The U of T Pre-Medical Society presents:

PRE-MEDICAL FOUNDATIONS I

Learn more:
www.uoft.me/premed1

Interested in Medical School?

Learn all about writing the MCAT and getting research experience!

Thursday September 27 at 5:30 – 7:30 pm
Please arrive by 5 pm if you need to purchase memberships.

Medical Science Building, room 3153

Free for members; **$5** for non-members.
Memberships can be bought at the door for $10*.

*All of our proceeds go to charity (e.g., Give A Day).

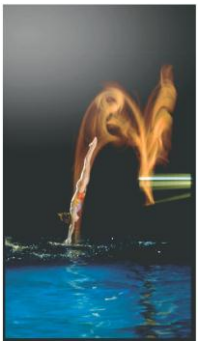
Raffling: FREE Kaplan MCAT course (valued at $2100) + $1000 discount off Prep101 MCAT course + books!

PHY131H1F - Class 6

Today, Chapter 4:

- Kinematics in One Dimension
- Kinematics in Two Dimensions
- Projectile Motion
- Relative Motion

MasteringPhysics Problem Set 2 due Friday, before 11:59pm.



Horizontal Acceleration Example

- A car starts from rest, then drives to the right. It speeds up to a maximum speed of 30 m/s. It coasts at this speed for a while, then the driver hits the brakes, and the car slows down to a stop.
- While it is speeding up, the acceleration vector of the car is

A. to the right.
B. to the left.
C. zero.

Horizontal Acceleration Example

- A car starts from rest, then drives to the right. It speeds up to a maximum speed of 30 m/s. It coasts at this speed for a while, then the driver hits the brakes, and the car slows down to a stop.
- While it is coasting, the acceleration vector of the car is

A. to the right.
B. to the left.
C. zero.

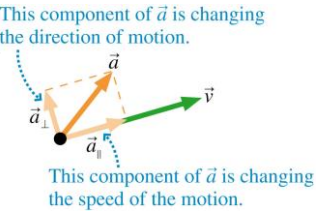
Horizontal Acceleration Example

- A car starts from rest, then drives to the right. It speeds up to a maximum speed of 30 m/s. It coasts at this speed for a while, then the driver hits the brakes, and the car slows down to a stop.
- While it is slowing down, the acceleration vector of the car is

A. to the right.
B. to the left.
C. zero.

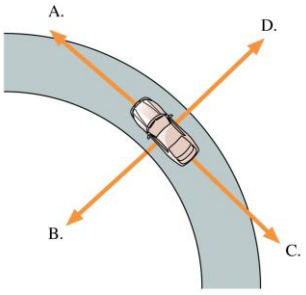
Analyzing the acceleration vector

- An object's acceleration can be decomposed into components parallel and perpendicular to the velocity.
- $\vec{a}_{\parallel}$ is the piece of the acceleration that causes the object to change **speed**
- $\vec{a}_{\perp}$ is the piece of the acceleration that causes the object to change **direction**
- An object changing direction *always* has a component of acceleration perpendicular to the direction of motion.



Discussion Question.. What do you think?

A car is traveling around a curve at a steady 45 mph. Which vector shows the direction of the car's acceleration?

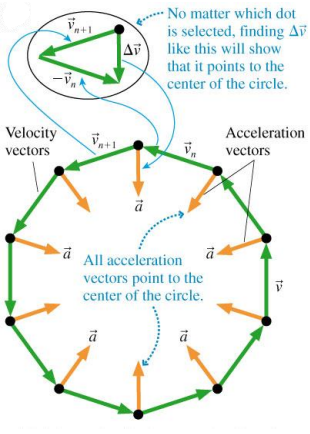


E. The acceleration is zero.

Slide 4-29

Uniform Circular Motion

Speed is constant.



Announcements

- The first term test will be on Tuesday, October 2, from 6:00pm to 7:30pm.
- The Room you write in will depend on your Practicals group. It will be announced on the Portal by tomorrow evening.
- If you have a time conflict with an academic activity (test, lecture, tutorial, lab), you must register to write at the alternate sitting of this test by coming (no email!) to MP129 no later than tomorrow at 5:00pm.
- There is **no third sitting** and there will be **no make-up test**. Students who miss Test 1 for documented medical reasons will have Test 2 count for 30% of their mark.

