Syllabus

Place to find everything about the course

- **Official Course Description and Website: http://www.pa.msu.edu/courses/phy231.**
- **Lecture**: BPS1410, Sec. 1, 10:20 – 11:40; Sec. 2, 12:40 – 2:00; **Attend ONLY your section.** You will have an **assigned seat for every lecture or exam**. It will be sent to you by email, and posted on the course website, above. Be sure to have (e.g., on your phone) seat number. **You Must Sit In Your Assigned Seat.** (Change request sheet at front)
- **Instructor**: C. Bromberg, Rm: BPS3225, Email: bromberg@pa.msu.edu, 517-884-5580
- **Office Hours**: Wednesday 11:00 – 1:00, BPS 3225, or by appointment, request via email.
- **Teaching Assistants**: Strosacker Physics Learning Center (BPS 1248) will have several TAs (TBD) available during the hrs. 9:00 am - 9:00 pm Monday & Tuesday
- **Textbook**: Rex&Wolfson(**R&W**), CollegePhysics **& MasteringPhysics(MP),** 1/e(2010)
  Bookstore - **MP access code** and (optional) Text 0321611187/ISBN-13: 9780321611185
  On Line - **MP access code** and (optional) E-book, use www.masteringphysics.com
  Course ID is BROMBERG07439. Instructions for Registration on the **Course Website.**
  If you want a top grade, I strongly recommend obtaining the Printed Text or the E-book.
  If you may drop PHY231, purchase **MP** access code **on line** (refund for 15days).
- **Readings**: R&W readings, Examples, and "Got It?" components of the text are listed in the *Course Schedule* (see next page) for each lecture. Pay close attention to the worked out examples, and the "Got It?" questions; answers are at the back of each chapter.
- **I-clickers**: You must own and bring **(only your own)** "I-clicker" to **(only your)** lecture section, and sit only in your assigned seat. There will typically be a few I-clicker quiz questions during each class on material listed on the *Course Schedule*.

  Register your I-clicker at www.iclicker.com (ID is @msu.edu email name).

- **Homework**: **MasteringPhysics** is used for homework. Course ID is BROMBERG07439
YOU MUST PURCHASE ACCESS and REGISTER - See **Textbook** and **website**
The Homework Set # on the *Course Schedule* is due at 11:59 pm on the Tues. evening listed. Keep a notebook and bring your attempts at solutions to any trip to the Learning Center. No credit for work done after the deadline, but complete for study.
- **Exams**: There are **3 midterm exams** during regular class hours on the dates shown on the *Course Schedule*. The exams are closed book, but you may use ONE (double-sided) 8-1/2"x11" sheet of handwritten (not a copy) notes and equations (Final Exam, 2 sheets). Exams are based on the textbook, lecture, homework, or quiz materials and will consist of conceptual and numerical problems. There will be a common **2-hr Final Exam on Mon., April 28, 8:00pm – 10:00pm**, Rm. TBD. You will need a calculator, a #2 pencil and your student ID when taking an exam. **NO cell-phone, PDA, calculator, or other device with external links can be used during any exam.** Alternate Final Exam will be available **ONLY** for students satisfying the requirements as stated by the Registrar.
- **Academic Dishonesty**: University rules and procedures regarding academic dishonesty will be strictly applied without exceptions, for I-clicker Questions, HW, and Exams.
- **Grading Criteria**: Grades are based on in-lecture I-clicker Questions (10%), **Mastering Physics** Homework (10%), three Midterm exams (10% each), Final Exam (50%). The 4 lowest Clicker Session scores will be dropped. See website for details. Only written Medical excuses for ONE missed Midterm Exam will be accepted. A makeup exam or 1.5 times the sum of the other two Midterm's grades, will be at the lecturer's discretion.
- **Grades**: The mean grade in PHY231 will be about 3.0. In *each section* the approx. % of enrolment for grades; 4.0(15%), 3.5(25%), 3.0(25%), 2.5(15%), 2.0 or lower (20%).
- **Disability?** For an accommodation, you **must register** immediately with the instructor.

