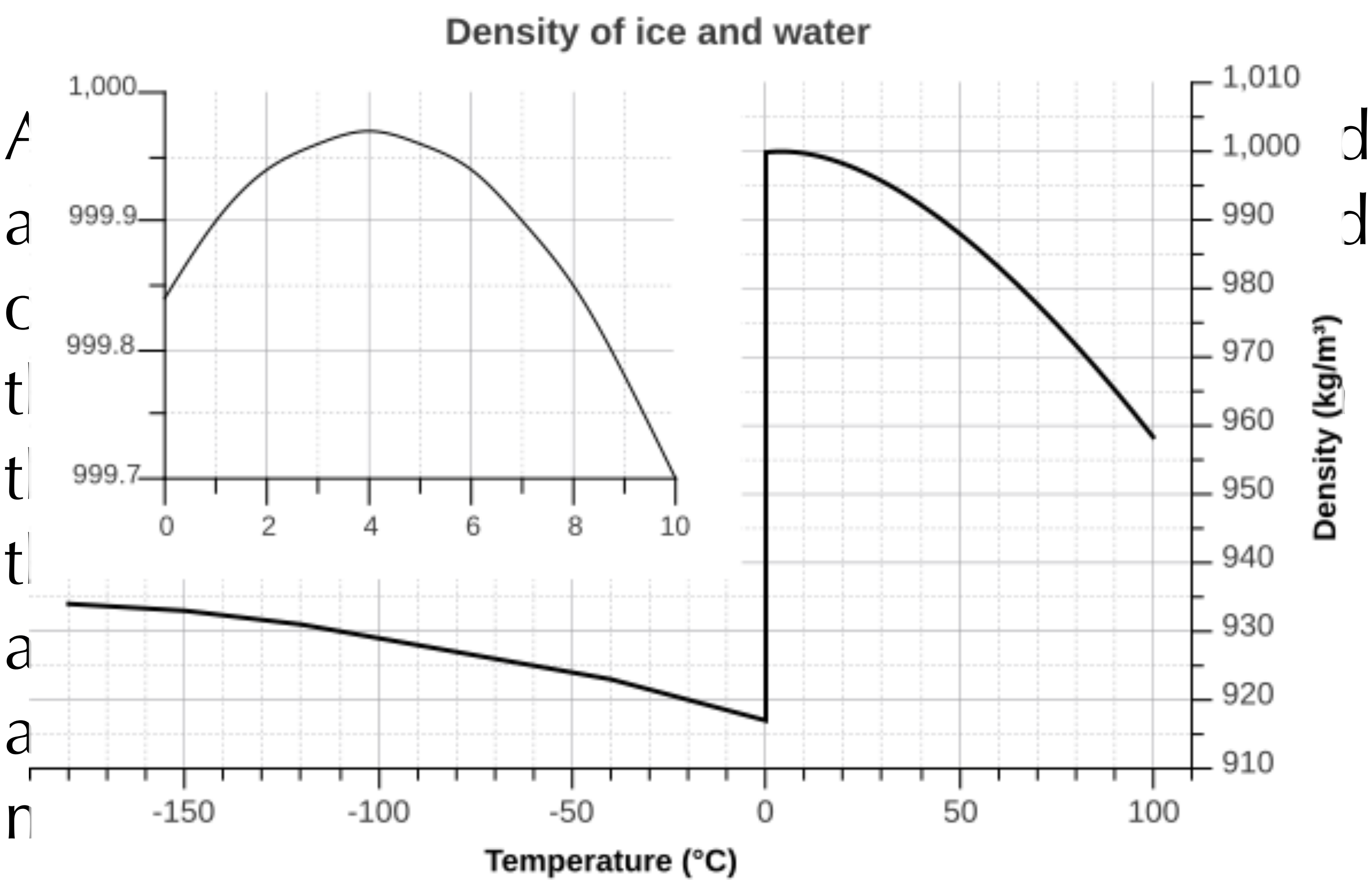
All things denote there is a God

And behold, all things have their likeness, and all things are created and made to bear record of me, both things which are temporal, and things which are spiritual; things which are in the heavens above, and things which are on the earth, and things which are in the earth, and things which are under the earth, both above and beneath: all things bear record of me.

Moses 6:63

All things denote there is a God



Moses 6:63

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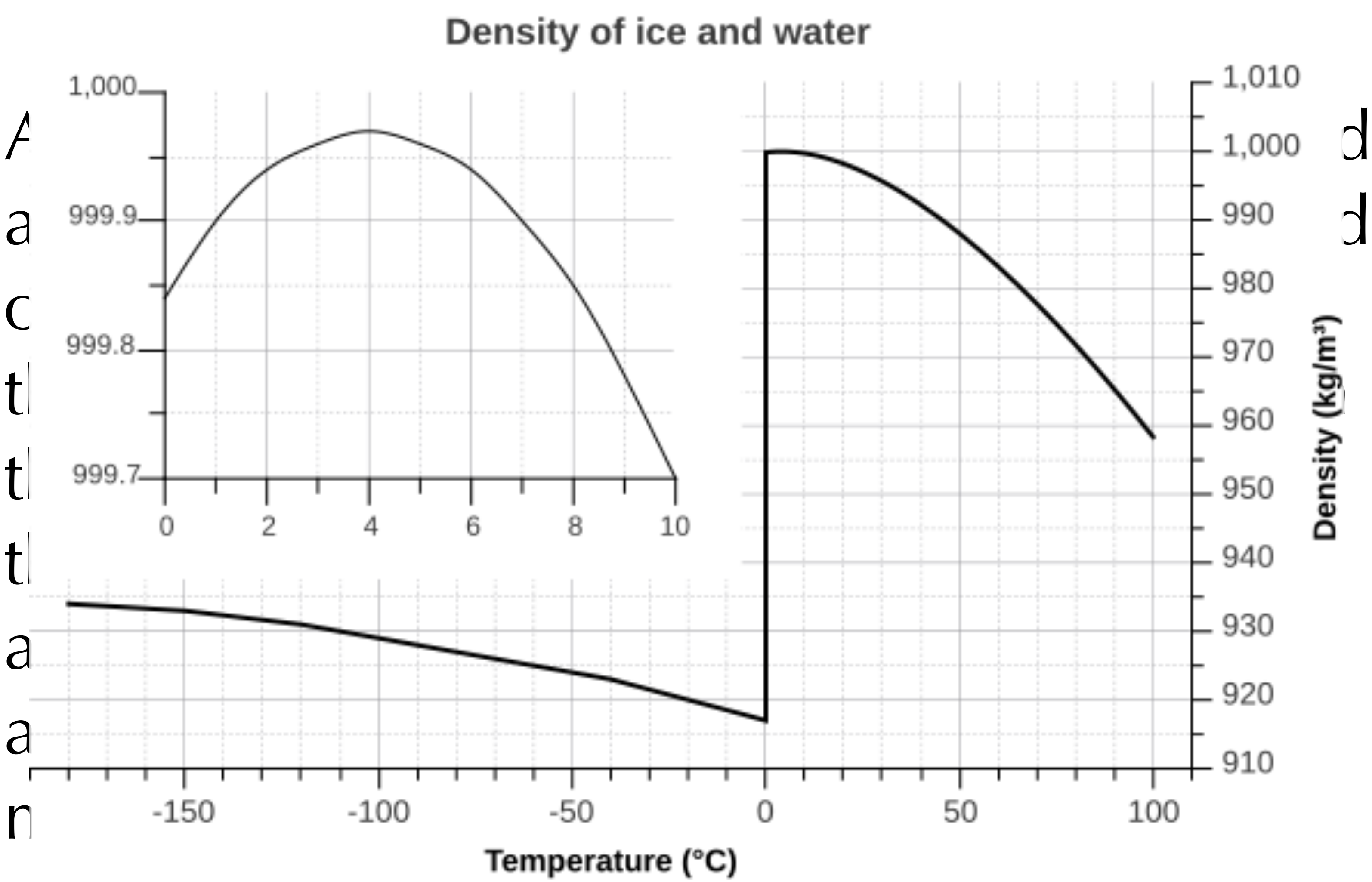

