PHYS2350: Acceleration in 1D

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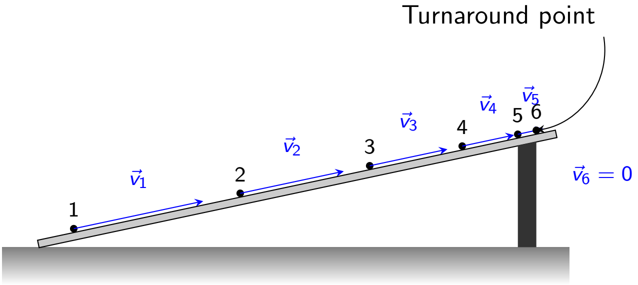
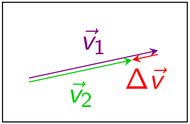
Fall 2024

Summary: Motion with decreasing speed

Making a velocity diagram:



- All velocity vectors point *up the ramp*
- All change in velocity vectors $\Delta\vec{v} = \vec{v}_f - \vec{v}_i$ point *down the ramp*



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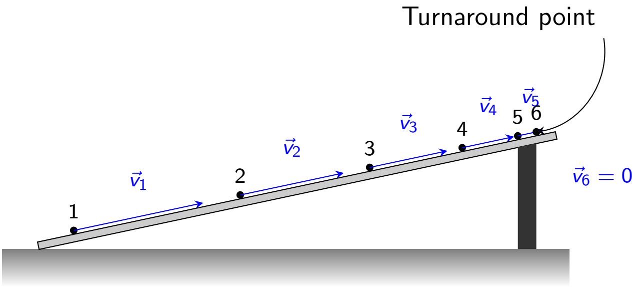
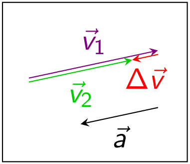
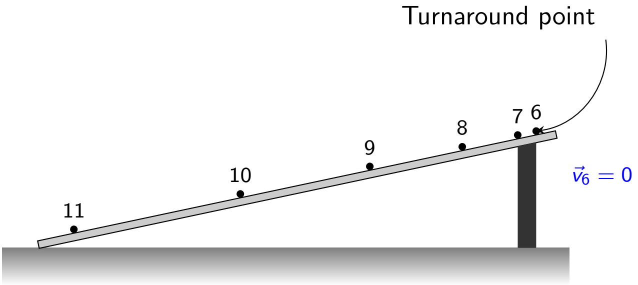


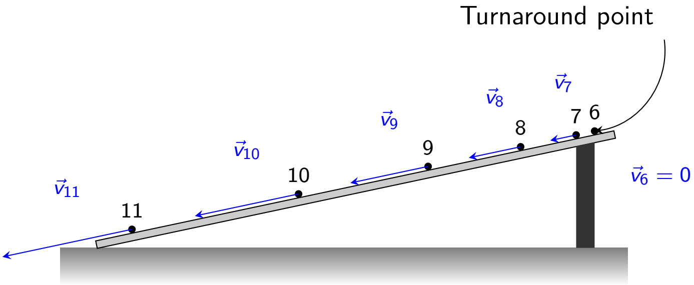
- Acceleration vector is *constant* in magnitude and direction
- Acceleration is $\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$ and points *down the ramp*



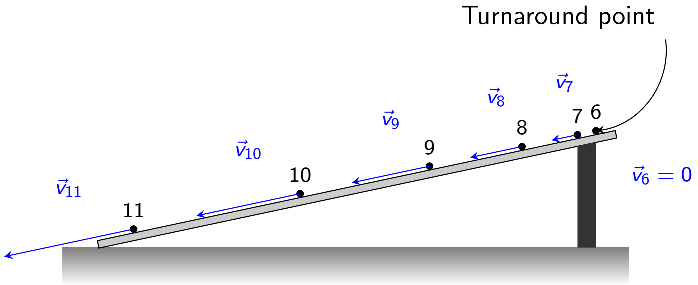
Motion with increasing speed



Motion with increasing speed



Motion with increasing speed



Summary:

- $\Delta\vec{v}$ is always in the same direction as $\vec{v}$
- $\vec{a}$ is always in the same direction as $\vec{v}$
- $\Delta\vec{v}$ and $\vec{a}$ are always pointing *down the ramp*.

Motion that includes a change in direction

Consider the velocity at instants 5 and 7:

Find the *change in velocity* vector, Δv for this scenario

Motion that includes a change in direction

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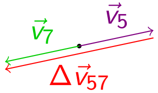

Find the *change in velocity* vector, Δv for this scenario

Motion that includes a change in direction

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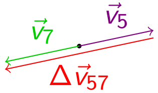


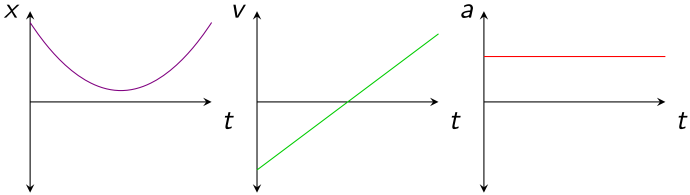
Find the *change in velocity* vector, Δv for this scenario

Direction of $\Delta\vec{v}$ and $\vec{a}$

- $\Delta\vec{v}$ and $\vec{a}$ are always pointing *in the same direction*.
- $\Delta\vec{v}$ and $\vec{a}$ are always pointing *down the ramp*.

Make a graph

For the motion of the ball on the ramp, make graphs of x vs. t, v vs. t, and a vs. t. Choose the +x direction to be *down the ramp*



Kinematic equations in 1D

Also called the "Constant acceleration equations".

$$x(t) = x_i + v_i t + \frac{1}{2}at^2 \tag{1}$$

$$v(t) = v_i + at \tag{2}$$

$$v_f^2 - v_i^2 = 2a(x_f - x_i) \tag{3}$$

Equation (3) is obtained by solving (2) for t and plugging into (1), then simplifying. It assumes $x(t) = x_f$ and $v(t) = v_f$.