What will the test cover?

- Test 1 covers:
  - Knight Chapters. 1-3 and the first 4 sections of Ch.4,
  - and the ***Error Analysis in Experimental Physical Science "Mini-Version"*** 10-page document available on portal.
- If it's in the above reading, on MasteringPhysics, done in classes, or done in Practicals, it is material that is important and that you should know for the tests and final exam.

Some Helpful Material

- Scroll down to the bottom of the "Lectures: Harlow" page on Portal
- There you will find Suggested End-Of-Chapter Material:
- **Chapter 2:** Conceptual Questions 8, 10, 12. Exercises and Problems: 7, 13, 19, 33, 41, 45, 51, 77
  Chapter 3: Exercises and Problems 5, 9, 33, 43
  Chapter 4: Conceptual Questions 4, 8, 14. Exercises and Problems 7, 13, 17, 21, 27, 47, 55, 65, 81
- Answers to the Conceptual Questions from Knight
- Past tests I have given in PHY131
- A correspondence table for Suggested end-of-chapter problems if you are using the 2nd edition of Knight

Practicals: No Outside Notes, Please!

- The goal of Practicals is to do some hands-on activities, laboratory experiments and working in teams of 3 or 4, and to discuss material from the class in a less formal environment.
- Looking at the write-ups on the portal before Practical is fine, if your purpose is to get familiar with the material so you can contribute more effectively in your team.
- However, you may ***not*** make notes at home and bring them to Practicals with you.
- Work in Practicals must be done during the 2 hours of Practicals

Where to get extra help

- The Physics **Drop In Help Centre** is in MP125 (BACK CORNER):
  - Mondays - 12:00 pm to 5:00 pm
  - Tuesday 11:00 am to 5:00 pm
  - Wednesdays - 12:00 pm to 5:00 pm
  - Thursdays - 11:00 am to 5:00 pm
  - Fridays - 11:00 am to 2:00 pm
- TA Office hours: Contact your Practicals TAs!! Office Hours where they can help with studying is part of their contract!
- My office hours in MP121B: W3, F9.
- Meyertholen's office hours in MP129A: R2, F11
- Form a study group?
- ULife Academics is ***not*** part of U of T, and should be a ***last*** resort after all of the above have failed you…

Projectile Motion

FIGURE 4.15 The parabolic trajectory of a bouncing ball.

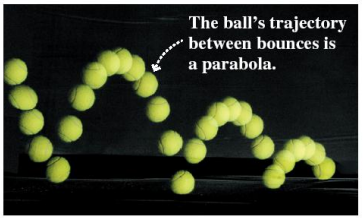
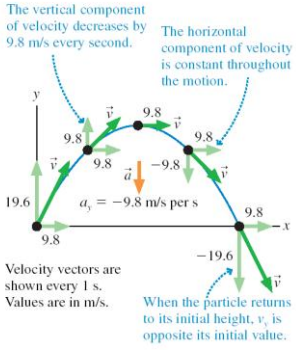


FIGURE 4.17 The velocity and acceleration vectors of a projectile moving along a parabolic trajectory.



Projectile Motion

Projectile motion is made up of two independent motions: uniform motion at constant velocity in the horizontal direction and free-fall motion in the vertical direction. The kinematic equations that describe these two motions are

$$x_f = x_i + v_{ix}\,\Delta t \qquad y_f = y_i + v_{iy}\,\Delta t - \tfrac{1}{2}g(\Delta t)^2$$

$$v_{fx} = v_{ix} = \text{constant} \qquad v_{fy} = v_{iy} - g\,\Delta t$$

What is *g*?

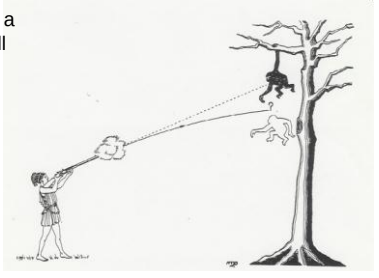
Place	Latitude	Altitude	"g" in m/s²
North Pole	90º	0m	9.832
Nuuk, Greenland	70º	20m	9.825
Toronto	44º	77m	9.805
Chicago	42º	182m	9.803
Denver	40º	1638m	9.796
San Francisco	38º	114m	9.800

- For this class: let's use g = 9.80 m/s², to 3 significant figures.