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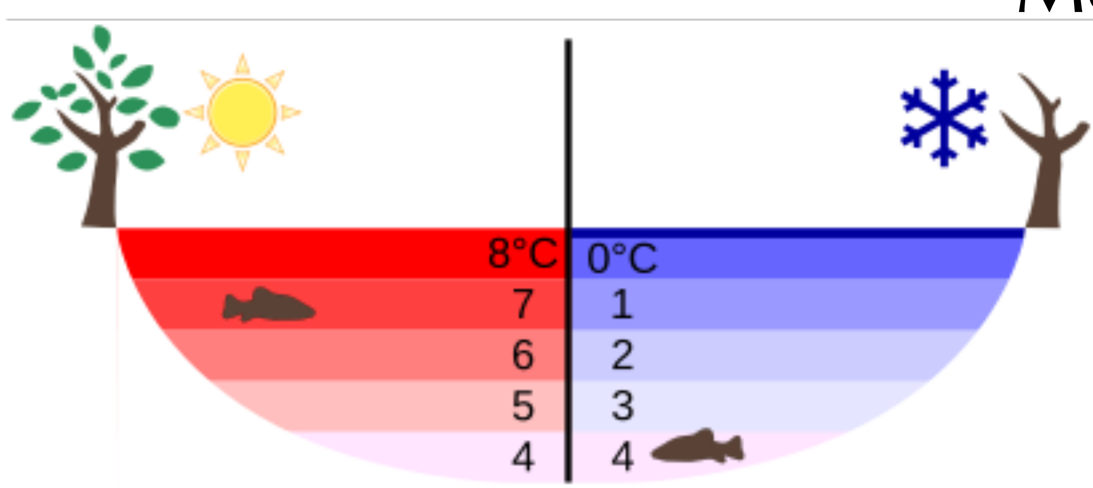
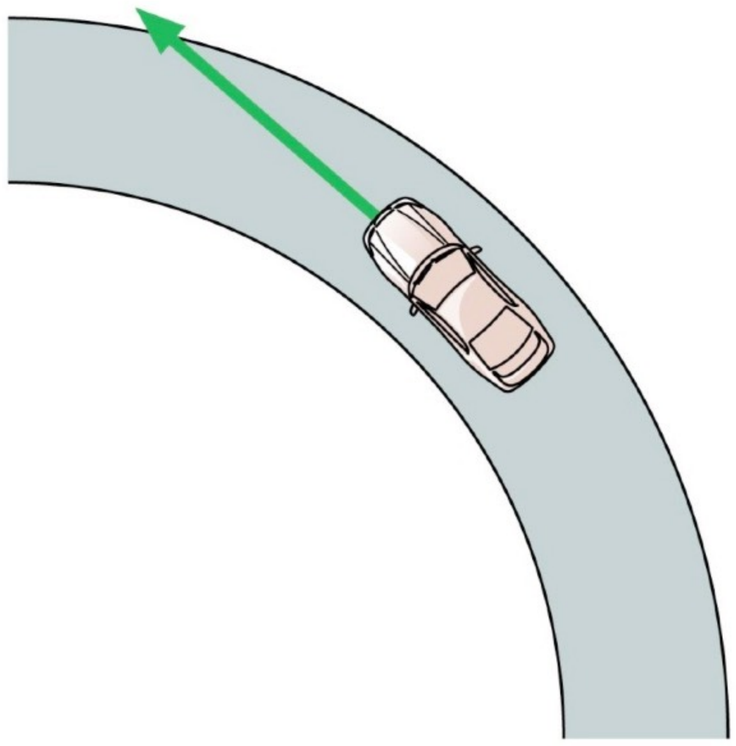


Quiz

A car is traveling around a curve at a steady 45 mph. Is the car accelerating?



a) Yes

b) No

Quiz

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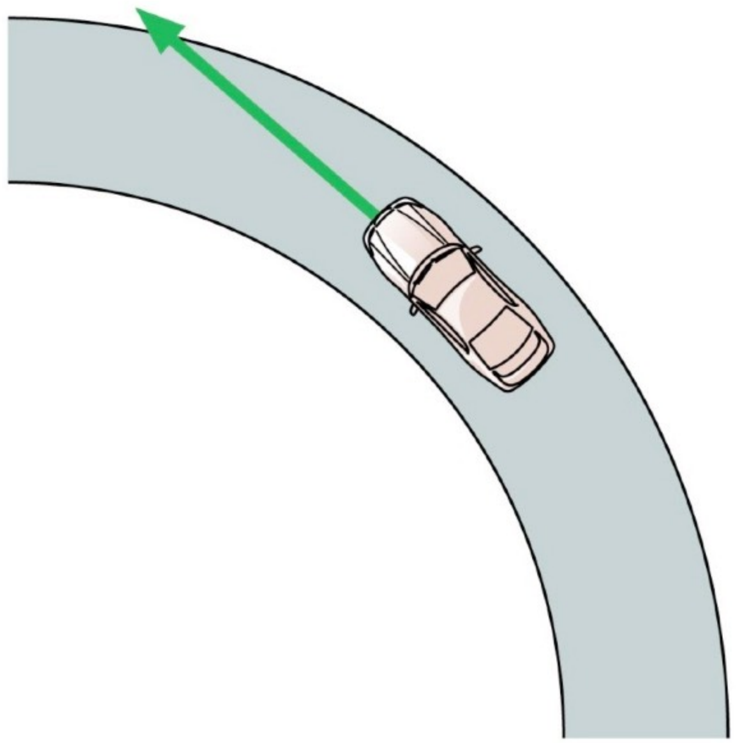
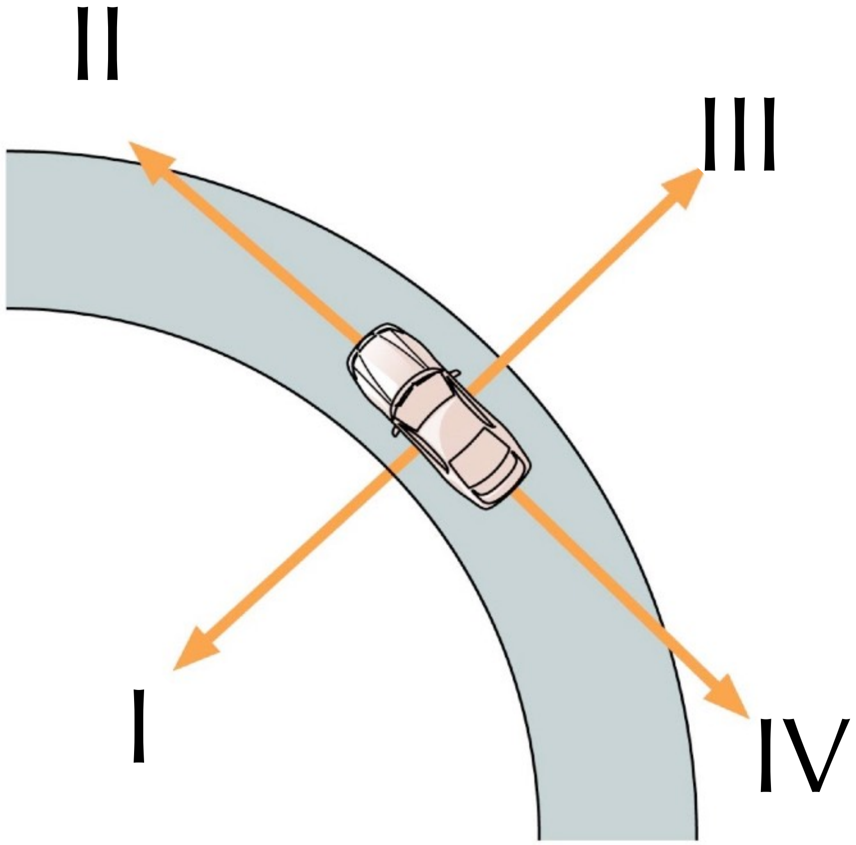


a) Yes

b) No

Quiz

A car is traveling around a curve at a steady 45 mph. Which vector shows the direction of the car's acceleration?