Wk	Date	Day	Topics	R&W Reading	Examples (E)	Got-It" (G	MP HW
1	1/7	T	Syllabus/Units/Sig. Fig.	Ch. 1.1-4	E 1.1-9	G 1.1-2, 4	
	1/9	Th	1D Motion Variables/Signs	Ch. 2.1-3	E 2.1-5	G 2.1-3	*Set 0*
2	1/14	T	1D Motion Constant Acceleration	Ch. 2.4-5	E 2.6-12	G 2.5	**Set 1**
	1/16	Th	2D Vector Algebra/Components	Ch. 3.1-3	E 3.1-4	G 3.1- 2	
3	1/21	T	2D Motion Equations/Projectiles	Ch. 3.4 (3.5 later)	E 3.5-9	G 3.4	**Set 2**
	1/23	Th	**Midterm Exam 1**	Ch. 1-3			

Chapter 1

Measurements in Physics

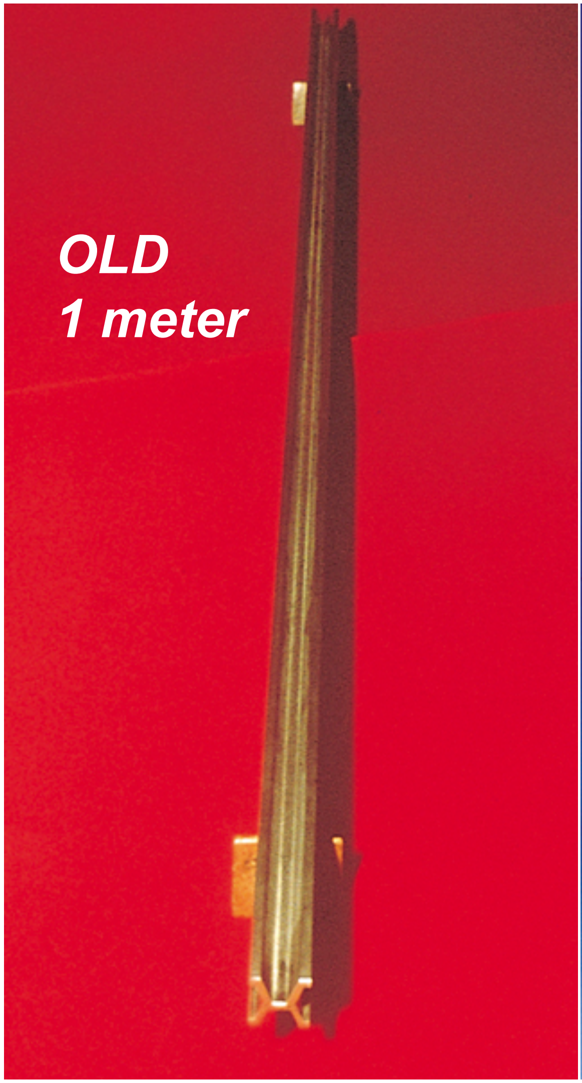
1.1 Distance, Time, and Mass Measurements

Physics experiments involve the measurement of a variety of quantities.

These measurements should be accurate and reproducible.

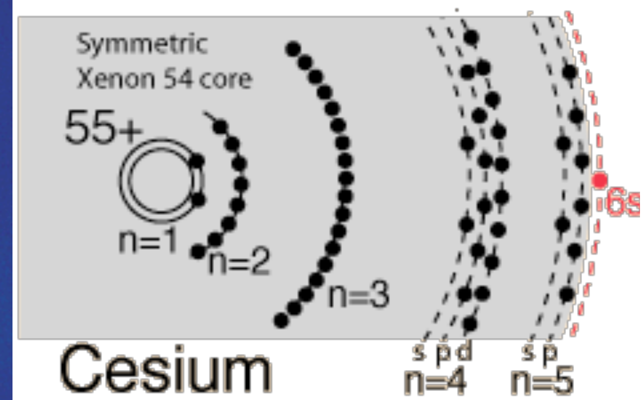
The first step in ensuring accuracy and reproducibility is defining the units in which the measurements are made.

