Law of Gravitation

Pre-Class Questions

Problem Set (due next time)
Ch 6 - 4, 5, 17, 20

Lecture Outline

1. Forces and Circular Motion
2. The Law of Gravitation

CONCEPTUAL Physics PRACTICE PAGE

Chapter 8 Rotational Motion

Acceleration and Circular Motion

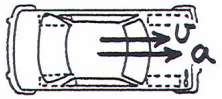
Newton's Second Law, $a = F/m$, tells us that net force and its corresponding acceleration are always in the same direction. (Both force and acceleration are vector quantities.) But force and acceleration are not always in the direction of velocity (another vector).

1. You're in a car at a traffic light. The light turns green and the driver steps on the gas. The sketch shows the top view of the car. Note the direction of the velocity and acceleration vectors.

   a. Your body tends to lurch [forward] [not at all] [backward].

   b. The car accelerates [forward] [not at all] [backward].

   c. The force on the car acts [forward] [not at all] [backward].

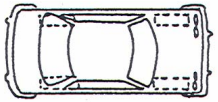


2. You're driving along and approach a stop sign. The driver steps on the brakes. The sketch shows the top view of the car. Draw vectors for velocity and acceleration.

   a. Your body tends to lurch [forward] [not at all] [backward].

   b. The car accelerates [forward] [not at all] [backward].

   c. The force on the car acts [forward] [not at all] [backward].

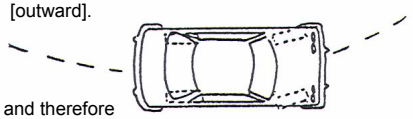


3. You continue driving and round a sharp curve to the left at constant speed. Draw vectors for velocity and acceleration of the car.

   a. Your body tends to lean [inward] [not at all] [outward].

   b. The direction of the car's acceleration is [inward] [not at all] [outward].

   c. The force on the car acts [inward] [not at all] [outward].

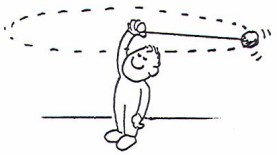


4. In general, the directions of lurch and acceleration, and therefore the directions of lurch and force, are [the same] [not relate] [opposite].

5. The whirling stone's direction of motion keeps changing.

   a. If it moves faster, its direction changes [faster] [slower].

   b. This indicates that as speed increases, acceleration [increases] [decreases] [stays the same].



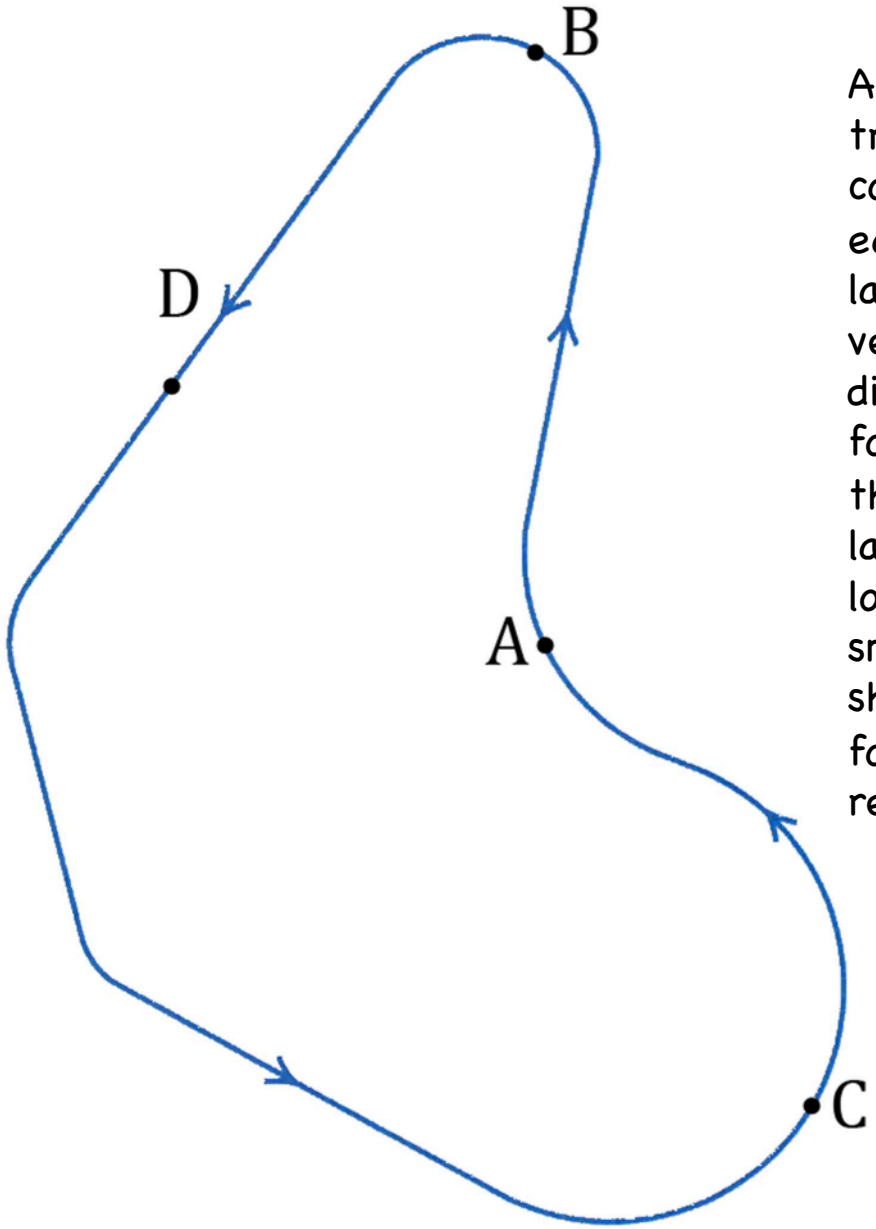
6. Like Question 5, consider whirling the stone on a shorter string—that is, of smaller radius.

   a. For a given speed, the rate that the stone changes direction is [less] [more] [the same].

   b. This indicates that as the radius decreases, acceleration [increases] [decreases] [stays the same].

thanx to Jim Harper

Example 1: A 100g ball is twirled overhead on the end of a 40.0cm string at 100rpm. Find the tension in the cord.



A car races around the track shown at a constant speed. At each of the four labeled points draw a vector to indicate the direction of the net force on the car. Draw them to scale so the largest force has the longest vector and the smallest force has the shortest vector. What force do these vectors represent?

Example 2: A car traveling at 50.0km/h rounds a curve with a 30.0m radius. Find the minimum coefficient of friction required to keep the car from skidding.

Example 3: Show that measuring the acceleration due to gravity, you are actually weighing Earth.

Lecture 13- Summary

Newton's Laws apply to circular motion.

The net force points toward the center because that is the direction of the centripetal acceleration.

The Law of Universal Gravitation $\vec{F}_g = G\frac{m_1 m_2}{r^2}\hat{r}$

The Gravitational Constant $G = 6.67x10^{-11}\ \frac{N \cdot m^2}{kg^2}$