The Claw

Combine the slowly rotating platform of the Carrousel with the pendulum motion of the PIRATE ship and you have THE CLAW. The interplay of motions on this ride provides a unique combination of sensations.

Questions:
(1) At what point (or points) in the ride will your seat apply the greatest "upward" force against your bottom? How many g's of acceleration will you feel when this happens?

(2) Knowing where the greatest upward force occurs, in what direction are you moving and in what direction is the centerpost of THE CLAW moving?

(3) How does the potential energy of THE CLAW at the top of the swing, compare to its kinetic energy at the bottom of the swing?

(4) What is the centripetal acceleration of THE CLAW (as a whole) when it is at the bottom of its swing? How does this compare with your accelerometer readings from Question 1?

Predictions: (1) I will feel the greatest "upward" force when the ride is (at its highest point in the swing, at its lowest point in the swing, at the halfway points) and the acceleration at this time will be closer to (.5 g's - I'll feel as if I weigh less than may normal weight; 1.0 g - I'll feel as if I weigh my normal weight; 2 g's, 3 g's - I'll feel as if I weigh 2 or 3 times my normal weight). Write your two choices on the line below.

_____

(2) The greatest "upward" force occurs when the rotation of the ride (makes me move in the same direction as the centerpost is swinging, makes me move opposite to the direction that the centerpost is swinging). Write your choice below.

_____

(3) The potential energy of THE CLAW, at the top of the swing is (less than, greater than, equal to) its kinetic energy at the bottom of the swing. Write your choice below.

_____

(4) The calculated accelerations will be (>, <, =) the actual readings from the accelerometer.

_____

Try It !!: (1) and (2) You'll have to answer Questions 1 and 2 while on the ride. You'll need the vertical accelerometer to take measurements and a partner. Before the ride begins, hold the accelerometer vertically (with both hands, if you can). Hold it this way for the duration of the ride. After THE CLAW has begun its swinging motion, watch the accelerometer to see when it reaches its greatest reading. You will have to let your partner know when the greatest readings occur, so that your partner can watch to see where, in the the swing, that this is happening.

(1) Maximum Acceleration:_____ g's occurs as_____

(2) Direction you are moving during maximum acceleration:_____

(3) Determine the potential energy (E_p) at the top:

E_p = m g h = _____ J (Use the average height of the ride below)

(4) Determine the average speed of the ride at the bottom by timing how long it takes for the carousel to cross the imaginary center line of the ride at the bottom of the swing and dividing the diameter of the carousel by the time. (See specifications on other side.)

Average speed = Diameter / Time to pass = _____ m/s

Calculate the average kinetic energy, E_K, from the average speed calculated above:

$E_K = 1/2\ m\ v^2$ = _____J

(5) Calculate the centripetal acceleration of a rider at the bottom of the swing using the average speed calculated above:

$a_C - v^2/r$ = _____ m/s^2 ("r" is the swing radius - see below.)

The accelerometer readings will be 1 g greater than the centripetal acceleration because the accelerometer will read 1 g when the ride is stopped. So how does the maximum acceleration measured in #1 compare to the calculated value above?

_____

Observations/Conclusions:

(1) Why did you feel the maximum acceleration where you did? Your explanation MUST be supported by your findings in #1 and 2.

_____

_____

(2) Give your best guess as to why the EP at the top of the swing and the EK at the bottom of the ride compared as they did.

_____

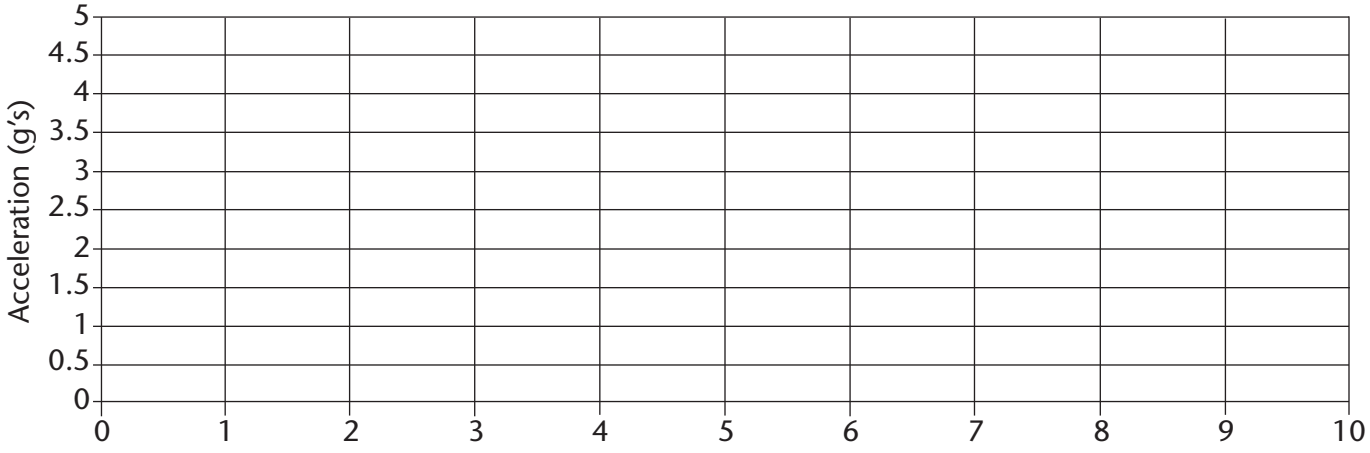
_____

(3) Give your best guess as to why the calculated centripetal acceleration and the measured accelerometer readings compared as they did.

_____

_____

Graph It!! Roughly sketch the accelerations that you undergo during a full period of the ride at maximum swing.



Specifications:

Mass of ride (loaded):_____ Diameter of Carousel:_____m

Average max. height of Carousel:_____ Swing Radius:_____m