Read 2.8

H.W Due today

NEXT H.W Available

Paid Tutor list on class web page

Free Departmental tutoring

office hours noon-1:00

For <u>constant</u> acceleration

$$a_{avg} = a$$

$$a = \frac{v_f - v_i}{t_f - t_i}$$

choose $t_i = 0$ start stopwatch

$t_f = t$

$V_i = V_0$ ← original

$V_f = V$

$$a = \frac{V - V_0}{t} \Rightarrow \boxed{V = V_0 + at} \quad (1)$$

$$V_{avg} = \frac{x_f - x_i}{t_f - t_i}$$

choose $x_f = x$

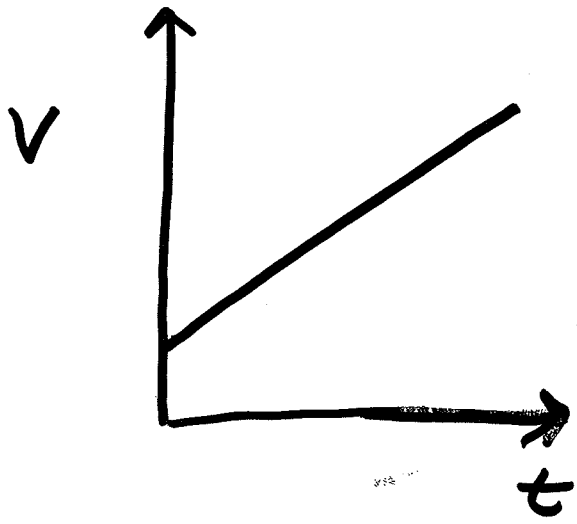
$x_i = x_0$

$t_f = t$

$t_i = 0$

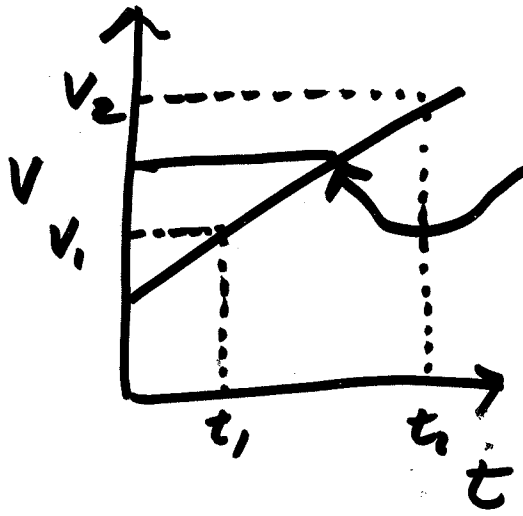
$$V_{avg} = \frac{x - x_0}{t}$$

$$x = x_0 + V_{avg}\, t$$



what is slope of line?

$$\text{slope} = \frac{\text{Rise}}{\text{Run}} = \frac{\Delta V}{\Delta t} = a \equiv \text{constant}$$



