PHY131H1F
Class 4

Today, Chapter 2!
- Constant Velocity Motion
- Constant Acceleration Motion
- Freefall, Motion on an inclined plane

Uniform motion?

- In chapter 2, “uniform motion” means:

A. The position does not change with time.
B. The position-versus-time graph is a straight line.
C. The velocity-versus-time graph is a straight line.
D. The acceleration-versus-time graph is a straight line.
E. The high school dress code is always changing.

Last day I asked at the end of class:

- Does constant velocity imply constant acceleration?
- ANSWER: YES, and even more, it implies zero acceleration! (zero is a constant!)
- Does constant acceleration imply constant velocity?
- ANSWER: NO! Unless that constant happens to be zero! Constant acceleration normally means constantly *changing* velocity!

Instantaneous Acceleration

The instantaneous acceleration a_s at a specific instant of time t is given by the derivative of the velocity

$$a_s \equiv \lim_{\Delta t \to 0} \frac{\Delta v_s}{\Delta t} = \frac{dv_s}{dt} \qquad \text{(instantaneous acceleration)}$$

Note: Knight uses “s” to denote a distance in a general direction. Usually in problems we substitute x or y instead of s.

$$a_s \equiv \lim_{\Delta t \to 0} \frac{\Delta v_s}{\Delta t} = \frac{dv_s}{dt} \qquad \text{(instantaneous acceleration)}$$

- If an object is stopped, then

A. its acceleration is negative.
B. its acceleration is zero.
C. its acceleration is positive.
D. its acceleration could be any of the above.

Acceleration in 1-D (along a line)

- Velocity is the time-derivative of position.
- Acceleration is the time-derivative of velocity.
- S.I. unit of acceleration is m/s ***per second***, also called m/s^2.
- Acceleration is like the “speed of the speed”
- Acceleration is “how fast fast changes!”
- It is possible to be momentarily stopped (v=0) with a non-zero acceleration!

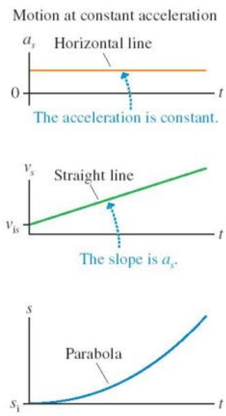
Finding Velocity from the Acceleration

If we know the initial velocity, v_{is}, and the instantaneous acceleration, a_s, as a function of time, t, then the final velocity is given by

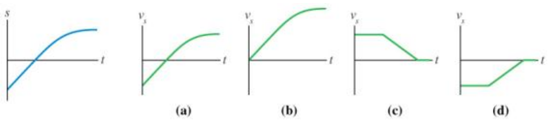
$$v_{fs} = v_{is} + \lim_{\Delta t \to 0} \sum_{k=1}^{N} (a_s)_k \Delta t = v_{is} + \int_{t_i}^{t_f} a_s \, dt$$

Or, graphically,

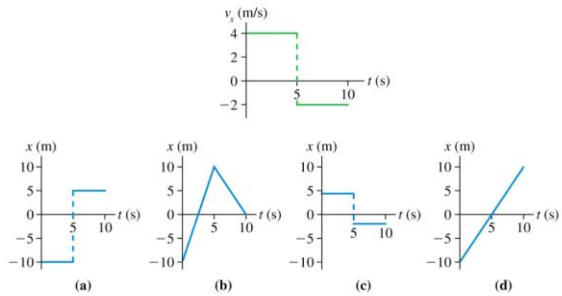
$v_{fs} = v_{is}$ + area under the acceleration curve a_s between t_i and t_f



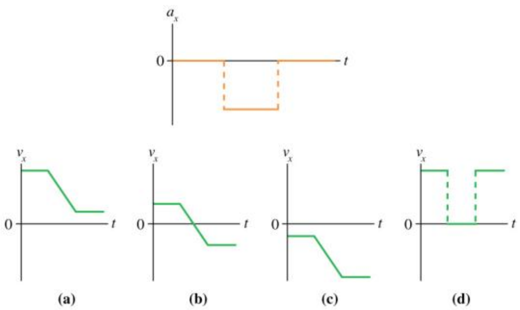
Which velocity-versus-time graph goes best with the position-versus-time graph on the left?



