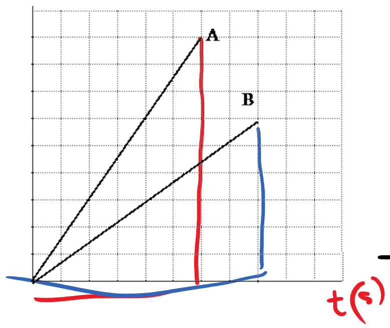
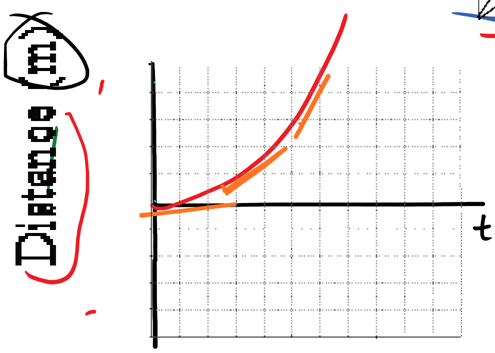
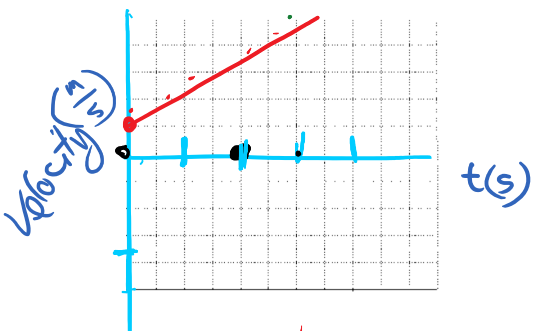
Changing V on D vs T

Thursday, September 30, 2010 11:57 AM

Remember the slope of a distance vs. time graph is speed, slope of displacement vs. time is velocity.
Which runner on the graphs below is faster, A or B, how can you tell?





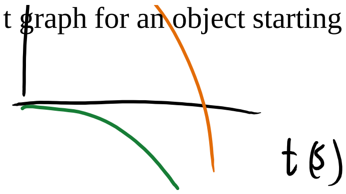


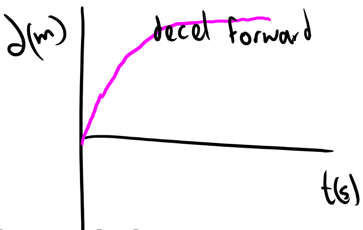
Find the average
Velocity between 0 and 7 seconds:

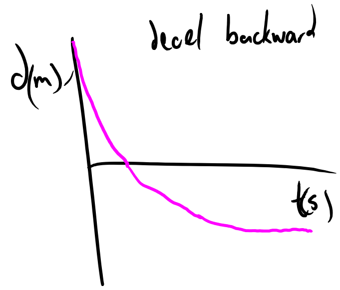
Acceleration is the increase in magnitude (size) of velocity. Sketch what a displacement
Vs. time graph will look like for an object starting with zero velocity, and accelerating
Forward.

Objects which are ACCELERATING will have lines getting steeper and steeper on
d vs t graphs: like above:

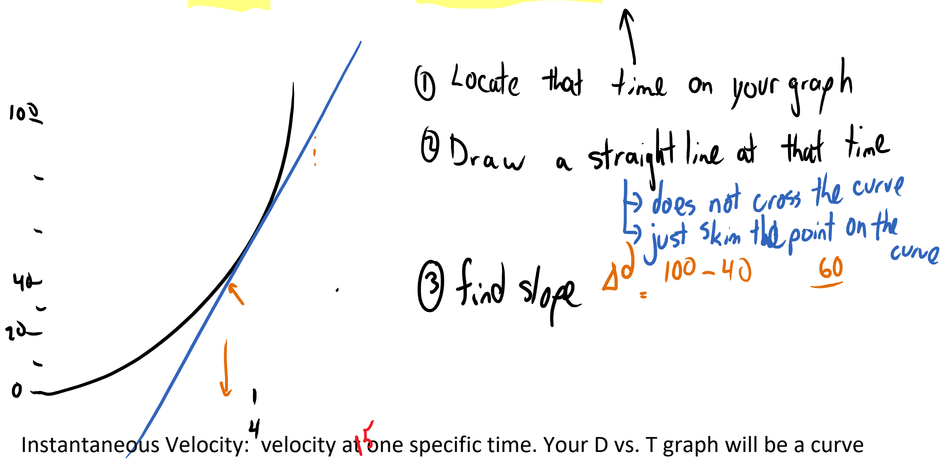
draw a d vs t graph for an object starting at rest accelerating backward draw a d vs t graph for an object starting at rest accelerating backward







