Name Key Hour _____

1-Dimensional Motion

(Objects that are moving in the x direction or y direction only!

Variables:

1. **Time (Δt):** How long an object does something (sec)
2. **Distance (Δx or Δy):** How far an object travels (m)
3. **Velocity:** How fast an object travels in a given direction (m/sec)
   a. v_i= Initial velocity
   b. v_f= Final velocity
4. **Acceleration (a):** How the speed of an object changes over time (m/sec^2)

Acceleration- For most of our problems, you will need to know the acceleration...

1. Object falling towards the Earth's surface $a = -9.8 m/s^2$

That means that as an object falls towards the Earth, its speed is:

increasing by 9.8m/s every sec

Time (s)	Speed (m/s)
0	0
1	9.8
2	19.6
3	29.4

2. If the object is not falling, (like a car) we need to calculate the acceleration using an equation.

THE EQUATIONS:

** $v = \frac{\Delta x}{\Delta t}$

$\Delta y = v_i \Delta t + 1/2 a \Delta t^2$

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

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

How do I know which equation to use?

Is the velocity constant? If yes- use #1 **(NOT VERY OFTEN)**

If not, use any of the other 3 that you have enough information to solve.

TIPS FOR SOLVING PROBLEMS:

1. Anything moving downward is negative (Δy, a)
2. Often you know some of the velocities right away
   If an object starts at rest, V_i = 0
   If an object stops, V_f = 0
   If you throw an object up, what is its speed at the top? 0
3. If an object is dropped, we know 2 things:
   V_i = 0 a = $-9.8 m/s^2$
4. Time up = Time down (If thrown and caught at same height)
   (If you throw an object up and it takes 6 sec to land back in your hand, how long did it take to go up? 3sec

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① read through #1-2
② complete #3,4

Motion in One Dimension Example Problems

Problem 1: Tommy drops a bottle from a height of **1.4 meters. How many seconds** will it take to reach the ground?

Given: $\Delta y = -1.4m$, $v_i = 0$, $a = -9.8 m/s^2$

Unknown: Δt

Equation: $\Delta y = \cancel{v_i \Delta t}^{0} + \frac{1}{2} a \Delta t^2$

$-1.4 = 0 + \frac{1}{2}(-9.8)\Delta t^2$

$-1.4 = -4.9 \Delta t^2$

$.286 = \Delta t^2$

$\boxed{\Delta t = 0.53 sec}$

Problem 2: Pikachu is battling Chimcharm. If Pikachu accelerates from **rest** at a rate of **1.5 m/s²** for 25.0 meters,

a. Find his **final velocity**.

G- $a = 1.5 m/s^2$, $\Delta x = 25 m$, $v_i = 0$

u- v_f

e- $v_f^2 = v_i^2 + 2a\Delta y$

$v_f^2 = 0 + 2(1.5)(25)$

$v_f^2 = 75$

$\boxed{v_f = 8.7 m/s}$

b. How many **seconds** will it take him?

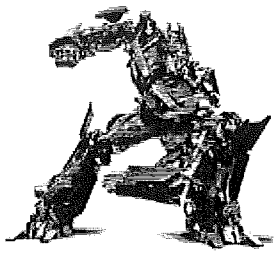
u: Δt

e: $a = \frac{v_f - v_i}{\Delta t}$

$1.5 = \frac{8.7 - 0}{\Delta t}$ $\quad 1.5 = \frac{8.7}{\Delta t}$ $\quad \Delta t = \frac{8.7}{1.5}$ $\quad \boxed{5.8 sec}$

Problem 3: Megatron is trying to catch up to Optimus Prime. He is traveling at a **velocity of 16 m/s** when he suddenly slams to a **stop.** If it takes him **7.88 sec** to stop, calculate his **deceleration.** (Deceleration is just a negative acceleration) $(a = -2.03 m/s^2)$

G: $v_i = 16 m/s$, $v_f = 0$, $\Delta t = 7.88 sec$



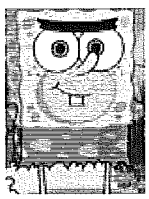
u: a

e: $a = \frac{v_f - v_i}{\Delta t}$

Problem 4: Spongebob drops a rock off a cliff. If it takes **3.5 seconds** for the rock to hit the ground, calculate:

a. The **velocity** at which the rock is traveling just before it hits the ground in **m/s** and in **miles per hour.** $-34.3 m/s$; $76.7 mph$

G: $v_i = 0$, $a = -9.8 m/s^2$, $\Delta t = 3.5 sec$



u: v_f

e: $a = \frac{v_f - v_i}{\Delta t}$

b. The **height** of the cliff. $(\Delta y = -60m)$

u: Δy

e: $\Delta y = \cancel{v_i \Delta t}^{0} + \frac{1}{2} a \Delta t^2$

_____ m/s

_____ mph