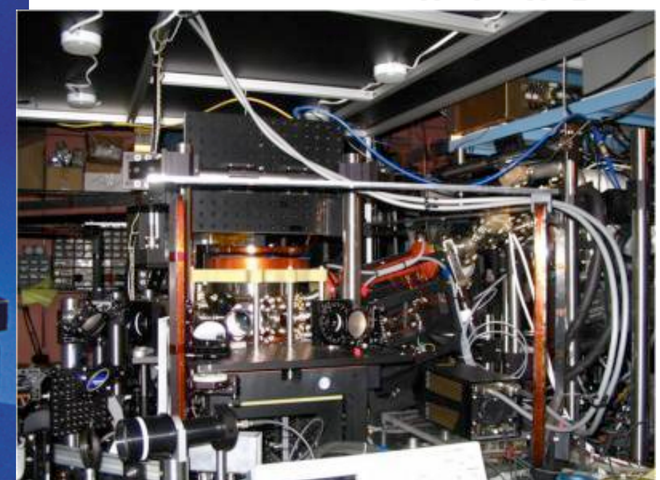
1.1 Distance, Time, and Mass Measurements



1 kg

1 second





1 meter, distance traveled by light (vacuum), in 1/299,792,458 of a second

SI units

meter (m): unit of length

kilogram (kg): unit of mass

second (s): unit of time

The units for length, mass, and time (as well as a few others), are regarded as *base* SI units.

These units are used in combination to define additional units for other important physical quantities such as force and energy.

1.1 Distance, Time, and Mass Measurements

Table 1.2 **Standard Prefixes Used to Denote Multiples of Ten**

Prefix	Symbol	Factor[a]
tera	T	10^{12}
giga[b]	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
hecto	h	10^{2}
deka	da	10^{1}
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}

[a] Appendix A contains a discussion of powers of ten and scientific notation.
[b] Pronounced jig′a.

THE CONVERSION OF UNITS

1 ft = 0.3048 m

1 mi = 1.609 km

1 hp = 746 W

1 liter = 10^{-3} m^3

1.2 Converting Units

The World's Highest Waterfall

The highest waterfall in the world is Angel Falls in Venezuela, with a total drop of 979.0 m. Express this drop in feet.

What if you can't remember there are 3.281 feet in a meter?
What do you remember? Perhaps 1 inch = 2.54 cm (yes?)
Also, 12 inches = 1 foot, and 100 cm = 1 m.

$$1\ \mathrm{m} = (1\ \mathrm{m})\overbrace{\left(100\ \frac{\mathrm{cm}}{\mathrm{m}}\right)}^{=1}\overbrace{\left(\frac{1}{2.54}\ \frac{\mathrm{inch}}{\mathrm{cm}}\right)}^{=1}\overbrace{\left(\frac{1}{12}\ \frac{\mathrm{ft}}{\mathrm{inch}}\right)}^{=1} = (1\ \mathrm{m})\left(\frac{100}{(2.54)(12)}\right)\left(\frac{\mathrm{ft}}{\mathrm{m}}\right) = 3.281\ \mathrm{ft}$$

Since 3.281 feet = 1 meter, it follows that

$$979.0\ \text{meters} = (979.0\ \text{meters})\overbrace{\left(\frac{3.281\ \text{feet}}{1\ \text{meter}}\right)}^{=1} = 3212\ \text{feet}$$

Reasoning Strategy: Converting Between Units

1. In all calculations, write down the units explicitly.

2. Treat all units as algebraic quantities. When identical units are divided, they are eliminated algebraically.

3. Use the conversion factors located on back of front and rear covers. Be guided by the fact that multiplying or dividing an equation by a factor of 1 does not alter the equation.