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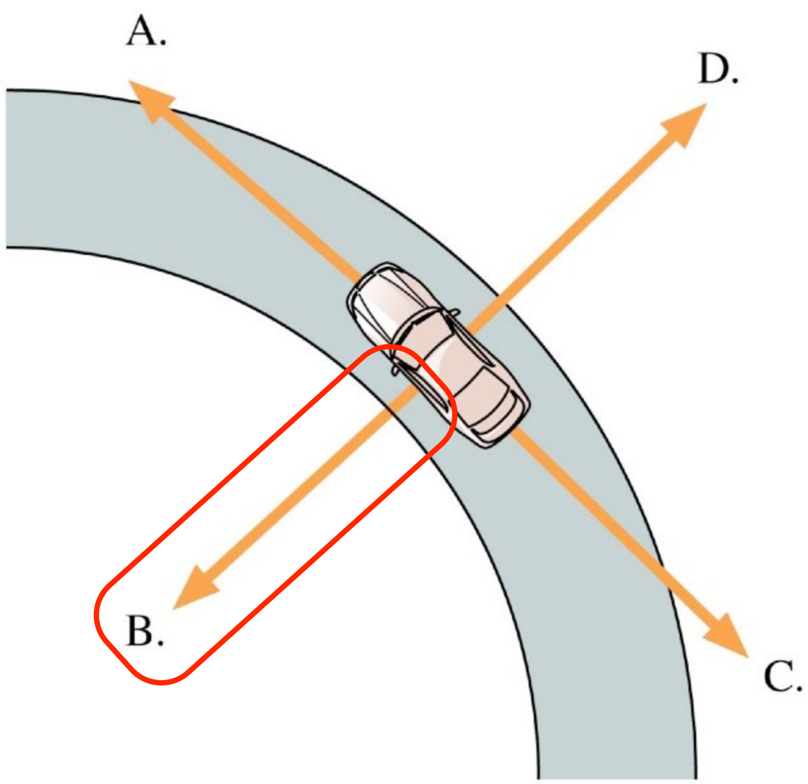


Acceleration

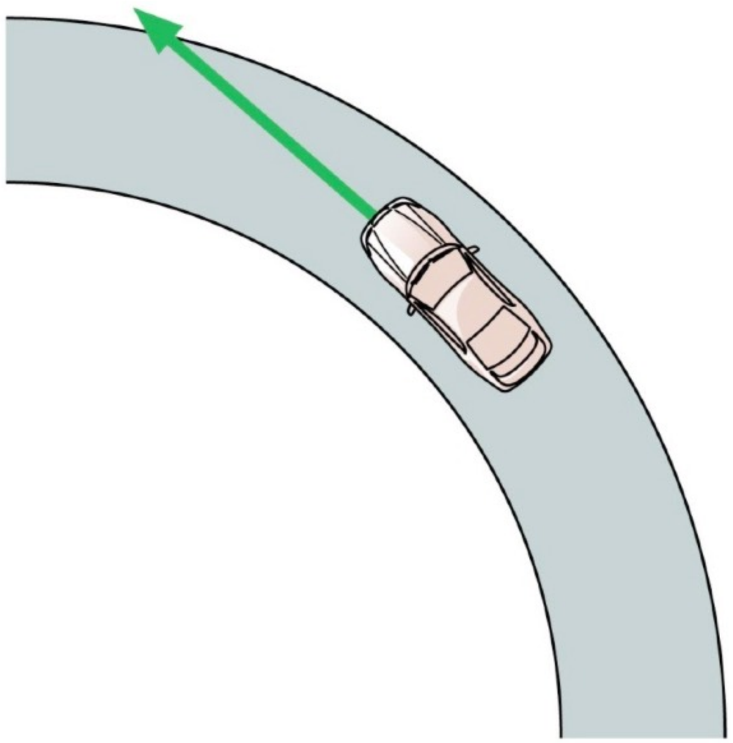
$$\vec{a}_{\text{avg}} = \frac{\Delta \vec{v}}{\Delta t}$$

An object's velocity vector can change in two ways:

- The magnitude of the velocity can change, indicating a change in speed, or
- The direction of the velocity can change, indicating that the direction of motion has changed

Reminder: Finding the Acceleration Vector

$$\vec{a}_{\text{avg}} = \frac{\Delta \vec{v}}{\Delta t}$$



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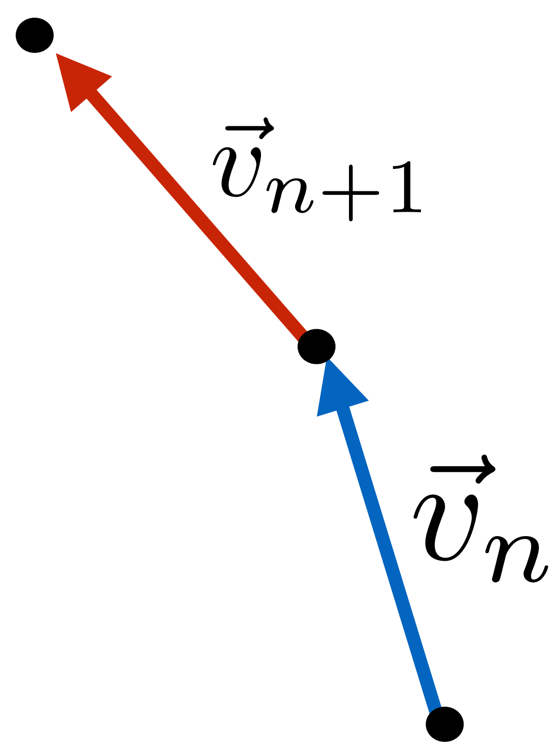