Which position-versus-time graph goes with the velocity-versus-time graph at the top? The particle's position at $t_i = 0$ s is $x_i = -10$ m.



Which velocity-versus-time graph or graphs goes with this acceleration-versus-time graph? The particle is initially moving to the right and finally to the left.



Announcements

- Pre-course diagnostic quiz on mechanics done during zeroth practical last week.
- Did you miss it? Still want your 0.5%? Here are four make-up times:
- Thurs. Sept 20 - 4:10 pm in MP125C
  Friday Sept 21 - 12:10 pm in MP125C
  Tues Sept. 25 - 10:10 am in MP125C
  Wed. Sept 26 - 6:10 pm in MP125C

Announcements

- The first term test will be on Tuesday, October 2, from 6:00pm to 7:30pm.
- If you have a conflict at that time 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 September 27 at 5:00pm.
- As indicated at the beginning of the Physics section in the Faculty Course Timetable, this alternate sitting will be held just before the main sitting. Therefore, you are expected to have kept the time between 4:30 and 6:00pm free if you wish to write at the alternate sitting.
- 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.

Announcements

- Don't change your Practical Section on ROSI – your TAs will never know, and you won't get your marks!
- You must go to MP129 and fill out a form if you want to change Practical Sections.
- If you've already switched Practicals on ROSI recently and you aren't sure if your new and old TAs have the updated information, please go to MP129 and ask April Seeley.

Announcements

- We're done Chapter 1 and the Error Analysis Document, and it's onward and upward from here.
- Physics concepts build upon previous concepts, so it's important to keep up!
- If you have extra time and are looking for more practice, here are some suggested end-of-chapter material
- These are not to be turned in and are not worth marks, just items that I thought were particularly helpful for practice
- **Chapter 1:** Conceptual Questions 1, 7. Exercises and Problems: 9, 15, 23, 29, 43
- Also it's good to go over and understand the 5 examples in the Error Analysis Document

The 4 Equations of Constant Acceleration:

1. $\boxed{v_f = v_i + a\Delta t}$ Does not contain position!

2. $\boxed{s_f = s_i + v_i\Delta t + \frac{1}{2}a(\Delta t)^2}$ Does not contain v_f!

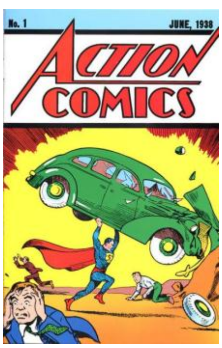
3. $\boxed{v_f^2 = v_i^2 + 2a(s_f - s_i)}$ Does not contain Δt !

4. $\boxed{s_f = s_i + \left(\frac{v_i + v_f}{2}\right)\Delta t}$ Does not contain a ! (but you know it's constant)

Strategy: When a = constant, you can use one of these equations. Figure out which variable you don't know and don't care about, and use the equation which doesn't contain it.

The Physics of Superheroes

©2009 by James Kakalios available at Chapters.ca for $15



- In the original comic, Superman only had super-strength and very tough skin!
- He could "leap tall buildings in a single bound."
- It was not until the 1940s that the writers changed his abilities to included guided flying.

Example Question.

Superman's parents came from a planet where the gravity was much stronger. His race has legs strong enough to jump to a maximum height of 1.0 m on planet Krypton.

On Earth, Superman can jump to a maximum height of 25 m. (a tall building in 1938!)

What was the acceleration due to gravity on planet Krypton?

- Your car starts at rest, and then you speed up to a maximum of 120 km/hr over a time of 25 seconds. During this time:

A. both your velocity and acceleration were constant.

B. your velocity was constant, but your acceleration was changing.

C. your velocity was changing, but your acceleration was constant.

D. both your velocity and acceleration were changing.

Before Class 5 on Monday

- If you haven't already done it, remember there is a MasteringPhysics.com problem set due in 2 days! Please submit this before 11:59pm Friday.
- Please read Chapter 3 of Knight.
- Something to think about: Can you add a scalar to a vector? Can you multiply a vector by a scalar?