*1.3 **Fundamental Constants and Dimensional Analysis***

DIMENSIONAL ANALYSIS

[L] = length   [M] = mass   [T] = time

A speed is a length divided by a time

Speed v, units are $\frac{[\mathrm{L}]}{[\mathrm{T}]}$

<u>Examples</u>

meters/second

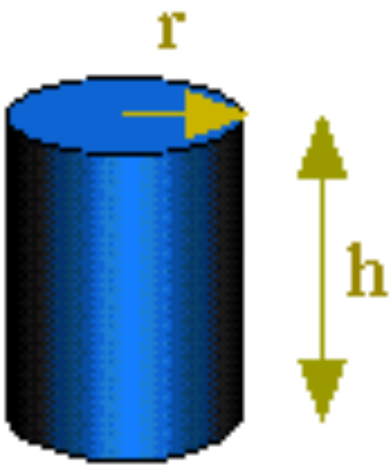
miles/hour

Is the following equation dimensionally correct?

$$x = \tfrac{1}{2} v t^2$$

$$[\mathrm{L}] = \left[\frac{\mathrm{L}}{\mathrm{T}}\right][\mathrm{T}]^2 = [\mathrm{L}][\mathrm{T}]$$

1.4 *Measurement, Uncertainty, and Significant Figures*



Measure the radius and height of this cylinder.

Using a "1 meter ruler", smallest division is 1 mm.

(Need to make sure ruler is "accurate")

wood and metal rulers agree at only 1 temperature

Measure radius – but it is hard to find the center.

Due to sharp edges, meaurement of diameter is more "precise".

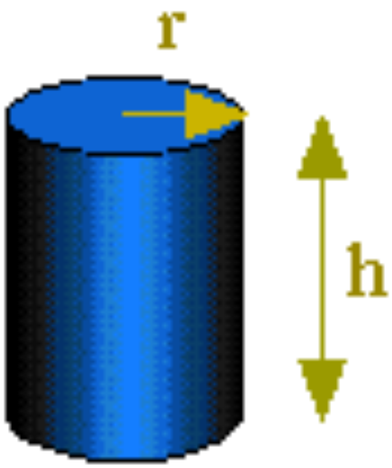
Measure diameter and divide by 2.

Measurements:	$d = 272 \pm 1$ mm	$h = 409 \pm 1$ mm
Calculation:	$r = 136 \pm 1$ mm	

Each dimension of the cylinder has 3 "significant figures"

Dimensions: $r = 13.6$ cm $\quad h = 40.9$ cm

Any function of these dimensions also has 3 significant digits, no more – no less! But don't round off intermediate calculations.



What is the volume of the cylinder **in m³** ?

Dimensions: $r = 13.6\text{ cm} \quad h = 40.9\text{ cm}$

Volume = [Area of circle](Height)

Using a calculator gives:

$$V = \left[\pi r^2\right](h) = \left[(3.14159...)(13.6\,\text{cm})^2\right](40.9\,\text{cm}) = 23{,}765.72...\ \text{cm}^3$$

>>3 significant figures?

Volume is NOT known more "precisely" than input dimensions.

$$V = 2.38 \times 10^4\,\text{cm}^3 \ \ (23{,}800\ \text{cm}^3)$$

Not done yet! Need answer in m^3!

$$V = (2.38 \times 10^4)(\text{cm}^3)\left(\frac{1\,\text{m}}{100\,\text{cm}}\right)^3$$
$$= 2.38 \times 10^{-2}\ \text{m}^3$$

Chapter 2

Kinematics in One Dimension

Kinematics describes motion,
and Dynamics investigates what causes motion

2.1 Motion in one dimension (definitions)

In Chapter 2: All motion is along a 1D line and is called the x-axis.

YOU decide which direction along x is POSITIVE.

1D line can be Horizontal, for motion of a car, boat, or human.

1D line can be Vertical, for objects dropped or thrown upward.

ID line can be a Diagonal, for objects moving on a ramp.

Speed v : can only be positive

Velocity v_x : value with sign indicating direction (in x)

} Instantaneous at the time t

Absolute value of the velocity is the speed : $v = |v_x|$

Example : Choose "to the right" as positive. Object's speed is $v = 20$ m/s.