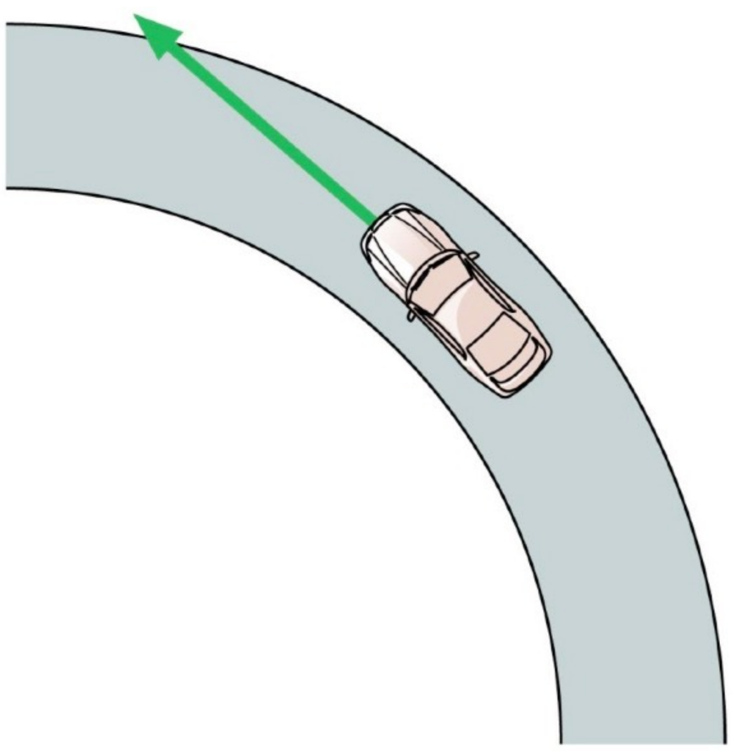

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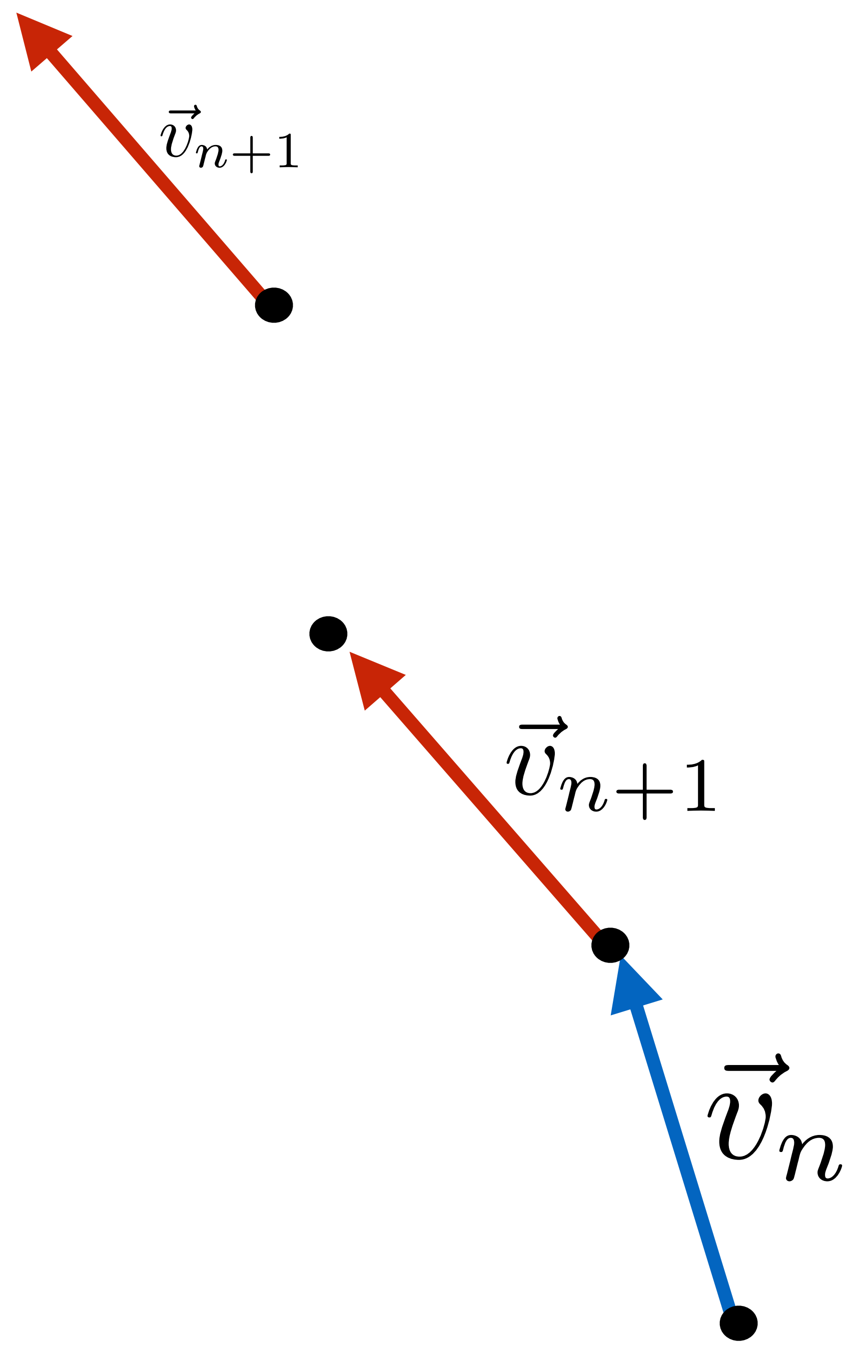

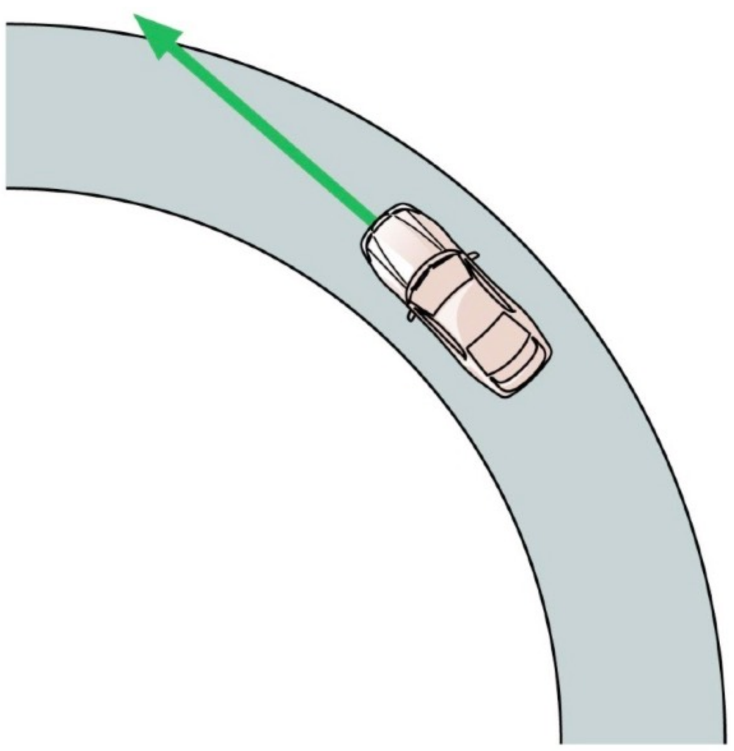

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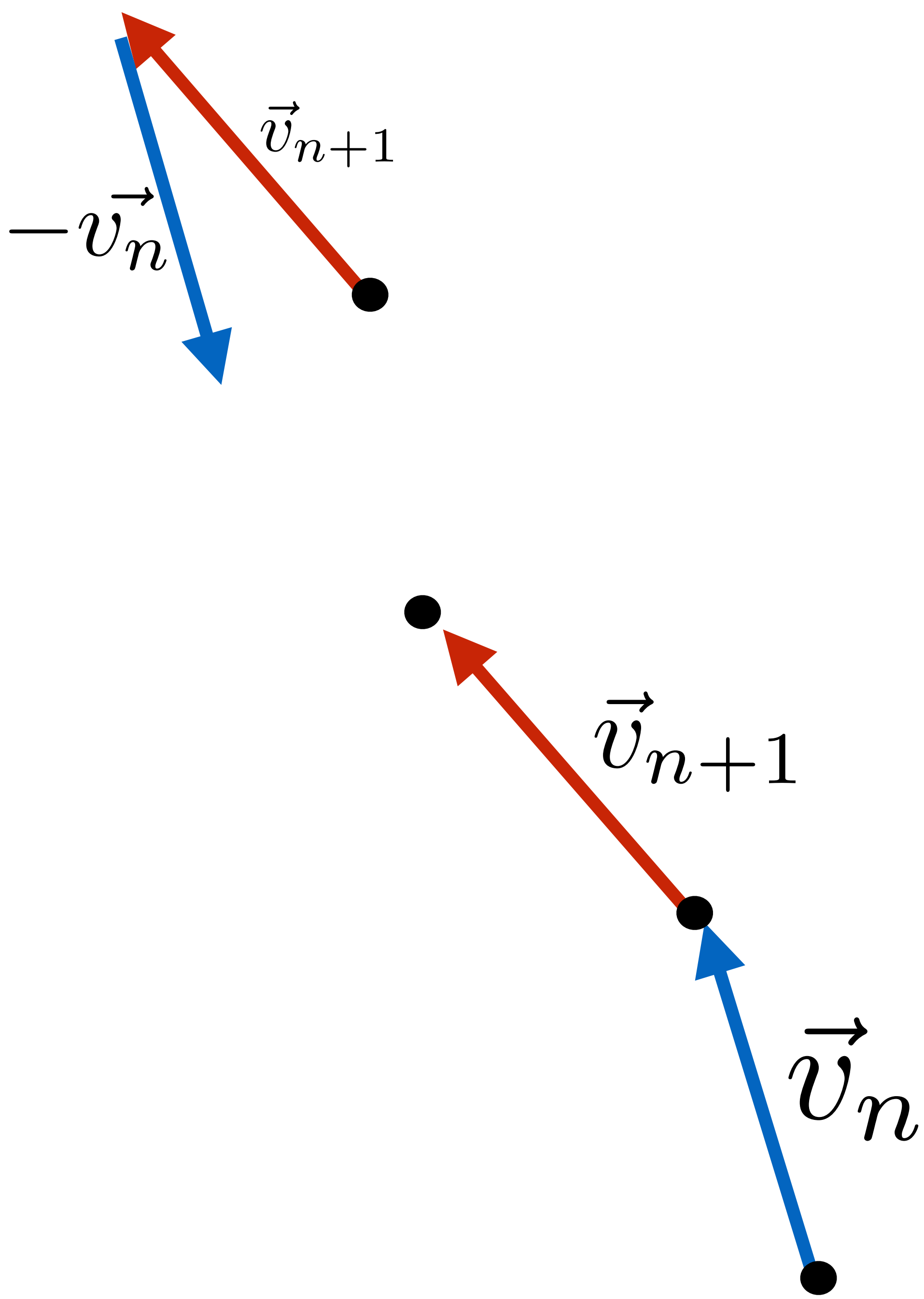

