PHY131H1F - Introduction to Physics I
Class 2
Today: Chapter 1.

- Motion Diagrams
- Particle Model
- Vector Addition, Subtraction
- Position, velocity, and acceleration
- Position vs. time graphs



## Clickers.

- There was a mistake in the notes from last class:

- You will receive marks participation only; there is no penalty for getting the wrong answer
- Clicker Participation is worth $\mathbf{2 \%}$ of your course mark.
- Clickers cost $\$ 42$ at the bookstore new, and can be sold back for half price after you are done. Many courses at $U$ of $T$ use these clickers.

I said $3 \%$ on day 1 ; it's actually $2 \%$.

Garden-Variety Clicker Instructions
Status Light
When I start asking clicker questions:

- Status light will flash green when your response is registered on my computer.
- Status will flash red
if your response is not registered.



## Clicker Question 1

Which car is going faster, A or B?
(Assume these are both motion diagrams.)


Additional Assignment to do during this quiz:

- Learn the name of at least one other student in this course.


## Class 2 Preclass Quiz on MasteringPhysics

- This was due this morning at 8:00am
- 753 students submitted the quiz on time
- The first 5 questions had correct answers which you can now review, but were "for practice" meaning you were not penalized if you got them wrong. The average on these 5 questions was $69 \%$.
- I will be going over the questions students did poorly on in class today


## Class 2 Preclass Quiz on MasteringPhysics

- Some common student comments/feedback:
- "I'm confused about positive and negative acceleration and how it relates to velocity."
- "All of them were quite straightforward and was mostly a review of high school physics."
- "None because there was no assigned reading." (!!!!)
" "Motion diagrams" (many questions about this)
- "Significant figures makes me feel dizzy and I always confuse about it."


## The Particle Model

- If we restrict our attention to objects undergoing translational motion, we can consider the object as if it were just a single point, without size or shape.
- We can also treat the object as if all of its mass were concentrated into this single point.
- An object that can be represented as a mass at a single point in space is called a particle.
- A particle has no size, no shape, and no distinction between top and bottom or between front and back.

Three motion diagrams are shown. Which is: a dust particle settling to the floor at constant speed,

- a ball dropped from the roof of a building,
- a descending rocket slowing to make a soft landing on Mars



## Scalars and Vectors

" A "scalar" is a quantity that can be represented by one number, and a unit
" A "vector" requires at least two numbers: for example, a magnitude and a direction

- Examples of scalar quantities: distance, speed, temperature, mass
- Some scalars are always non-negative, such as mass or speed
- Examples of vector quantities: displacement, velocity, acceleration, force


## Distance and Displacement

- Distance: how far you traveled.
S.I units
scalar ST units: [m]
- Displacement: final position minus initial position. Vector

$$
\text { unit: }[m]
$$

$$
d \geq|\Delta \vec{s}|
$$



## Vector Subtraction

$\vec{D}=\vec{A}-\vec{B}=\vec{A}+(-\vec{B})$




## Speed and Velocity

$$
\vec{v}_{a v g}=\frac{\Delta \vec{s}}{\Delta t}
$$

- Average Speed: distance traveled divided by time
- Average Velocity: displacement divided by time
 $\longleftarrow$ Scalar



## Average Velocity



Units of $\vec{v}_{\text {average }}$ are metres per second.

## Velocity (a.k.a. <br> "instantaneous velocity")

$$
\vec{v}=\lim _{\Delta t \rightarrow 0}\left(\frac{\Delta \vec{s}}{\Delta t}\right)=\frac{d \vec{s}}{d t}
$$


$\Delta \vec{s} \quad$ Units of $\Delta \vec{s}$ are metres.

$\vec{v} \quad$ Units of $\vec{v}$ are metres per second.

A particle undergoes acceleration $\vec{a}$ while moving from point 1 to point 2 .
Which of the choices shows the velocity vector $\vec{v}_{2}$ as the object moves away from point 2 ?

(c)

(d)

non


## Average Acceleration

$$
\vec{a}_{\text {average }}=\frac{\vec{v}_{\mathrm{f}}-\vec{v}_{\mathrm{i}}}{\Delta t}=\frac{\Delta \vec{v}}{\Delta t}
$$



$$
\overrightarrow{\vec{a}_{\text {average }}}
$$

$$
\text { Units of } \vec{a}_{\text {average }}
$$ are $\mathrm{m} / \mathrm{s}^{2}$.