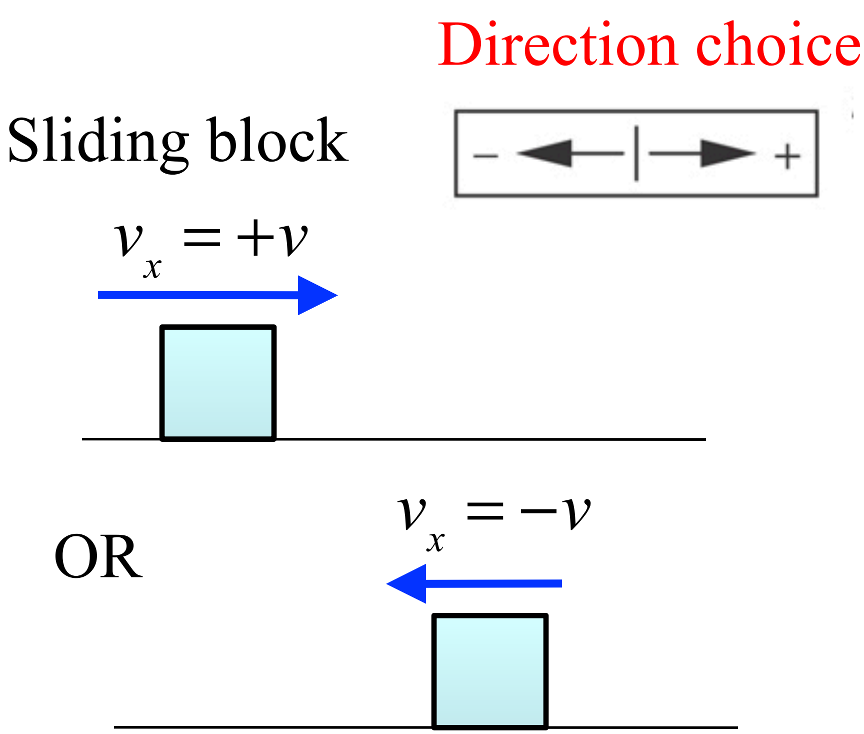
If object is moving to the right, the velocity, $v_x = 20$ m/s.

If object is moving to the left, the velocity, $v_x = -20$ m/s.

2.1 *Motion in one dimension (examples)*

Speed v : is always positive

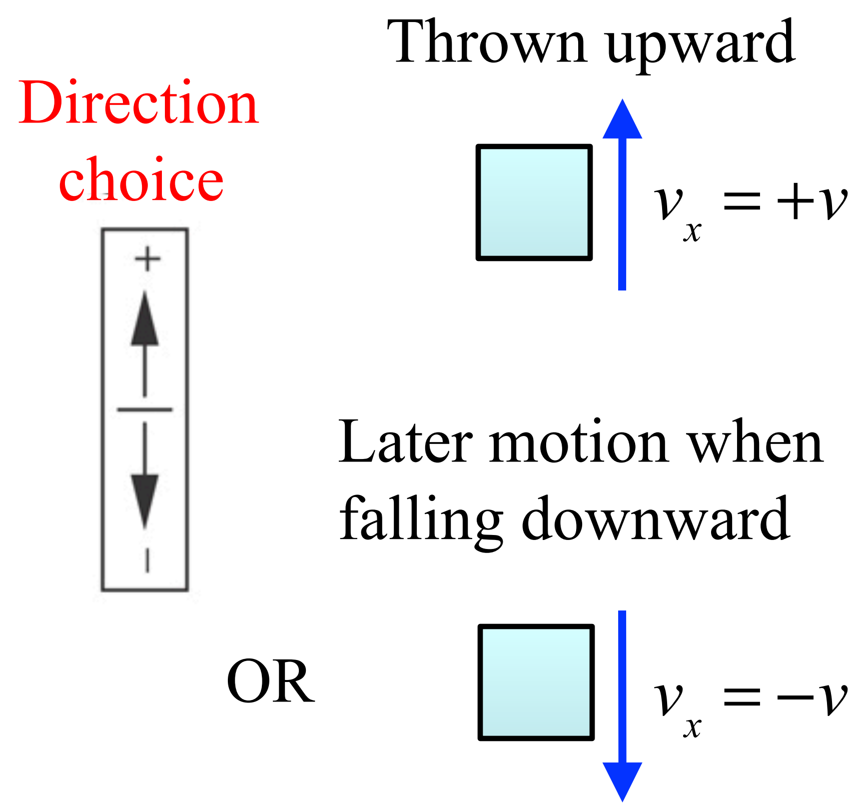
Horizontal motion



If you determine that $v_x = -20\text{m/s}$

it must be moving to the left.

Vertical motion



If you determine that $v_x = -20\text{m/s}$

it must be moving downward.

2.1 *Motion in one dimension (definitions)*

Moving: How can one tell if an object is moving at time, t ?

Look "at a few times a little bit" earlier.

Then look "at a few times a little bit" later.

Check if the object is at the same place as it was at time t!

If the position of the object changes --- it is MOVING at time t !

If the position of the object doesn't change, it is NOT MOVING at time t!

(stationary)

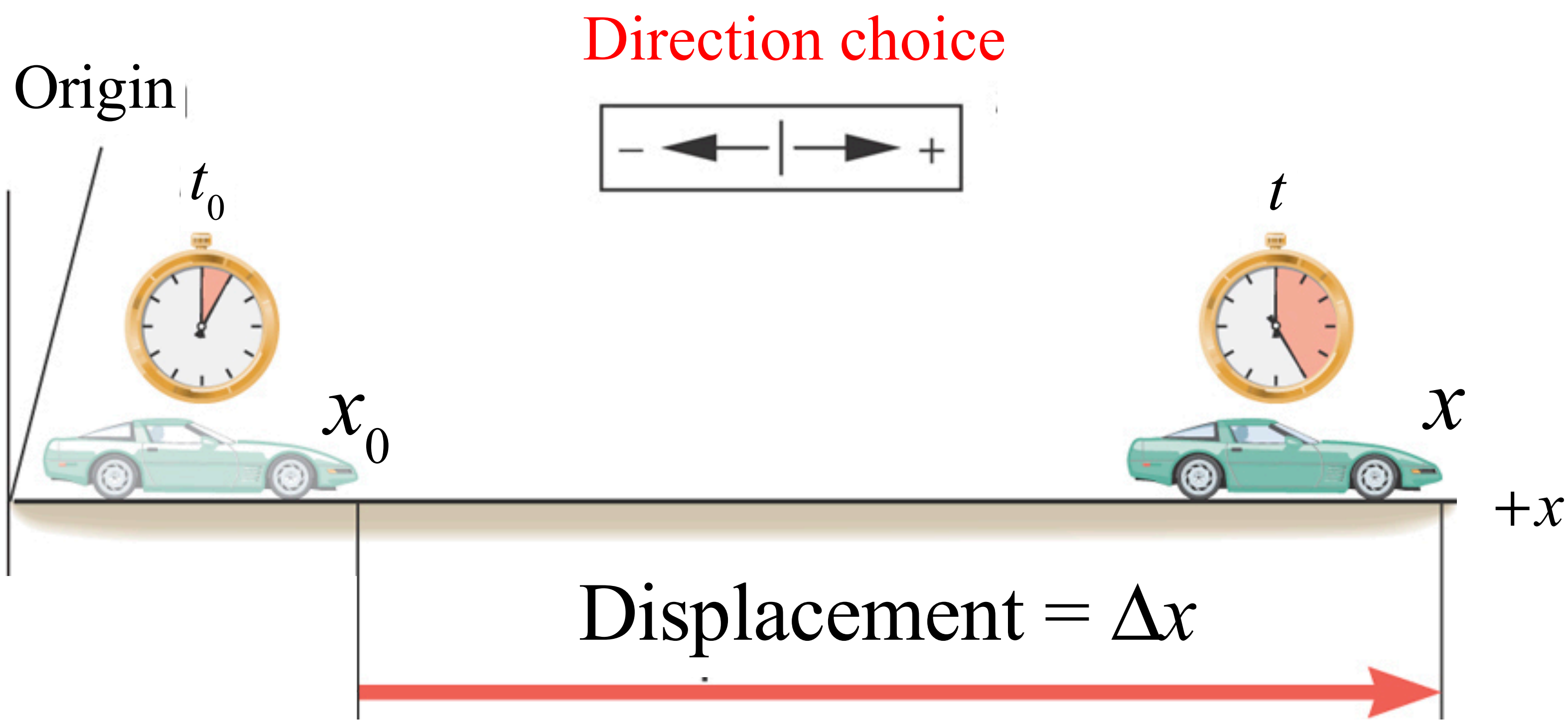
Example:

If an object is thrown upward, at the one time it reaches its highest point its speed v is 0 (instantaneously) **but** the object IS MOVING at that time!