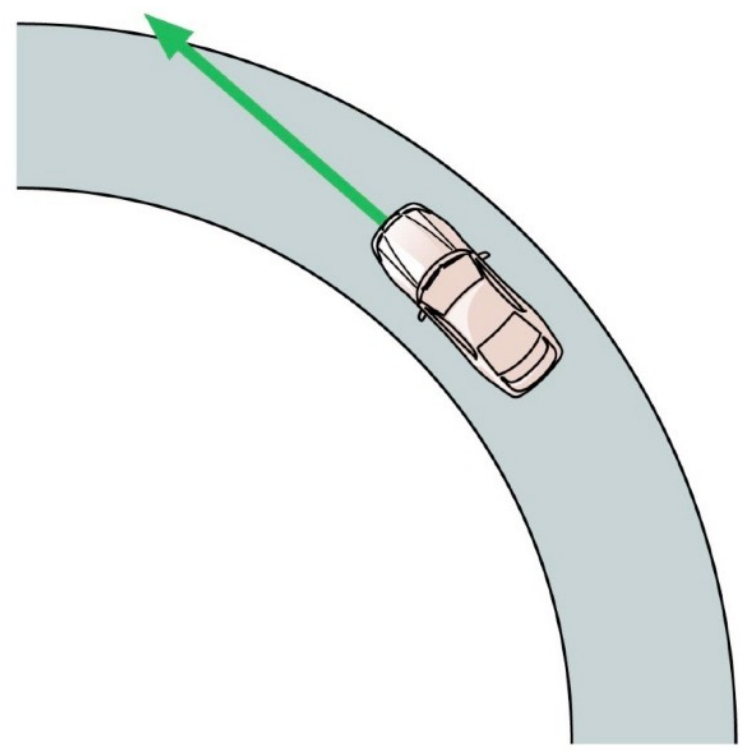

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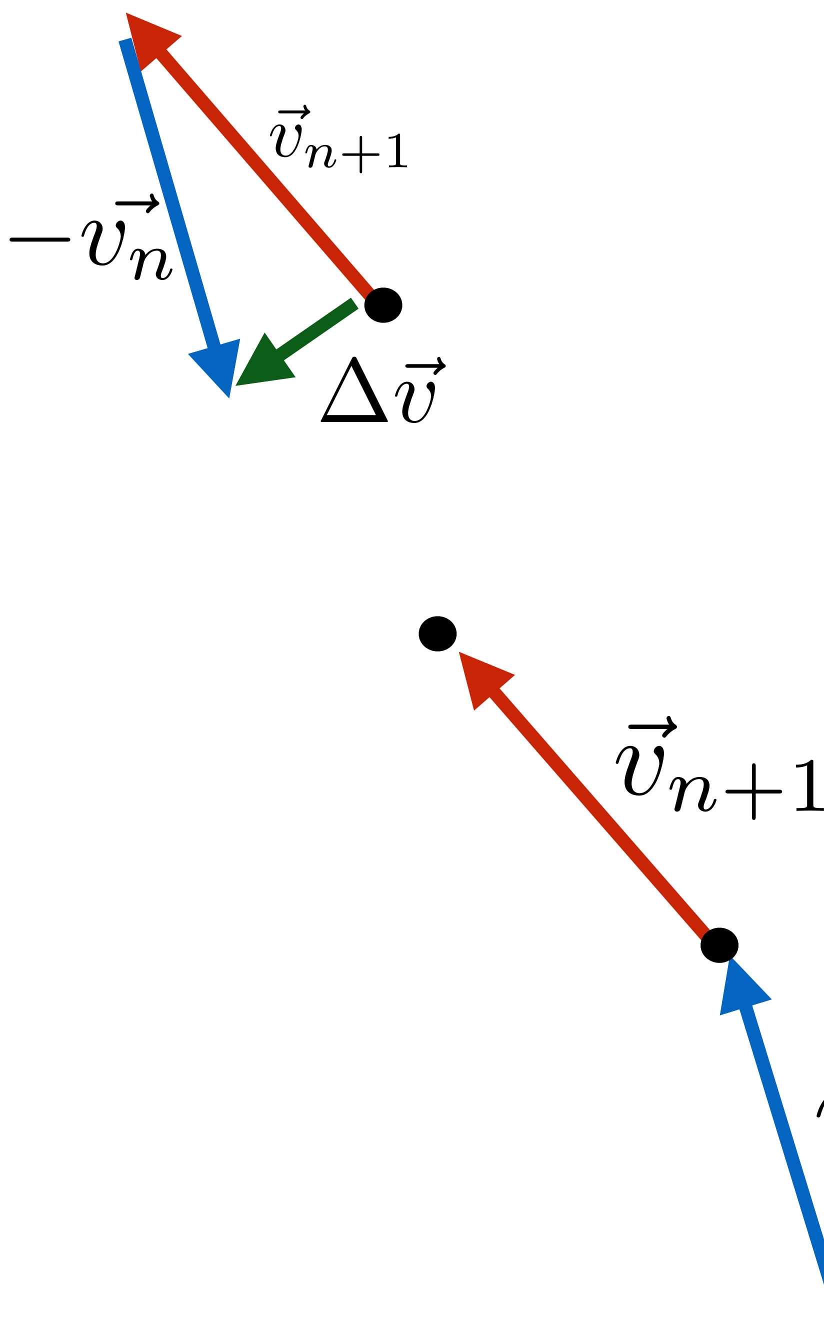

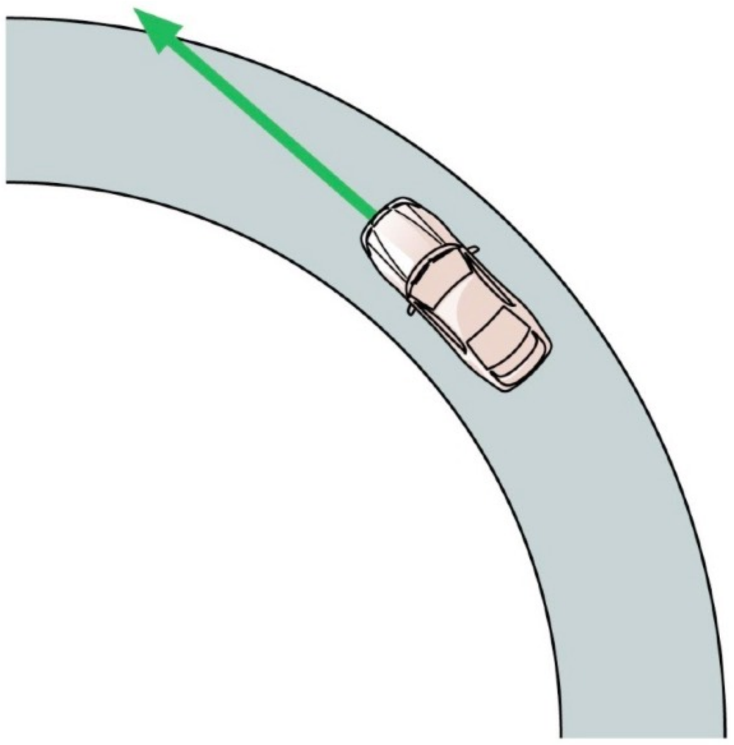

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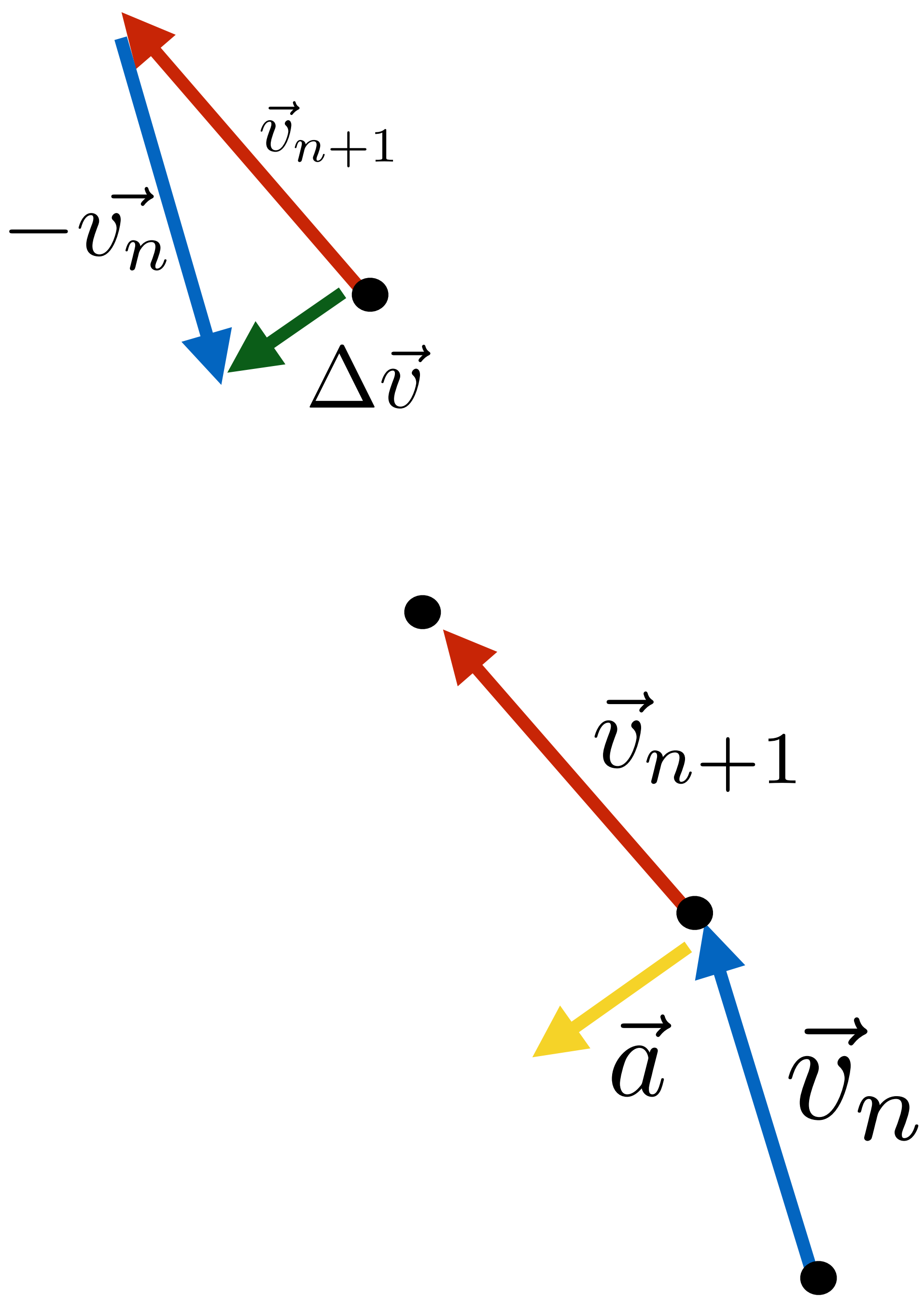

