Acceleration

Acceleration is the rate of change of velocity.

Either speed and/or direction of motion can change.

For 1D motion:

- object is slowing down
- OR speeding up
- OR changing direction between forward and backward
  OR North to East (2 Dimensions)

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v_2} - \vec{v_1}}{\Delta t}$$

Units: $\frac{m/s}{s} = \frac{m}{s^2}$

ACCELERATION PROBLEM:

What is the average acceleration of a train which changes its velocity from 95 km/h north to 22 km/h north in a time of 15 minutes?

Ans:

Let N = +

V1=95 km/h [N]

V2=22 km/h [N]

Δt=15 min=0.25 h

$$a = \frac{(v_2 - v_1)}{\Delta t}$$

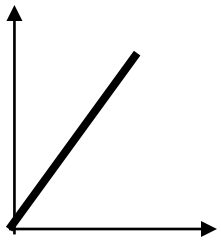
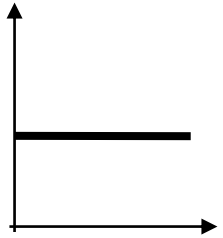
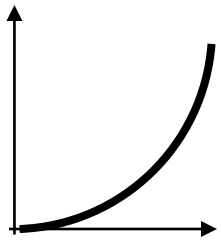
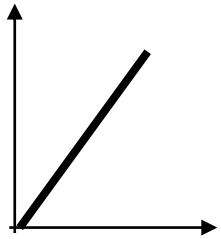
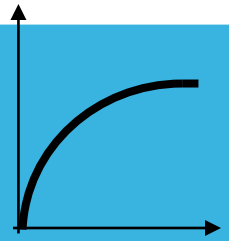
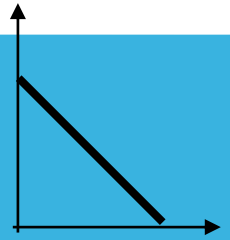
$$a = \frac{(22-95)\ km/h}{0.25\ h}$$

$$a = -292\ km/h^2\ [N]$$

$\vec{a}$=2.9 x 10 ^{2} km/h^2 [S])

MOTION GRAPH COMPARISON

Imagine a car that is dripping oil at a constant rate moving in three different scenarios:

	Position-Time Graph	Velocity-Time Graph
Constant velocity		
Speeding up uniformly		
Slowing down uniformly		

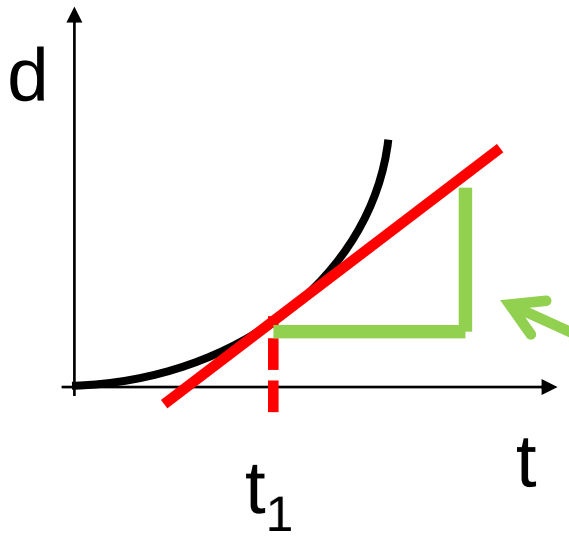
ACCELERATION IS A VECTOR!

In 1D, use signs to account for direction.

Direction of Initial Velocity	Direction of Initial Acceleration	Change in Speed
East (+)	East (+)	+ (Speeds up)
East (+)	West (-)	- (Slows down)
West (-)	East (+)	- (Slows down)
West (-)	West (-)	+ (Speeds up)

If the acceleration is in the same direction as the initial velocity the object speeds up!!!

ANALYZING D-T GRAPHS FOR UNIFORM ACCELERATION



To find velocity from a position-time graph we take the _____slope_____.

The slope of this tangent gives us the velocity at time t_1!

When we have a curved d-t graph the velocity changes!

To find the instantaneous velocity at any moment we draw a tangent to the curve and take the slope of the tangent!