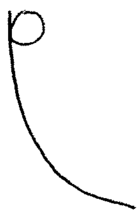
Do you understand the difference between velocity and acceleration? In each situation, state whether it ↑, ↓, or remains constant.

I. 

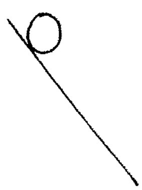
$\vec{v}$ ↑

$\vec{a}$ ↑

II. 

$\vec{v}$ ↑

$\vec{a}$ ↓

III. 

$\vec{v}$ ↑

$\vec{a}$ const.

Sample Data:

t(s)	v(m/s)	
0	0	
		1 m/s/s
1	1	
		2 m/s/s
2	3	
		3 m/s/s
3	6	

t(s)	v(m/s)	
0	0	
		5 m/s²
1	5	
		4 m/s²
2	9	
		3 m/s²
3	12	

t(s)	v(m/s)	
0	0	
		2 m/s²
1	2	
		2 m/s²
2	4	
		2 m/s²
3	6	

14a

- What must I do FIRST when using a physics eqn?

- Rearrange the eqn to solve for the one unknown
- DO NOT PLUG #'S IN FIRST!
- This allows you to calculate in one step <u>and eliminates over-rounding</u>.
- This also lowers your chances of making errors.

Practice:

1. $F = ma$ (solve for "a")

$\frac{F}{m} = \frac{\cancel{m}a}{\cancel{m}}$

$a = \frac{F}{m}$

2. $v = \frac{\Delta x}{t}$ (solve for "t")

$t \cdot V = \frac{\Delta x}{\cancel{t}} \cdot \cancel{t}$

$\frac{t \cdot \cancel{V}}{\cancel{V}} = \frac{\Delta x}{V}$

$\boxed{t = \frac{\Delta x}{V}}$

3. $\Delta x = \cancel{vt} + 0.5at^2$ (solve for "a")

$-vt \quad -\cancel{vt}$

$\frac{\Delta x - vt}{.5t^2} = \frac{\cancel{.5}a\cancel{t^2}}{\cancel{.5t^2}}$

$\boxed{a = \frac{\Delta x - vt}{.5t^2}}$

4. $d^2 \cdot F = \frac{Gm_1m_2}{\cancel{d^2}} \cdot \cancel{d^2}$ (solve for "d")

$\frac{d^2 \cdot \cancel{F}}{\cancel{F}} = \frac{Gm_1m_2}{F}$

$\sqrt{d^2} = \sqrt{\frac{Gm_1m_2}{F}}$

$d = \sqrt{\frac{Gm_1m_2}{F}}$

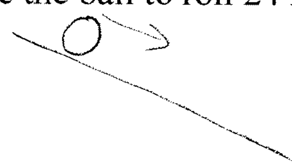
14b

Mechanics Unit   Accelerated Motion Math   gpb video: Phys Std:

- What are some common phrases used in physics problems?
  - How fast was it going? ==> means $V_i = ?$
  - How fast will it go? ==> means $V_f = ?$
  - Object starts at rest ==> means $V_i = 0\ m/s$
  - Object slows down ==> means a is negative
  - Object comes to a stop ==> means $V_f = 0\ m/s$
  - Object moves at a constant velocity ==> $a = 0\ m/s^2$
- What are the steps required to solve physics problems?
  - Step 1: Draw a pic and/or graph
  - Step 2: List variables/given information
  - Step 3: Do algebra to solve for the unknown (if anything equals 0, eliminate from the eqn before doing the algebra)
  - Step 4: Plug #'s in (be consistent with units and be sure they cancel to give the appropriate unit!!)

Practice:

1. Starting from rest, a ball rolls down a hill, uniformly accelerating at 3.2 m/s². How long does it take the ball to roll 24 meters?



$\vec{V}_1 = 0\ m/s$

$\vec{a} = +3.2\ m/s^2$

$t = ?$

$\vec{\Delta x} = +24m$

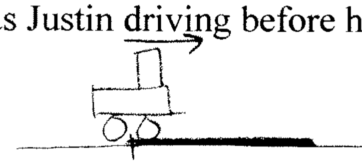
V_f is not mentioned so use the eqn that doesn't have V_f in it:

$\Delta x = V_i t + \frac{1}{2} a t^2$

$$\frac{\Delta x}{\frac{1}{2}a} = \frac{\cancel{V_i t} + \frac{1}{2} a t^2}{\frac{1}{2}a} \quad \sqrt{t^2} = \sqrt{\frac{\Delta x}{\frac{1}{2}a}} \quad t = \sqrt{\frac{\Delta x}{\frac{1}{2}a}}$$

$$t = \sqrt{\frac{24m}{\frac{1}{2}\left(3.2\frac{m}{s^2}\right)}} = \boxed{3.87s}$$

2. Skid marks at the scene of an accident show that Justin Time's car moved 64 m before it stopped. If the car decelerated at a rate of 8.0 m/s², how fast was Justin driving before he applied the brakes?



$\vec{\Delta x} = +64m$

$\vec{V}_f = 0\ m/s$

$\vec{a} = -8\ m/s^2$

$\vec{V}_i = ?$

t isn't mentioned so use the eqn that doesn't have t in it:

$V_f^2 = V_i^2 + 2a\Delta x$

$$0\ \cancel{V_f^2} = V_i^2 + 2a\Delta x$$

$$\sqrt{-2a\Delta x} = \sqrt{V_i^2}$$

$$\vec{V}_i = \sqrt{-2a\Delta x}$$

$$\vec{V}_i = \sqrt{-2\left(-8\frac{m}{s^2}\right)(64m)}$$

$$\boxed{\vec{V}_i = +32\frac{m}{s}}$$

More on your own:

1. $KE = 0.5mv^2$ (solve for "m")
2. solve #1 for v
3. $V_f^2 = v_i^2 + 2a\Delta x$ (solve for "Δx")
4. solve # 3 for v_i

skipped these in class

- How do I know what symbol I am solving for?