$$V_{avg} = \frac{V_1 + V_2}{2}$$

From before $X = X_0 + V_{avg}\, t$

$$\boxed{X = X_0 + \frac{1}{2}(V + V_0)\, t} \quad (2)$$

Can show 2 more relationships

$$X = X_0 + V_0 t + \frac{1}{2} a t^2 \quad (3)$$

$$V^2 = V_0^2 + 2a(X - X_0) \quad (4)$$

4 EQUATIONS
WHICH ONE TO USE?

1 $v = v_0 + at$

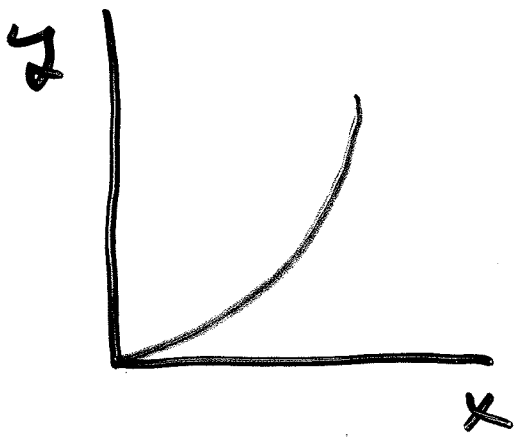
2 $x = x_0 + \frac{1}{2}(v_0 + v)t$

3 $x = x_0 + v_0 t + \frac{1}{2}at^2$

4 $v^2 = v_0^2 + 2a(x - x_0)$

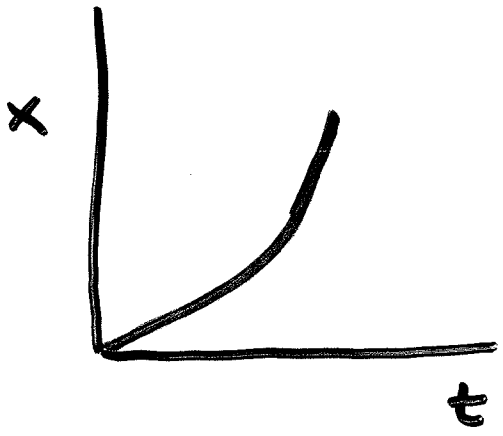
EQ.	RELATES	DON'T KNOW Variable
1	v, v_0, a, t	x, x_0
2	x, x_0, v_0, v, t	a
3	x, x_0, v_0, a, t	v
4	v, v_0, a, x, x_0	t

what does $y = x^2$ look like



parabola

eg ③ $x_0 = 0$
$v_0 = 0$ $\quad x = \frac{1}{2} a t^2$



parabola

Now do lots of examples

1) DRAW picture
2) write down known variables
3) write down what variable question is asking about
4) identify which kinematic equation(s) relate knowns to the unknown
5) solve (put in numbers at end) use variables!
6) reasonable answer?
7) units

ex) A ship is traveling with a speed of 3250 m/s. It slows down at a rate of 10 m/s². What is the ship's velocity after it has traveled 215 km?

$V_0 = 3250 m/s$

$a = -10 m/s^2$

$x_0 = 0 m$

$x = 215 km = 215,000 m$

Find V no t

(4) $V^2 = V_0^2 + 2a(x - x_0)$

$V^2 = (3250 m/s)^2 + 2(-10 m/s^2)(215,000 m)$

$V = 2.5 \times 10^3 m/s$

ex) A car can accelerate at $4.5\ m/s^2$. It starts from rest and accelerates in the negative x-direction. After 8s what is its speed and how far has it gone?

$a = -4.5\ m/s^2$

$t = 8.0s$

$v_0 = 0\ m/s$

$x_0 = 0\ m$

Find speed

① $v = v_0 + at$

$= 0 + (-4.5\ m/s^2)(8.0s)$

$= \underline{-36\ m/s}$ $\underline{\text{speed} = 36\ m/s}$

x:

② $x = x_0 + v_0 t + \frac{1}{2} a t^2$

$= 0m + 0 + \frac{1}{2}(-4.5\ m/s^2)(8.0s)^2$

$\boxed{= -144m}$

Interactive Question

Starting from rest, a roller coaster that is confined to move along a straight line is accelerated at a rate of 4 m/s^2. After 10 seconds how far will the roller coaster have traveled?

A) 20 m
B) 40 m
C) 100 m
D) 200 m
E) 400 m

ex A person picks up a foot ball at the 20 yard line and runs toward the end zone at a speed of 7.3 m/s. A person standing on the 23 yard line wants to stop a touch down. what must be the person's minimum acceleration to stop the touch down? (constant acceleration)

① → $V = 7.3 m/s$, $x = 20 yd = 18.29 m$ (→ +)

② → $V_0 = 0$, $x = 23 yd = 21.03 m$

① know x_1, v_1, $a_1 = 0 m/s^2$

② know x_2, $v_0 = 0 m/s$, $a_2 = ?$

find t for ①

$$x = x_0 + vt \Rightarrow t = \frac{x - x_0}{v} = \frac{18.29 m}{7.3 m/s} = 2.5 s$$

② t, x find a 3

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

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

$$a = \frac{2x}{t^2} = \frac{2 \cdot (21.03 m)}{(2.5 s)^2} = 6.7 m/s^2$$