Year 12 physics extended experimental Investigation

An experimental analysis of Dreamworld’s “Tower of Terror 2”.

Contents

# Abstract

# Introduction

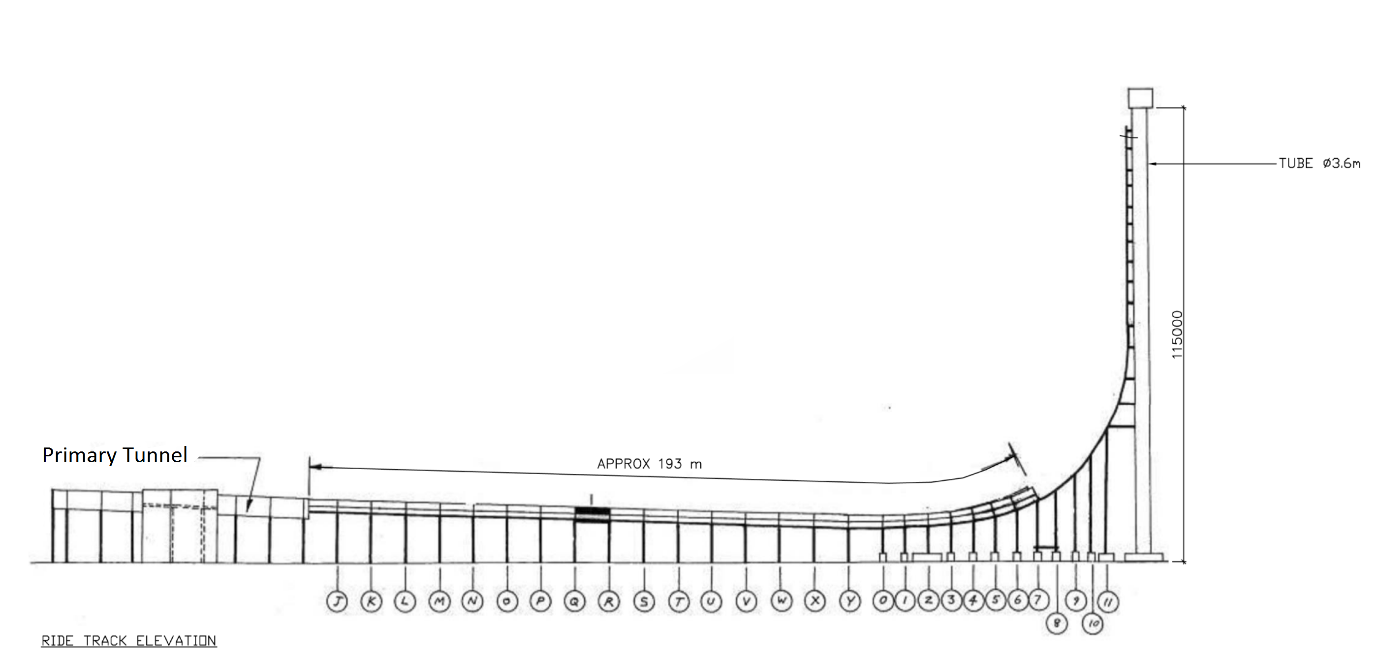


Figure 1: Tower of Terror 2 Schematics

The *Tower of Terror II* is a reverse free-fall ride, residing in the Dreamworld Theme park in the Gold Coast, Australia. Although there are a number of physics concepts that can be examined on this ride, the focus of the following investigation will be drag and energy. The investigation will focus on the kinetic and gravitational potential energy of the ride’s cart at various points, but will further evaluate the kinetic energy of the cart when it leaves and re-enters the primary tunnel (See Figure 1).

An object that possesses motion or a position also possesses mechanical energy. Mechanical energy is defined as the sum of potential and kinetic energy, or

Where is potential energy, and represents kinetic energy. Since this ride only deals with gravitational potential energy, the formula for mechanical energy can be rewritten as

Kinetic energy is energy possessed by an object in motion, and is defined as the work required to obtain a stated velocity through acceleration. In the Tower of Terror, the cart possesses kinetic energy at every point except for when the cart is momentarily paused at its maximum height. Since the cart is accelerated to approximately 44 during the initial stage, it exits the tunnel with a large amount of kinetic energy.

Kinetic energy for an object in motion is defined in terms of object mass and object velocity, or more specifically:

Where is the mass of the object, and is the velocity of the object.

Gravitational Potential Energy is potential energy possessed by an object that would be converted to other forms of energy if it were to be moved a fixed distance by the force of gravity. It can also be defined as:

Where is the mass of the object, is the acceleration due to gravity, and is height above the resting elevation of the object. Note that on earth, is roughly equal to .

On the Tower of Terror, a measurable amount of energy is lost due to frictional and drag forces. Due to this, the ride will most likely have lost total mechanical energy between the point that the cart exits the primary tunnel and re-enters it. The formula for drag is more complex than what is covered in the scope of this investigation, as it includes drag coefficients that need to be obtained experimentally. The formula for drag is:

Where is the density of the air, is the velocity of the object, is the drag coefficient, and is the affected surface area of the object. The drag coefficient is reliant on the speed of airflow, the skin friction and form drag of the object.

Dry friction (Hereon referred to as friction) is friction which opposes movement of two objects in motion, which is the secondary resisting force while on the Tower of Terror, the first being drag. Friction is defined in terms of , a dimensionless number, and the normal force of the two objects acting on each other: