constant motion unless acted on by an outside force. We say that if an object is hard to get moving, it has a lot of

inertia, or resistance to change. This means that the moment of inertia is defined more simply as the resistance to change in an object’s rotational state. The rotational inertia of an object is a relationship between the mass and the radius from the center of rotation. B. Conservation of Angular Momentum

Conservation of Angular Momentum ()

Analogous to conservation of linear momentum, the conservation of angular momentum law states that the angular momentum of a system of objects is conserved if there is not external net torque acting on the system. We can use this law and the ideas of angular velocity and rotational inertia to derive the Conservation of Angular Momentum equation. This relationship is very important and easily observed in figure skating. When the skater pulls their arms in, they reduce the radius component in the equation. This reduces their rotational inertia. Because of the Conservation of Angular Momentum Law, something must balance out the loss of rotational inertia. That balancing effect is an increase in angular velocity.

IV. Rotational Inertia Experiment

We can do a simple experiment to demonstrate this concept.

Equipment and Materials

1. Office or computer chair that will rotate 360°

2. 2 books or dumbbells.

Procedure

1. Sit in a computer chair that will rotate. Move into a clear area. Spin around in the chair with your arms and feet tucked in close to the body. 2. While still

spinning, extend your arms and feet out away from you. To amplify the effect, hold the books or dumbbells in each hand. Discussion

What happened? When the arms and legs were extended you slowed down. Just like the ice skater mentioned above, when you bring your arms and legs back into your body, you speed up. We can also observe these same effects on a carousel.

V. Conclusion

Carousels are not considered “ thrill machines” by any stretch of the imagination. Still, carousels are as reliant on the laws of motion as their more exciting cousins, the roller coasters. It’s theoretically possible that, allowed to spin out of control, a carousel could gain enough speed so that the riders would be thrown off. Thankfully, runaway carousels are not the least bit common. With all of its beauty and seeming simplicity, the carousel is a delicate balance of motion and forces. All of the horses move through one complete circle in the same amount of time. The horses on the outside of the carousel have to cover more distance than the inside horses in the same amount of time. This means the horses on the outside have a faster linear speed than those at the hub. The physics that a carousel demonstrates is centripetal force, which is the force that is directed to
the center of the path, in this case the center of the carousel. Though all of the horses on a carousel experience the same acceleration and tangential speed, the horses on the outside of the carousel have a greater radius and must travel a greater distance around the center. (“ Centripetal Force”) The equation to find the centripetal force of one of the horses is= (), the

centripetal force is equal to the mass times the velocity squared divided by the radius. (“ Angular Velocity”) The horses in a carousel move in a circular motion and therefore can have an angular velocity which is the speed that the object moves around the central axis, this speed is the same at every point since the angular velocity remains constant. The equation to find the angular velocity (ω) would be ω= v/r, angular velocity equals the velocity divided by the radius.

VI. References

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