Monkey and Hunter Demonstration

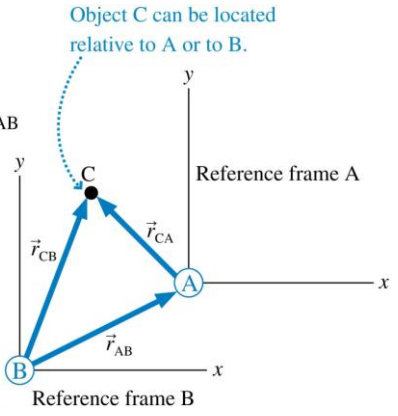
The classic problem: "A monkey hanging from the branch of a tree is spotted by a hunter. The monkey sees that the barrel of the gun is pointed directly at him. At the exact instant the gun is fired, the monkey lets go of the branch. Will the bullet (A) go above the monkey, (B) go below the monkey, or (C) hit the monkey?

Our demonstration uses a pressurized tennis ball launcher. The laser is aimed directly at the monkey, which is supported by an electromagnet. As the tennis ball leaves the launcher, it breaks a connection that releases the magnet.



Relative Position

$$\vec{r}_{CB} = \vec{r}_{CA} + \vec{r}_{AB}$$



Relative Velocity

- Relative velocities are found as the time derivative of the relative positions.
- $\vec{v}_{CA}$ is the velocity of C relative to A.
- $\vec{v}_{CB}$ is the velocity of C relative to B.
- $\vec{v}_{AB}$ is the velocity of reference frame A relative to reference frame B.

$$\vec{v}_{CB} = \vec{v}_{CA} + \vec{v}_{AB}$$

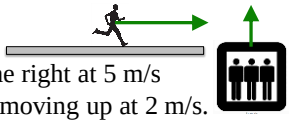
- This is known as the **Galilean transformation of velocity.**

Relative Motion

- Note the "cancellation"
- $\vec{v}_{TG}$ = velocity of the **T**rain relative to the **G**round
- $\vec{v}_{PT}$ = velocity of the **P**assenger relative to the **T**rain
- $\vec{v}_{PG}$ = velocity of the **P**assenger relative to the **G**round

$$\vec{v}_{PG} = \vec{v}_{PT} + \vec{v}_{TG}$$

Inner subscripts disappear



You are running toward the right at 5 m/s toward an elevator that is moving up at 2 m/s. Relative to you, the direction and magnitude of the elevator's velocity are

A. down and to the right, less than 2 m/s.
B. up and to the left, less than 2 m/s.
C. up and to the left, more than 2 m/s.
D. up and to the right, less than 2 m/s.
E. up and to the right, more than 2 m/s.

Relative Motion

- Also: $v_{12} = -v_{21}$
- **Example 1:** A passenger walks toward the front of the train at 5 m/s. The train is moving at 36 m/s. What is the speed of the passenger relative to the ground?
- **Example 2:** Car A is traveling at 25.0 m/s E toward Bloor and Keele. Car B is traveling at 15.8 m/s N toward Bloor and Keele. Just before they collide, what is the velocity of car A relative to car B?

You are on an Eastbound subway train going at 20 m/s. You notice the Westbound train on the other track. Relative to the ground, that Westbound train has a speed of 20 m/s. What is the velocity of the Westbound train as measured by you?

A. 40 m/s, West
B. 20 m/s, West
C. zero
D. 20 m/s, East
E. 40 m/s, East

Before Class 7 on Monday

- Remember there is a MasteringPhysics.com problem set due Friday. If you haven't already done it, please submit this before 11:59pm Friday.
- Monday's class will be review for the test, which is on Tuesday at 6:00pm.
- The test will cover Chapters 1-3, the Error Analysis Mini-Document, and Sections 4.1 through 4.4.
- You must bring a calculator and one 8.5x11' aid sheet which ***you*** prepare, double-sided