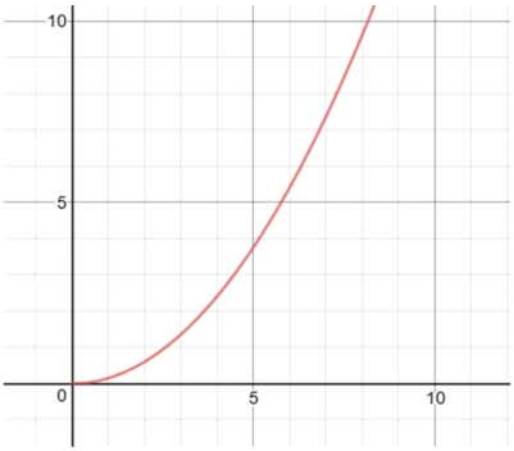
Example 6: Consider the following displacement vs time graph. Determine the instantaneous velocity at exactly 5 seconds.



D. Non-Uniform Velocity - Graphing d vs t and v vs t

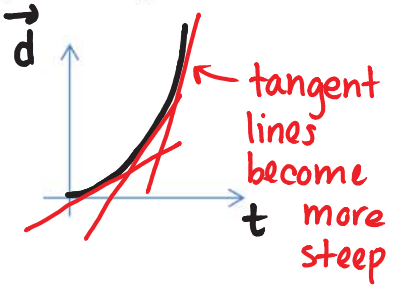
Remember that acceleration is the rate of change of velocity.

The slope of a velocity vs time graph gives us acceleration.

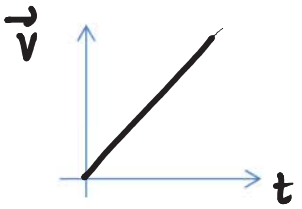
$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$

Objects which are **accelerating** (increasing their velocity/speeding up) will have curved graphs that get steeper on a d vs t graph.

Object moving **forward – Accelerating**

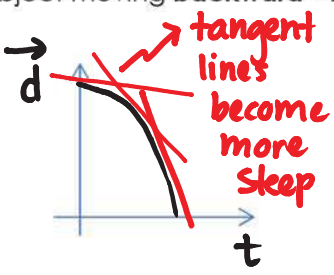


- moving in a positive $\vec{d}$ direction (moving forward)
- tangent lines represent instant. velocities and they are positively sloped.
  - → $\vec{v}$ is also positive and it is increasing.

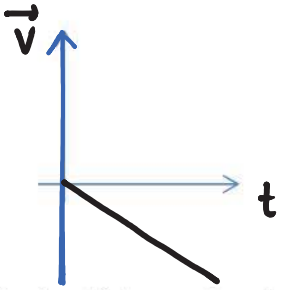


- velocities increase so the object is accelerating
- acceleration is positive (because the slope is positive)

Object moving **backward** – **Accelerating**



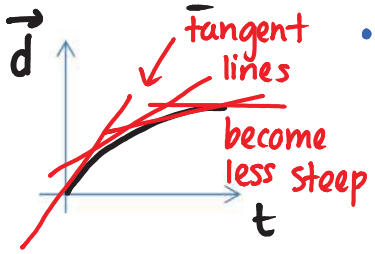
- moving in a negative $\vec{d}$ direction (object is moving backward)
- tangent lines are negatively sloped ($\vec{v}$ is negative and it continues to increase in magnitude)



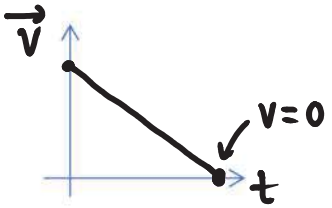
- velocity's magnitude is increasing (but it's negative) because object is accelerating
- acceleration is negative (because slope is negative)

Objects which are **decelerating** (decreasing their velocity/slowing down) will have curved graphs that become less steep on a d vs t graph.

Object moving **forward** – **Decelerating**

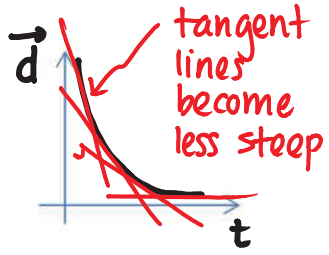


- object moving in positive $\vec{d}$ direction (object moving forward)
  - tangent lines are positively sloped ($\vec{v}$ is positive and large initially but gradually goes to zero).

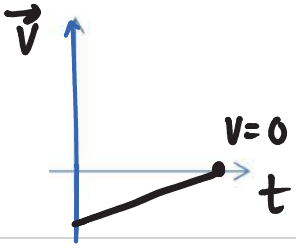


- velocity magnitude is decreasing until it reaches zero.
- accel. is negative (deceleration)

Object moving **backward** – **Decelerating**



- object moving in negative $\vec{d}$ direction (moving backward)
- tangent lines are negatively sloped ($\vec{v}$ is negative and gradually goes to zero)



- velocity's magnitude is decreasing until it reaches zero (stopped).
- acceleration is a positive.