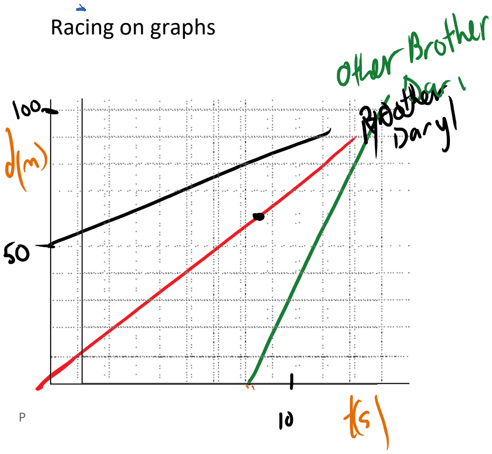
Objects which are DECELERATING have curves which become less and less steep, on d vs t graphs, like below:



Instantaneous Velocity: velocity at one specific time. Your D vs. T graph will be a curve

The question will ask: Find the instantaneous velocity at EXACTLY 4.0 s

Racing on graphs



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d(m)

Δt $\overline{5.2 - 3.5} = 1.7 = 35.3 \frac{m}{s}$

t(s)

t(s)

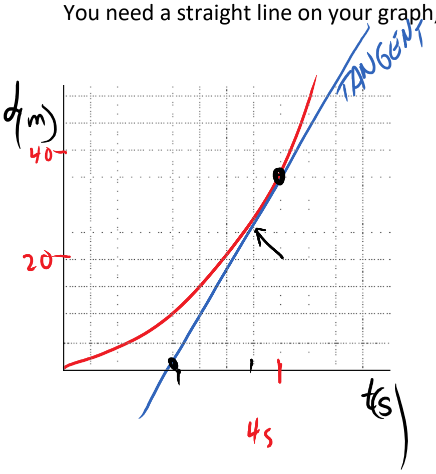
INSTANTANEOUS VELOCITY

It means the velocity at a specific instant for an object which is accelerating or decelerating.

You need a straight line on your graph, BUT your graph is a curve.

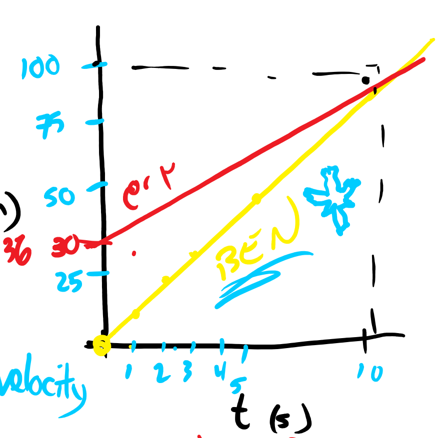
$\frac{10.5}{2.5} = 4.2 \frac{m}{s}$

$\frac{-20.5}{5} = -4.1 \frac{m}{s}$



Find the velocity at Exactly 4.0s

- Place dot at that Time
- estimate a best line at that time
  touch but not cross the curve
- find slope of the tangent $\frac{\Delta d}{\Delta t} = \frac{25.5 - 0}{3.5 - 2} = \frac{25.5}{1.5} = 17 \frac{m}{s}$



Ben 10 m/s

Carl 6 m/s

Slope of Dvst = velocity

$\frac{\Delta d}{\Delta t} = V$

When looking for a velocity AT AN EXACT TIME

When looking for a velocity AT AN EXACT TIME
- draw a tangent ← it touches but does not cross
- find the slope of the tangent

d (m)	t (s)
10	0
13.1	0.5
15.9	1
18.1	1.5
19.5	2
20.5	2.5
19.5	3
18.1	3.5
15.9	4
13.1	4.5
10	5
6.9	5.5
4.1	6
1.9	6.5
0.5	7
0	7.5
0.5	8
1.9	8.5
4.1	9
6.9	9.5
10	10

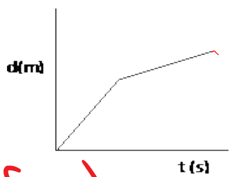
Slope of D vs T = Velocity

$\frac{\Delta d}{\Delta t} = V$

slope of V vs. t = accel

$\frac{\Delta d}{\Delta t} = \frac{0 - 20.5}{7.5 - 2.5} = \frac{-20.5}{5} = -4.1\frac{m}{s}$

$\frac{\Delta d}{\Delta t} = \frac{20.5 - 10}{2.5 - 0} = \frac{10.5_m}{2.5_s} = 4.2\frac{m}{s}$