- "How far?" means solve for Δx
- "How fast" means solve for v
- "How long?" means solve for t

Uniform Motion Review Problem:
Anita Break and Earl E. Byrd drive 48 km east. Anita drives at a constant 88 km/hr while Earl drives at a constant 92 km/h. How long will Earl have to wait on Anita at their destination?

I skipped this problem in the notes.

- What are the kinematic eqns for uniformly accelerated motion? (Write these in your gems of wisdom)

Acceleration Eqn	Missing variable
$v_f = v_i + at$	$\Delta \vec{x}$
$\Delta x = v_i t + \frac{1}{2}at^2$	v_f
$\Delta x = v_f t - \frac{1}{2}at^2$	v_i
$v_f^2 = v_i^2 + 2a\Delta x$	t
$\Delta x = \frac{1}{2}(v_f + v_i)t$	$\vec{a}$

That is a "v_f"
↓
Final velocity

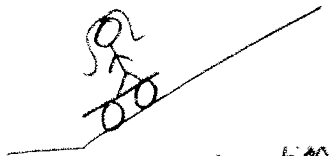
*There are 5 possible variables: Δx, vi, vf, a, t
*A typical problem won't mention one of these
*Find this "missing variable" in the table to determine the eqn you will use.
*Note: We will assume direction of motion is always positive unless otherwise stated.

p. 69 (in text) #26

* Solve it 2 ways:
  1. use algebra
  2. use a v-t graph

(You should get the same answer both ways)

Algebra method



changes direction at the top of the ramp $\Rightarrow \vec{V}_f = 0$ m/s

$\vec{V}_i = +1.75$ m/s

$\vec{a} = -.2$ m/s^2

$t = ?$

This problem did not mention Δx:

$$V_f = V_i + at$$

$$0 = V_i + at$$

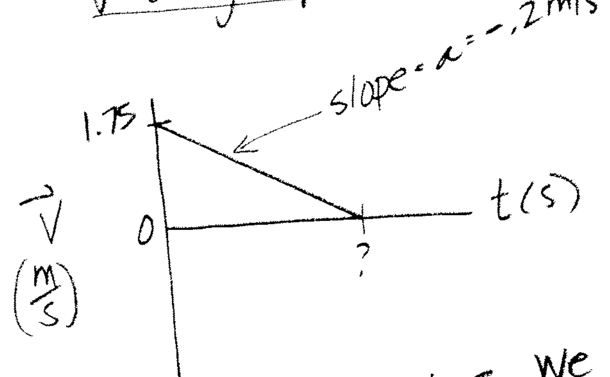
$$-V_i = at$$

$$t = \frac{-V_i}{a}$$

$$t = \frac{-1.75\,\text{m/s}}{-.2\,\text{m/s}^2}$$

$$\boxed{t = 8.75\,\text{s}}$$

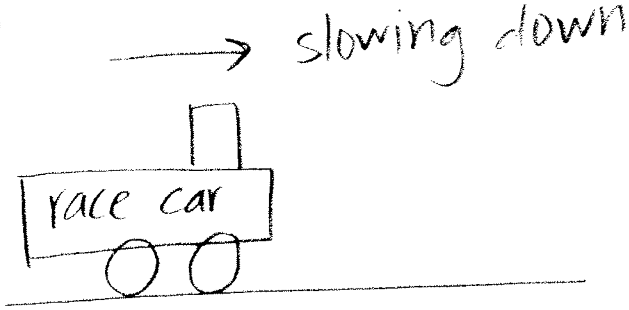
v-t graph method



We know rise & slope. We need to solve for "run". That will be the time.

$$\text{slope} = \frac{\text{rise}}{\text{run}}$$

P. 69 #27



$\vec{v}_i = +44\,m/s$

$\vec{v}_f = +22\,m/s$

$t = 11\,s$

$\Delta\vec{x} = ?$

Algebra method

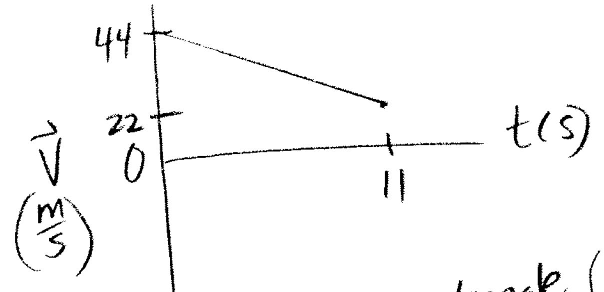
$$\Delta\vec{x} = \frac{1}{2}(v_f + v_i)t$$

$$\Delta\vec{x} = \frac{1}{2}\left(22\frac{m}{s} + 44\frac{m}{s}\right)(11s)$$

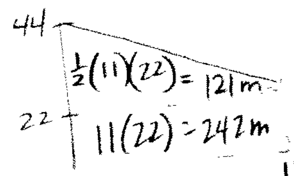
$$\boxed{\Delta\vec{x} = +363\,m}$$

V-t graph method

$\Delta x = \text{area} = ?$



Area = area of rectangle $(b \cdot h)$
+
area of triangle $(\frac{1}{2}bh)$



$\Delta\vec{x} = \text{area} = 121m + 242m$

$$\boxed{\Delta\vec{x} = 363m}$$