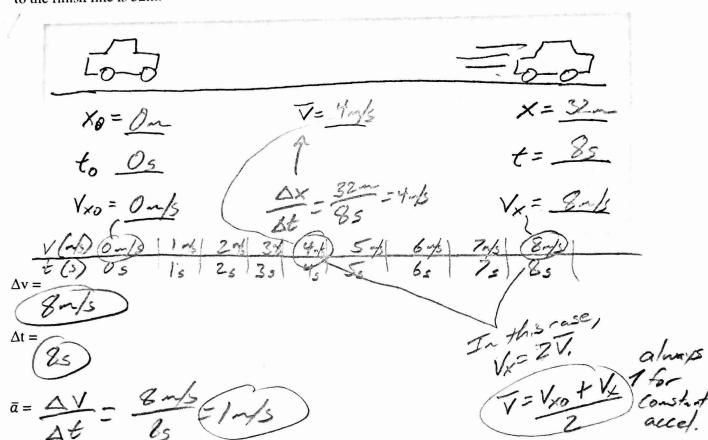
Physics 2	200
-----------	-----

Notes: Intro to Kinematics Formulas

Name: Key

Deriving a formula for constant acceleration of an object starting from rest:

Suppose the car below moves with **constant acceleration** after starting from rest at the starting line. The car travels from the starting line to the finish line in a time of 8s. The distance from the starting line to the finish line is 32m.



We can also solve this algebraically using only the symbols...

$$a = \frac{\Delta V}{\Delta t} = \frac{\Delta V}{V_{+}} = \frac{\Delta V}{\Delta t}$$

$$S_{0} \dots V_{x} = 2\left(\frac{\Delta V}{\Delta t}\right) \Rightarrow \Delta V = \frac{2\Delta V}{\Delta t} \Rightarrow \alpha = \frac{2\Delta V}{\Delta t} = 2\Delta \frac{\Delta V}{\Delta t} = \alpha$$

This can be rearranged to give...

The box on the right contains a more complete set of kinematics formulas for constant acceleration (including zero acceleration). If you're curious, some or all of the derivations can be found in the online textbook.

Other ways to write and think about the equations on the right...

$$\nabla = \frac{\Delta x}{\Delta t} \quad \nabla = \frac{\sqrt{2}}{2}$$

$$\nabla = \frac{\Delta x}{\Delta t} \quad \Delta x = \sqrt{2}t$$

$$\nabla = \frac{\sqrt{2}}{2}$$

$$\nabla = \frac{\sqrt{2}}{2}$$

$$\Delta x = \sqrt{2}t$$

$$\nabla = \sqrt{2}t$$

Formulas for zero or Constant Acceleration
$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{\Delta v}{\Delta t}$$

$$\Delta x = v_{x0}t + \frac{1}{2}at^{2}$$

$$\Delta x = \frac{1}{2}(v_{x0} + v_{x})t$$

$$v_{x} = v_{x0} + at$$

$$v_{x}^{2} = v_{x0}^{2} + 2a(x - x_{0})$$

Rightword + Upward = positive directions

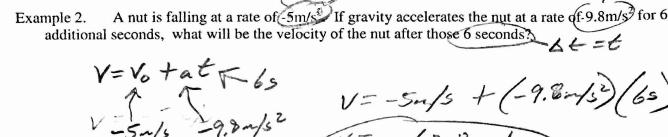
Downward + Leftward = negative directions

Practice With Motion Equations:

The G.U.E.S.S. method...

- Steps: Identify what is Given. Identify the Unknown(s). Find an *Equation that incorporates the givens and the unknown. **Substitute givens into the equation. Solve.
- *Sometimes you will need more than one equation
- **It will sometimes save time and confusion if you solve for the unknown algebraically before substituting givens into the equation.

Example 1. What is the displacement of a car that starts from rest and accelerates at 6m/s² for 7 seconds?



1. A grouse takes off from the 8 yard line of a football field and travels to the 40 yard line over a time of 8 seconds. What is its average velocity?

$$\overline{V} = \frac{\Delta x}{\Delta E} = \frac{(40 \text{yd} - 8 \text{yd})}{85} = \frac{32 \text{yd}}{25} = \frac{4 \text{m/s}}{25}$$

A car accelerates from 30mph to 50mph over a time of 4 seconds. What is the car's average velocity during this time period? (Assume constant acceleration)

You drop a rock off of a very high bridge. Starting from rest the rock accelerates at a rate of -9.8m/s² You see a splash 8 seconds after you release the rock. What is the rock's velocity when it hits the water?

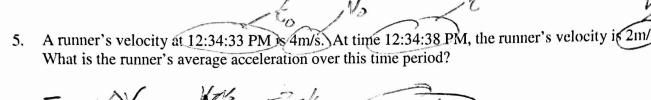
$$V = V_0 + at$$

 $V = On/s + 83(-9.8n/s^2) = (-78.4n/s)$

Starting from rest, a car accelerates at 7m/s² for 10 seconds What is the car's displacement during this time?

$$\Delta x = \sqrt{6}t + 1/2at^2$$

$$= 0t + 1/2(7m/s^2)(105)^2 = 350m$$



$$0^{2} = (15\pi/s)^{2} + 2a(40m)$$

$$0 = 225 \frac{m^2}{3^2} + 80n(a)$$

$$-225 \frac{m^2}{3^2} = 80n(a)$$

$$a = -\frac{225 \frac{m^2}{3^2}}{900n} = -2.81 \frac{m^2}{5}$$

$$V = V_0 + at$$

$$Om/s = *15m/s + (-2.81m/s^2)t$$

$$-15m/s = -2.81m/s^2(t)$$

$$-178\frac{m^2}{5^2} - 2a(20m)$$

$$V^2 = V_0^2 + 2a\Delta \times$$

 $(0n/s)^2 = (3.33n/s)^2 + 2a(20n)$
 $0 = 178 = +2a(20n)$