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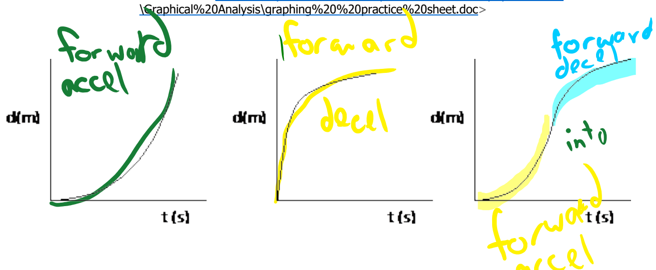

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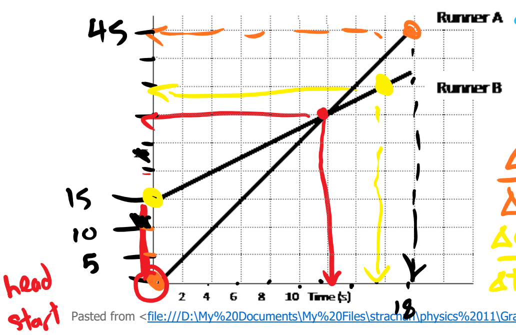

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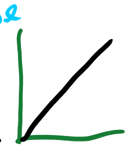
velocity = slope on d vs t

$\frac{\Delta d}{\Delta t} = \frac{45 - 0}{18 - 0} = \frac{45}{18} = 2.5\frac{m}{s}$

$\frac{\Delta d}{\Delta t} = \frac{35 - 15}{16 - 0} = \frac{20}{16} = 1.25\frac{m}{s}$



12s, 30m

$\frac{45 - 0}{18 - 0} = \frac{45}{18} = 2.5\frac{m}{s}$

Acceleration is the rate of change of velocity ← this means acceleration is Δv / Δt or

- $a = \frac{\Delta v}{\Delta t}$ the units of acceleration are the units of velocity / the units of time = $\frac{m}{s^2}$

Slope of a V vs. t graph = accel

This formula is often written as ~~aΔt~~ = ~~$v_f - v_o$~~ where v_f is final velocity and v_o is initial velocity or

$*at = v_f - v_o$

The equation ~~Δd~~ = $v_{average}$ can be written as $\Delta d = v_{average}\Delta t$ or

$*at = v_f - v_o$

The equation $\frac{\Delta d}{\Delta t} = v_{average}$ can be written as $\Delta d = v_{average}\Delta t$ or

- $*d = ½ (v_f + v_o)t$

Negative slopes

On a D vs T graph a negative slope means the object is moving backward
On a V vs T graph a negative slope means the object is either decelerating or accelerating backward

Each of the equations with the * are called kinematic equations because they are used to find and describe motion, there are two other kinematic equations

$*d = v_o t + 1/2\ a\ t^2$
And
$*v_f^2 = v_o^2 + 2ad$

Anyone of these equations may be used depending on what variables are given in a problem.
Some special words give us information about a problem these are:

REST: this tells us either the vf or vo, when something is at rest it is not moving, if an object starts at rest then vo = 0 m/s if it ends at rest then vf = 0 m/s

DROP: when an object drops it starts at rest vo = 0 m/s and falls due to the acceleration due to gravity which on earth is $9.8\ m/s^2$ for all objects.

FALL: as dropped

THROWN DOWN: starts with vo > 0m/s and accelerates due to gravity $a = 9.8\ m/s^2$
THROWN UP: starts with vo > 0 m/s and DECELERATES due to gravity $a = -9.8\ m/s^2$
1-14 sheets

Examples:
A cat is dropped from a 100 m high tower, what speed does it have when it hits the ground?
When looking for information the key words are dropped and 100 m:
vo = 0 m/s (dropped)
a = 9.8 m/s2 (dropped)
d = 100 m
Unknown is vf (speed at ground)
Formula with these four variables is $v_f^2 = v_o^2 + 2ad$
Substitute:
$Vf^2 = 0^2 + 2\,(9.8)(100)$
$Vf^2 = 1960$
Vf = 44.3 m/s

A car starts at rest and travels 50 m in 20 seconds, find its acceleration.

Vo = 0 m/s (starts at rest)
D = 50 m
T = 20 s
A = unknowns

Formula with these variables is $d = v_o t + ½\ at^2$
Substitute

$50 = 0\ (20) + ½\ a\ (20)^2$
$50 = 0 + 200a$
$50 = 200a$
$50 / 200 = a = 0.25\ m/s^2$

Do 1 – 14 on sheets for homework

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