Turning around to a new direction is motion. It is MOVING.

Zero speed at one time t is NOT EQUIVALENT to not moving.

2.1 Motion in one dimension (Displacement and Distance)



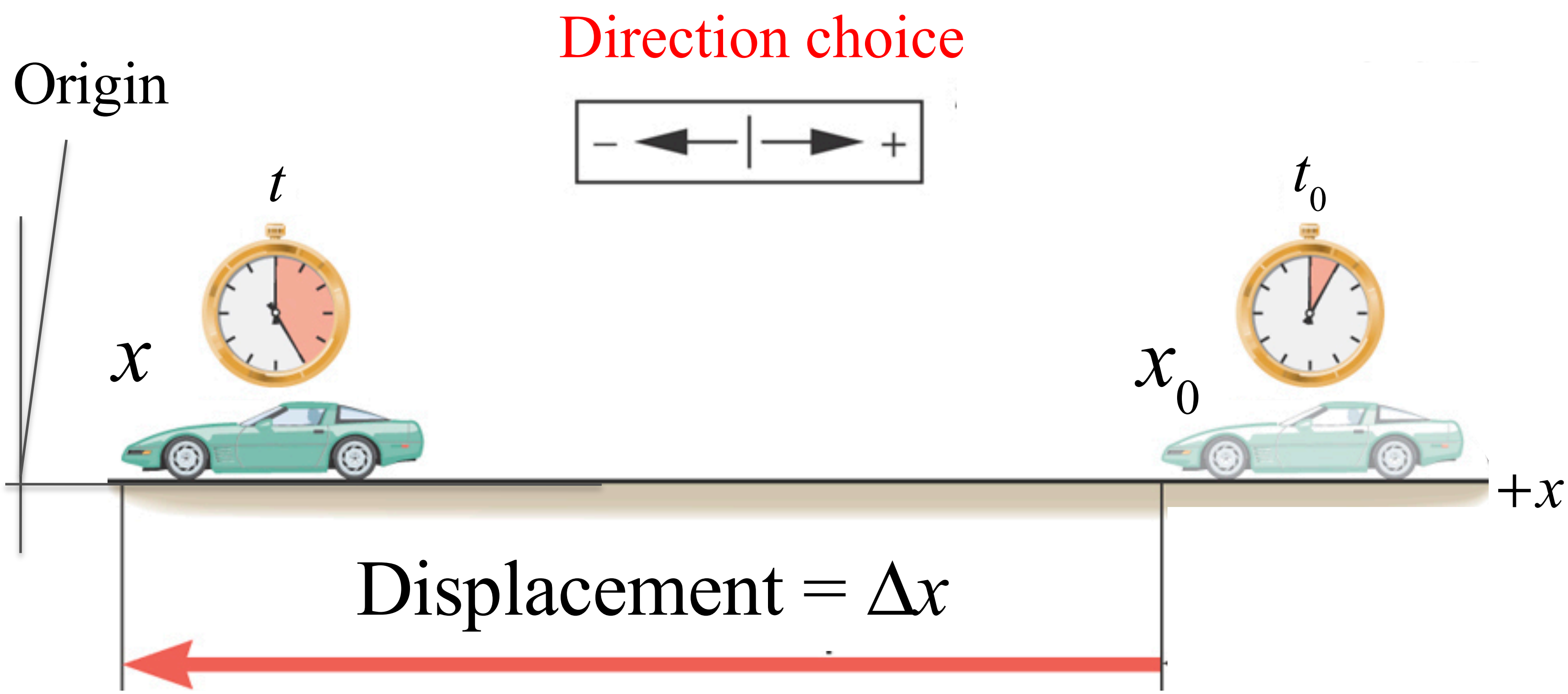
$x_0 =$ position (at $t = 0$) $\quad$ $x =$ final position

$$\Delta x = x - x_0 = \text{displacement}$$

Since $x > x_0$, then displacement Δx is positive

The travel distance $d = |\Delta x|$ is always positive.

