

Carousels and Roller Coasters

Turn off all electronic devices

Observations about Carousels and Roller Coasters

You can feel your motion with your eyes closed
You feel pulled in unusual directions
You sometimes feel weightless
You can become inverted without feeling it

5 Questions about Carousels and Roller Coasters

1. What aspects of motion do you feel?
2. Why do you feel flung outward on a carousel?
3. Why do you feel light as a roller coaster dives?
4. Why do you feel heavy as a roller coaster turns?
5. How do you stay seated on a loop-the-loop?

Question 1

Q: What aspects of motion do you feel?
A: You feel acceleration, but not velocity

Your feeling of weight involves a real force

- Results from internal stresses as parts of you support one another

Your feeling of acceleration does not involve a real force

- Results from internal stresses as parts of you accelerate one another
- It is a sensation caused by your body's inertia
- It is directed opposite your acceleration
- It is proportional to that acceleration

You feel an overall apparent weight

- that is your feeling of weight plus your feeling of acceleration

The Feeling of Weight

When you are at equilibrium,

- a upward support force balances your downward weight
- That upward support force acts on your lower surface
- Your downward weight is spread throughout your body

You feel internal supporting stresses

You identify these internal stresses as weight

The Feeling of Acceleration

When you are accelerating forward,

- a forward support force causes your forward acceleration
- That forward support force acts on your back surface,
- while your mass is spread throughout your body

You feel internal supporting stresses

You misidentify these internal stresses as weight

Question 2

Q: Why do you feel flung outward on a carousel?

A: You are accelerating inward on the carousel

Carousel riders undergo uniform circular motion

- They follow a circular path at a constant speed
- They are always accelerating toward the circle's center
- This acceleration depends on speed and circle size

$$\text{acceleration} = \frac{\text{velocity}^2}{\text{radius}}$$

Carousels and Centripetal Acceleration

The acceleration of uniform circular motion is

- a center-directed or centripetal acceleration
- caused by a center-directed or centripetal force

A centripetal acceleration

- gives rise to a feeling of acceleration
- that points away from the center of motion
- and is a sensation due to inertia, not a real force

This feeling is often called “centrifugal force”

Question 3

Q: Why do you feel light as a roller coaster dives?

A: Your feeling of acceleration is upward

As you dive down a hill,

- your acceleration is downhill
- your feeling of acceleration is uphill
- your apparent weight is weak and points down and back

Question 4

Q: Why do you feel heavy as a roller coaster turns?

A: You are accelerating rapidly toward the center of the turn

As you turn at high speed,

- your acceleration is large and inward (toward the center of the turn)
- your feeling of acceleration is large and outward (away from the center)
- your apparent weight is strong and points out and down

Question 5

Q: How do you stay seated on a loop-the-loop?

A: You are accelerating downward very rapidly

At you arc through the top of the loop-the-loop,

- your acceleration is large and downward (toward the center of the loop)
- your feeling of acceleration is large and upward
- your apparent weight points upward!

Choosing a Seat

As your car goes over the edge of the first hill and begins to dive,

- your acceleration is downward
- your feeling of acceleration is upward

The faster you dive over the first hill,

- the greater the downward acceleration
- the stronger the upward feeling of acceleration

First car dives slowly – you feel slightly weightless

Last car dives quickly – you feel almost completely weightless!

Summary about Carousels and Roller Coasters

You are often accelerating on these rides

You experience feelings of acceleration

Those feelings point opposite your acceleration

Your apparent weight can

- become larger or smaller than your real weight
- point at any angle
- can even point upward!