Acceleration (a.k.a. "instantaneous acceleration")
$\vec{a}=\lim _{\Delta t \rightarrow 0}\left(\frac{\Delta \vec{v}}{\Delta t}\right)=\frac{d \vec{v}}{d t}$

$\rightarrow \Delta \vec{v}$

Units of $\Delta \vec{v}$ are $\mathrm{m} / \mathrm{s}$.
$\xrightarrow[\vec{a}]{ }$
Units of $\vec{a}$ are $\mathrm{m} / \mathrm{s}^{2}$.

## Tactics: Finding the acceleration vector

- The sign of position ( $x$ or $y$ ) tells us where an object is.
- The sign of velocity ( $v_{x}$ or $v_{y}$ ) tells us which direction the object is moving.
- The sign of acceleration ( $a_{x}$ or $a_{y}$ ) tells us which way the acceleration vector points, not whether the object is speeding up or slowing down.

Tactics: Finding the acceleration vector


## Clicker Question 4

## If an object is slowing down,

A. its velocity must be positive.
B. its velocity must be negative.
C. its acceleration must be positive.
D. its acceleration must be negative.
$E$. the acceleration and velocity vectors must be in opposite directions.

## Tactics: Finding the acceleration vector



## Clicker Question 5

From the PHY131H1F Fall 2012 Test 1, Oct. 2, 2012

Below is a motion diagram for an object with smooth motion and a constant value of acceleration. We define positive displacements as being toward the right. What can you say about the sign of the acceleration and whether the object is speeding up or slowing down?
A. The acceleration is negative, and the object is slowing down.
B. The acceleration is positive, and the object is speeding up.
C. The acceleration is positive, and the object may be speeding up or slowing down.
D. The acceleration may be positive or negative, and the object is speeding up.
E. The acceleration may be positive or negative, and the object may be speeding up or slowing down $\qquad$

Fall 2012 Test 1 results


Fall 2012 Final Course Marks


| $32 \%$ of the class got A | $25 \%$ got C |
| :--- | :--- |
| $28 \%$ got B | $10 \%$ got D |
|  | $6 \%$ failed |

644 students completed the course.

That's $3 / 4$ of the students who wrote Test 1.
$10 \%$ got D $6 \%$ failed

## Piazza Discussion Board

## piazza

 PHY 13141 ~ Q A A Course Page Manage ClassUniversity of Toronto - Fall 2013

## PHY 131H1: Introduction to Physics I

- This is a fast way to get answers to your questions, sometimes from other students
- It is optional, and it is free
- Simply visit https://piazza.com/


## Clicker Question 6

A ball rolls up a ramp, and then down the ramp. We keep track of the position of the ball at 6 instants as it climbs up the ramp. At instant 6 , it stops momentarily as it turns around. Then it rolls back down. Shown below is the motion diagram for the final 6 instants as it rolls down the ramp.
At which instant is the speed of the ball the greatest?
A. 6
B. 9
C. 11
D. The speed is zero at point 6 , but the same at points 7 to 11
$E$. The speed is the same at points 6 through 11


Tennis ball thrown straight up:



Clicker Question 7
A ball rolls up a ramp, and then down the ramp. We keep track of the position of the ball at 6 instants as it climbs up the ramp. At instant 6 , it stops momentarily as it turns around. Then it rolls back down. Shown below is the motion diagram for the final 6 instants as it rolls down the ramp.
At which instant is the acceleration of the ball the greatest?
A. 6
B. 9
C. 11
D. The acceleration is zero at point 6 , but about the same at points 7 to 11
$E$. The acceleration is about the same at points 6 through 11


Clicker Question 8

## Significant Figures

- Which of the following has the most number of significant figures?
A. 8200
$\leftarrow 2$
sig figs.
Os are place-
B. $0.0052 \leftarrow 2$
C. Q. $430 \leftarrow 3$
D. $4 \times(10-23) \leftarrow 1$
E. $8000.01 \leftarrow 6$ sig figs


## Before Class 3 on Monday

- Please read the Error Analysis Mini-Document (10 page PDF) available on course web-site.
- Please do the short pre-class quiz
- Problem Set 1 on MasteringPhysics is due Sep.22: take a look at it. Don't leave problem sets until the last minute!
- Something to think about: If your height is 150 cm , is there necessarily an error in that number?