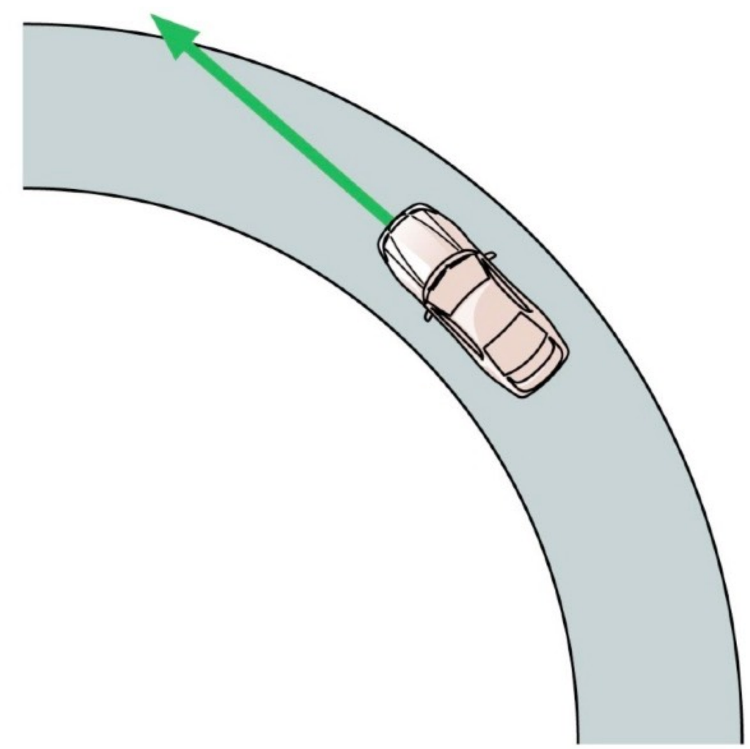

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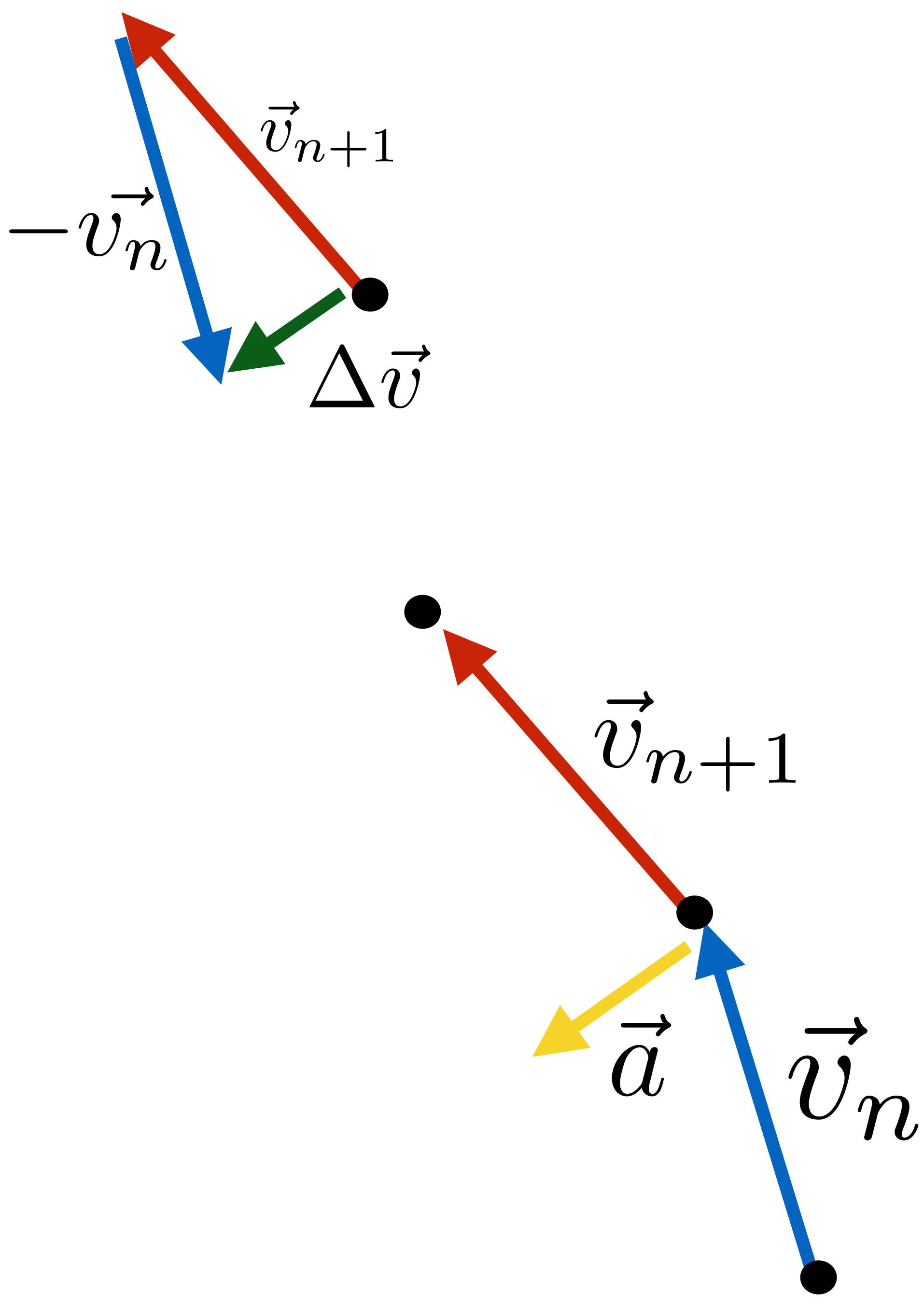
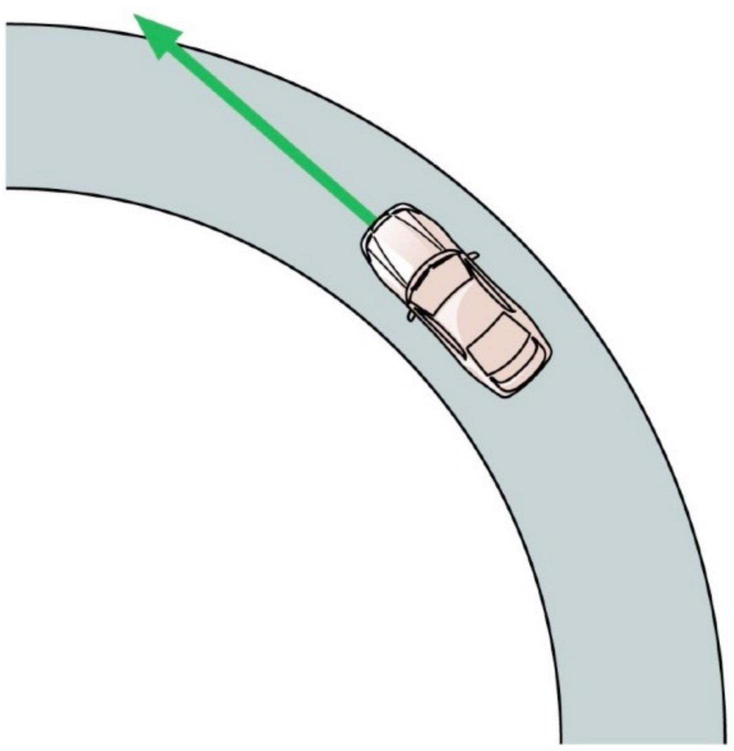
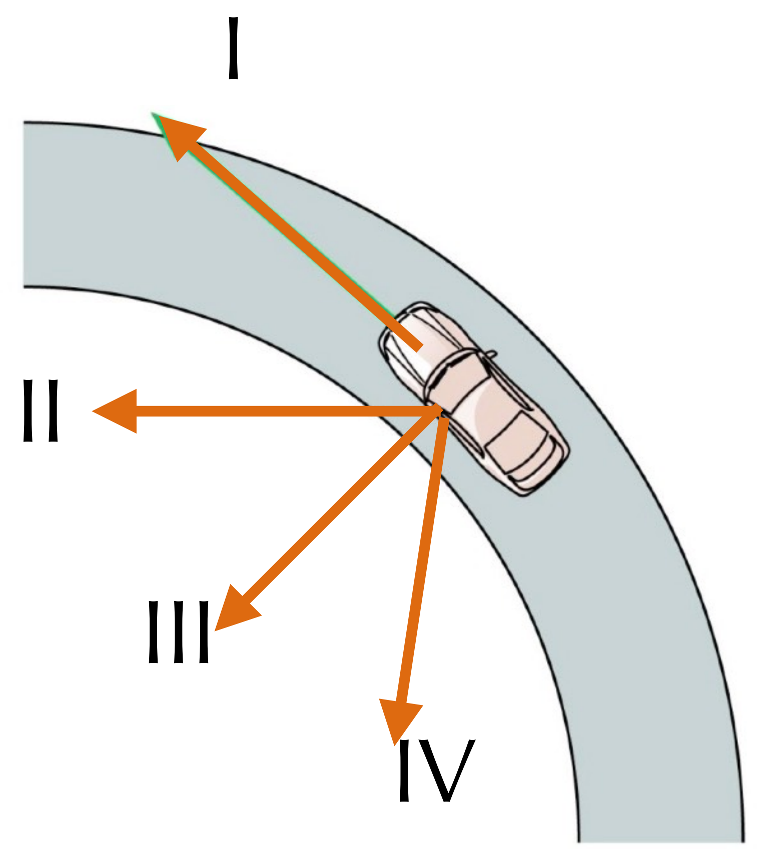




Quiz

A car is traveling around a curve and speeding up. Which vector shows the direction of the car's acceleration?



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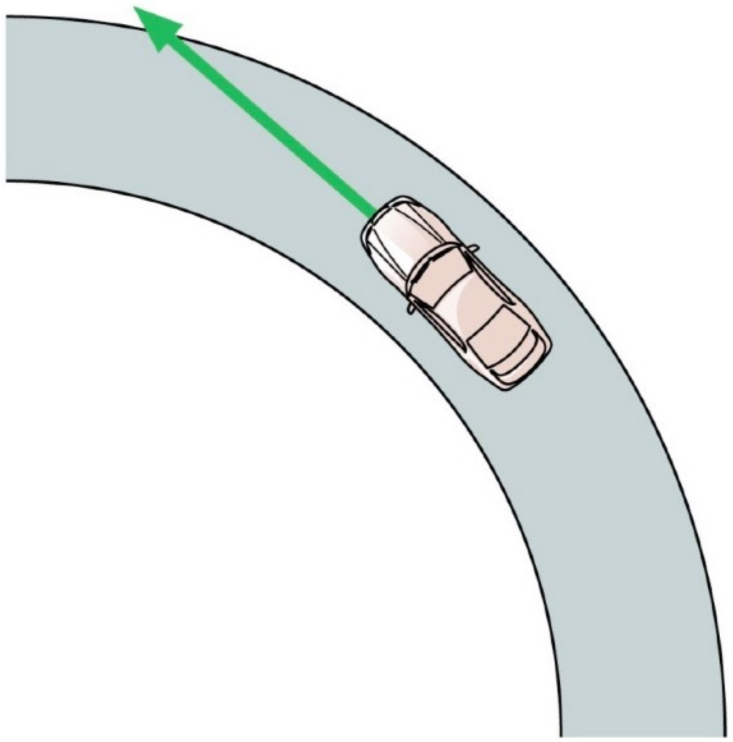

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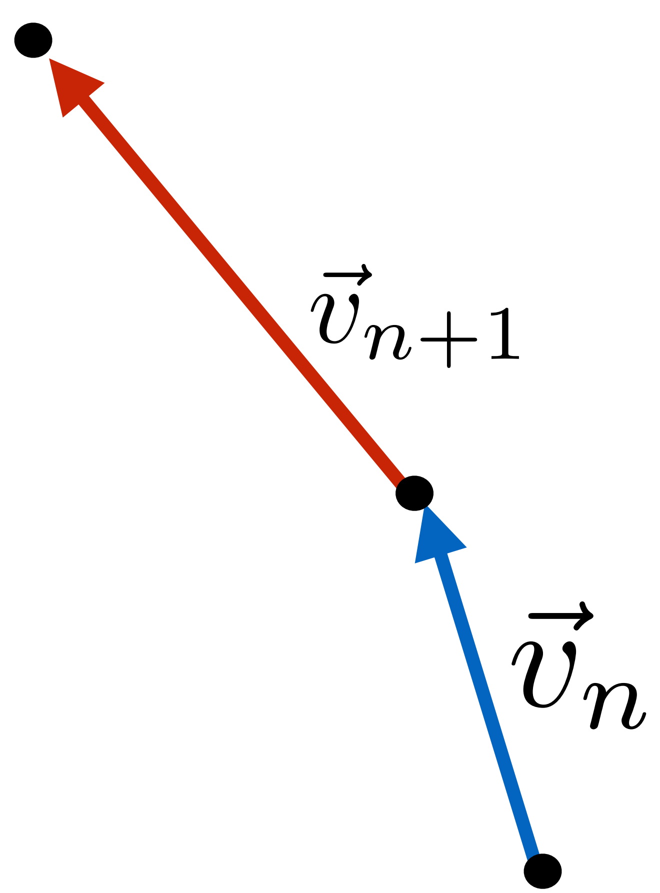

