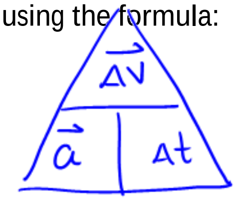
Calculating Acceleration **Ch9 Physics**
Science 10 Notes

What is Acceleration $\vec{a}$

- Acceleration measures the <u>change</u> in velocity
- Acceleration can calculated using the formula:

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$



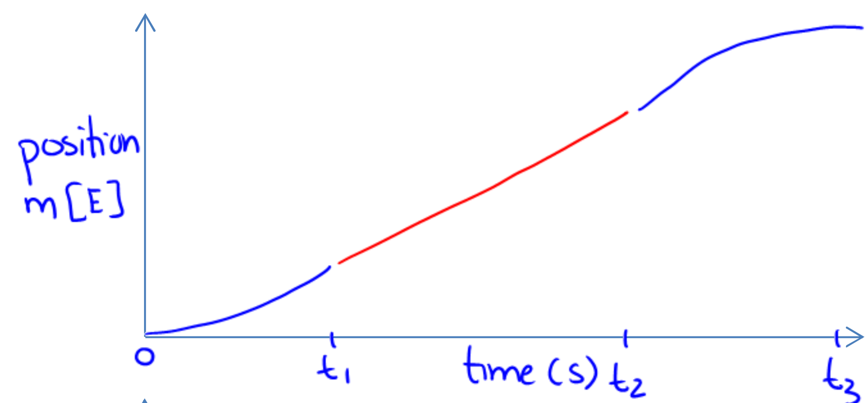
- Note: Increasing the time makes the acceleration <u>lower</u>
- Decreasing the time <u>increases.</u> the acceleration

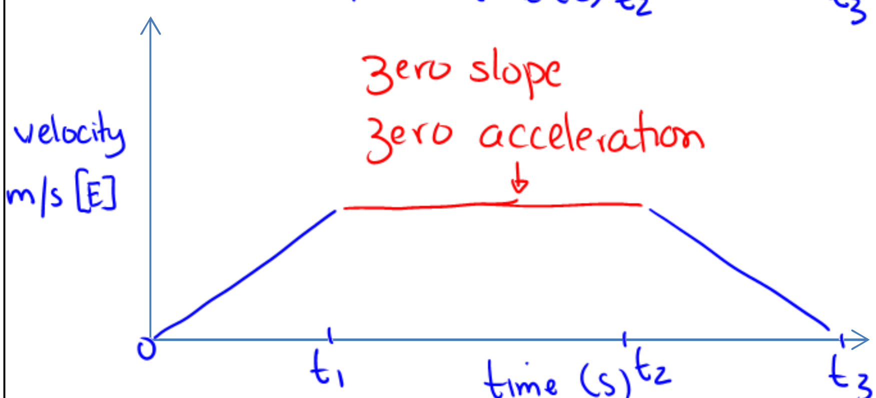
airbags work to increase the amount of time to change velocity.

airbag increases your Δt which reduces your acceleration, because it makes denominator in $\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$ larger

Relating Distance-Time and Velocity-Time Graphs

- Acceleration can be calculated as the <u>slope</u> of a <u>velocity - time</u> graph
- Acceleration is measured as <u>m/s²</u>.





interval

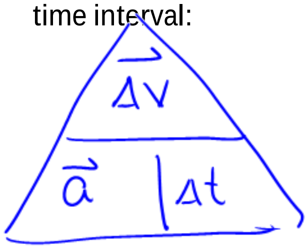
$0 - t_1$: positive acceleration
position-time graph
- curve upwards
velocity-time graph
- positive slope.

$t_1 - t_2$: no acceleration
uniform motion.

$t_2 - t_3$: negative acceleration
- negative slope on a velocity time graph.

Calculating Acceleration

- Remember the relationship between acceleration, velocity and time interval:



$$\vec{\Delta v} = \vec{v}_f - \vec{v}_i$$

Example 1:
A car accelerates from rest. It reaches a velocity of 8m/s [N] in 4 seconds. What is its acceleration?

at rest means 0 m/s

$\vec{v}_i = 0\ m/s$

$\vec{v}_f = +8\ m/s$

$\vec{\Delta v} = +8\ m/s - 0\ m/s$

$\vec{\Delta v} = +8\ m/s$

$\vec{a} = \frac{\vec{\Delta v}}{\Delta t}$

$\vec{a} = \frac{+8\ m/s}{4\ s} = +2\ m/s^2$

Example 2:
A motorcycle goes from 5m/s [E] to 2m/s [E] in 8 seconds. What is its acceleration?

$\vec{v}_i = +5\ m/s$

$\vec{v}_f = +2\ m/s$

$\vec{\Delta v} = (+2) - (+5)$

$\vec{\Delta v} = -3\ m/s$

$\vec{a} = \frac{-3\ m/s}{8\ s}$

$\vec{a} = -.375\ m/s^2$ or $.375\ m/s^2$ [W]

Example 3:
Frank is in a car accident, and his airbags help slow his velocity from +22m/s to 0m/s in 0.5 seconds. What is his acceleration?

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

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

$\vec{\Delta v} = 0\ m/s - 22\ m/s$

$\vec{\Delta v} = -22\ m/s$

$\vec{a} = \frac{-22\ m/s}{0.5}$

$\vec{a} = -44\ m/s^2$

Example 4:
Frank was in a car accident because he was driving recklessly. His car can accelerate at 8m/s^2. If he was driving at a constant speed of +15m/s, how long did it take him to accelerate to +22m/s?

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

$\vec{\Delta v} = (+22) - (+15)$

$= +7\ m/s$

$\Delta t = \frac{\vec{\Delta v}}{\vec{a}}$

$\Delta t = \frac{+7\ m/s}{+8\ m/s^2} = 0.875\ s$

Example 5:
I'm on a boat, and traveling east at 6m/s. The boat accelerates at 0.5m/s^2 [W] for 5 seconds. What is the boat's final velocity?

$\vec{a} = -.5\ m/s^2$

$\Delta t = 5\ s$

$\vec{\Delta v} = ?$

$\vec{\Delta v} = \vec{a} \times \Delta t$

$= -.5\ m/s^2 \times 5\ s$

$\vec{\Delta v} = -2.5\ m/s$

$\vec{\Delta v} = \vec{v}_f - \vec{v}_i$

$-2.5\ m/s = \vec{v}_f - 6\ m/s$

$\vec{v}_f = +3.5\ m/s$