

Sky Rider – The Ferris Wheel

Introduction

The Ferris wheel was developed to be an alternative to the carousel or ‘merry go round’ by a bridge maker George Ferris in 1893 in Chicago. One of his aims was to make a structure that would rival the Eiffel Tower in Paris. It cost US\$380,000.00 to make and stood 79.2 metres high with the diameter of the wheel being 75 metres. Since then many have been built and they are a very popular ride at most amusement parks worldwide.

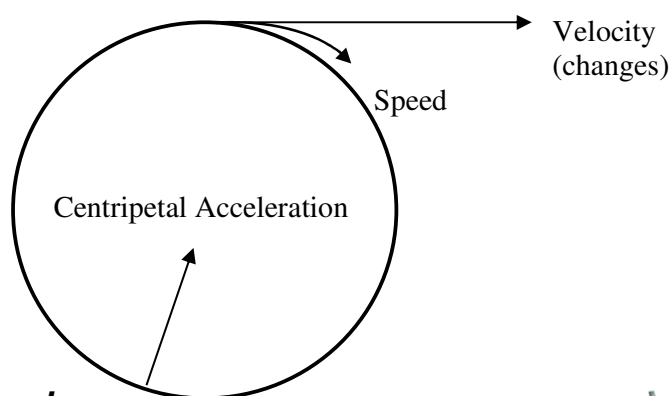
Compared to the original Ferris wheel, the model at Luna park is a baby. It stands about 20 metres high and has a diameter of 18 metres.



Aim:

All amusement rides that involve circular motion for the participants generate a range of physiological effect because of the affects of force of gravity and reaction forces and centripetal acceleration. In this activity you will observe the propulsion and braking mechanisms, measure the period of a Ferris wheel, and perform calculations on your measurements.

The diagram below shows some of the scalar and vector properties of the sort of circular motion that is evident on the Ferris wheel.



Materials/Method:

Watch or stopwatch, calculator, pencils.
Access to Luna Park’s Ferris Wheel



Observations:

Measuring and Calculating Average Speed

The speed of the circular motion of a ferris wheel when it is going is constant, it can be calculated from the radius of the wheel and its period of rotation. This speed is also called the linear velocity.

Measure the period of rotation: $T =$ sec

Average Speed = $2 \times \pi \times R / T =$ ms^{-1}

Speed (or linear velocity) varies with the radius, even though the angular velocity (or revolution per minute) stays the same. Calculate the linear velocity (speed) of the rotating Ferris wheel at half the radius.

Observing the Mechanism of the Ride.

Describe in detail (use a drawing) how the propulsion mechanism propels this ride?

Explain the safety design features of the ride (and associated equipment) and any safety procedures that you can observe?

<u>Feature/Procedure</u>	<u>Explanation (How it makes the ride safe)</u>

Calculating Acceleration on a Ferris Wheel

Acceleration can be computed quite easily for objects that are moving in a circular motion using the following formula.

$$\text{Acceleration} = v^2 / R = (4 \times \pi^2 \times R) / T^2$$

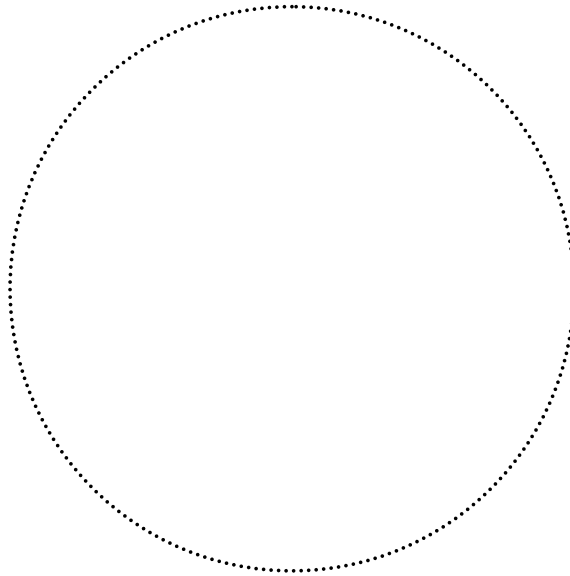
Question 1: Work out the centripetal acceleration of the Ferris wheel using the value for velocity that you calculated above? Since you already know v and R you can use the first part of the equation. When would you use the second?

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Examining Centripetal Acceleration

Question 2: Draw on the large circle representing the orbit of the ride.

- a. Label with dots the position of occupant at the following points 12:00, 3:00, 6:00 and 9:00 o'clock



- b. Draw with arrows the direction of the 2 forces acting on the occupants at each position. Label each force as "Force by A on You", e.g the weight force is the Force by Earth on You
- c. Draw in the acceleration vector for each position.

The net force on the occupant is in the same direction as the centripetal acceleration. This enables you to determine which of the two forces acting on the occupant is the larger.

- d) Using mg for the weight and N for the reaction force write an expression for the net force at the 12 o'clock and 6 o'clock positions
- e) Since Net Force = ma , use your value of the acceleration calculated above to determine the size of the reaction force, N , at these two positions for an occupant with a mass of 65 kg..

12 o'clock position

6 o'clock position

d) Net Force expression

e) Calculation of N

Extension Problems

Examining the Propulsion and Braking Mechanisms

Answer the following extension questions on loose leaf and attach to your report.

Question 1. Examine the propulsion mechanism of the ride. It involves the use of car tyres to propel the ride. Explain briefly the process using the words, electrical energy, mechanical energy, heat, friction, control mechanisms.

Question 2. Estimate the size of the car tyre and using your knowledge of the period of rotation of the ferris wheel, determine the speed of revolution of the tyre in RPM.

Question 3. Look closely and see what type of braking mechanism is used by the operator. Explain what you have observed below.