2.1 Motion in one dimension (Displacement and Distance)



$x =$ final position $\qquad x_0 =$ initial position (at $t = 0$)

$$\Delta x = x - x_0 = \text{ displacement}$$

If $x_0 > x$, then displacement Δx will be negative

The travel distance, $d = |\Delta x|$ is always positive.

2.2 Speed and Velocity

Average speed is the distance traveled divided by the time (t - t_0) required to cover the distance.

Average value of v, is written as $\bar{v}$ (v with a bar over it).

$$\text{Average speed, } \bar{v} = \frac{\text{Distance}}{\text{Elapsed time}}$$

SI units for speed: meters per second (m/s)

Clearly

$$\text{Distance} = (\text{Average speed})(\text{Elapsed time})$$

$$d = \bar{v}\Delta t$$

2.2 Speed and Velocity

Average velocity is the displacement divided by the elapsed time.

$$\text{Average velocity} = \frac{\text{Displacement}}{\text{Elapsed time}}$$

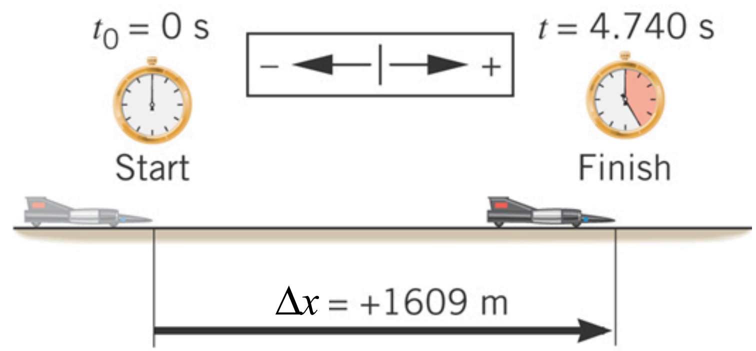
$$\bar{v}_x = \frac{x - x_0}{t - t_0} = \frac{\Delta x}{\Delta t}$$

This average places no restriction on how the velocity has changed over time. For example, it could reverse direction a number of times over the time of the displacement.

2.2 Speed and Velocity

Example: The World's Fastest Jet-Engine Car

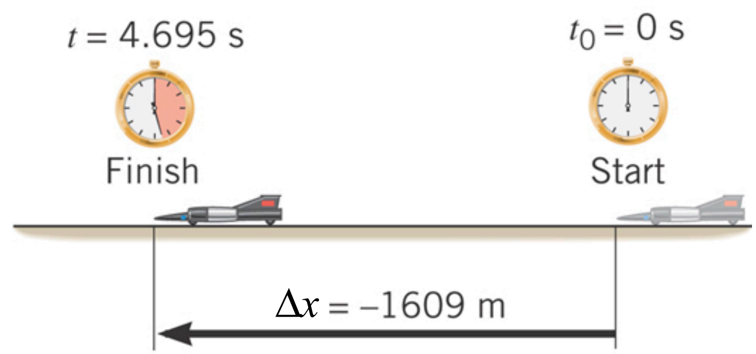
Andy Green in the car *ThrustSSC* set a world record of 341.1 m/s in 1997.
Two runs are made through the course, one in each direction.
From the data shown, determine the average velocity for each run.



(a)

Average velocity run 1

$$\overline{v}_x = \frac{\Delta x}{\Delta t} = \frac{+1609\text{ m}}{4.740\text{ s}} = +339.5\text{m/s}$$



(b)

Average velocity run 2

$$\overline{v}_x = \frac{\Delta x}{\Delta t} = \frac{-1609\text{ m}}{4.695\text{ s}} = -342.7\text{m/s}$$

negative

Average speed

$$\overline{v} = \frac{v_1 + v_2}{2} = 341.1\text{ m/s}$$

2.2 Speed and Velocity

The ***instantaneous velocity*** indicates how fast the car moves and the direction of motion at each instant of time.

$$v_x = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}$$