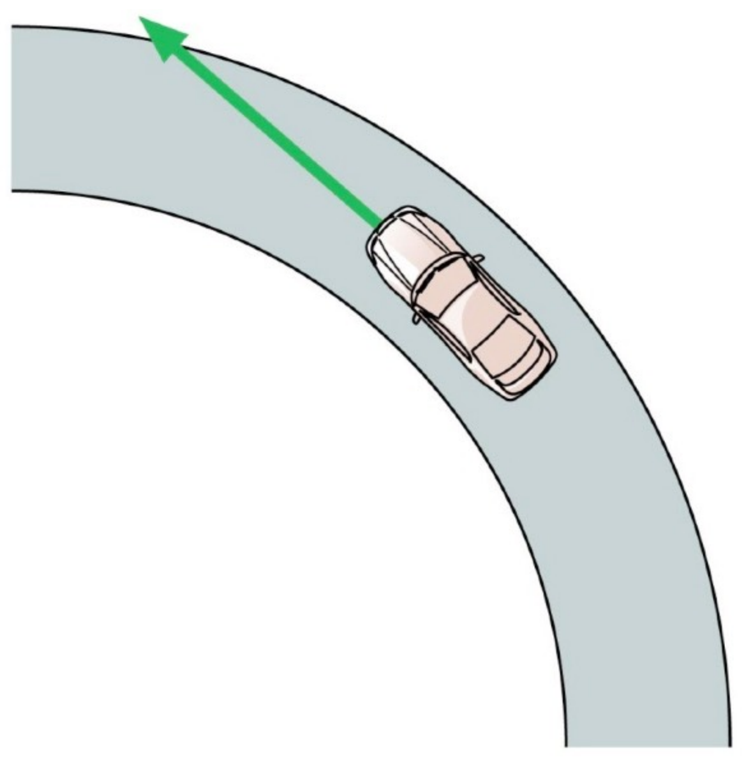

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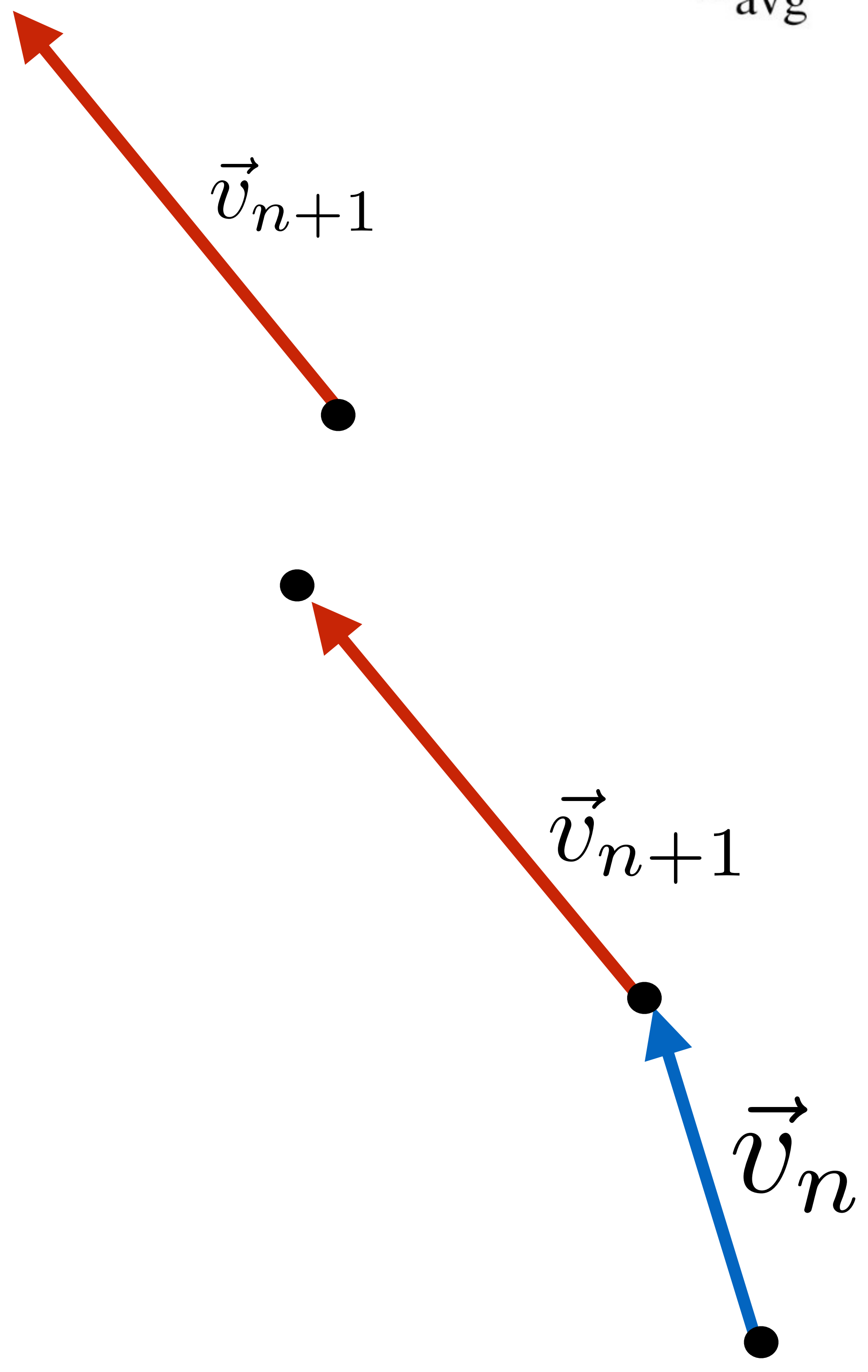

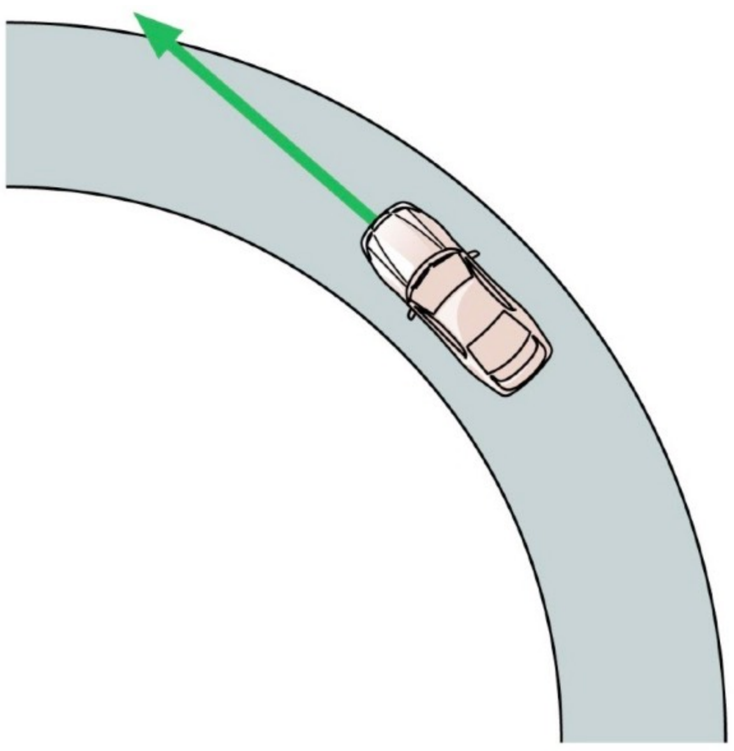

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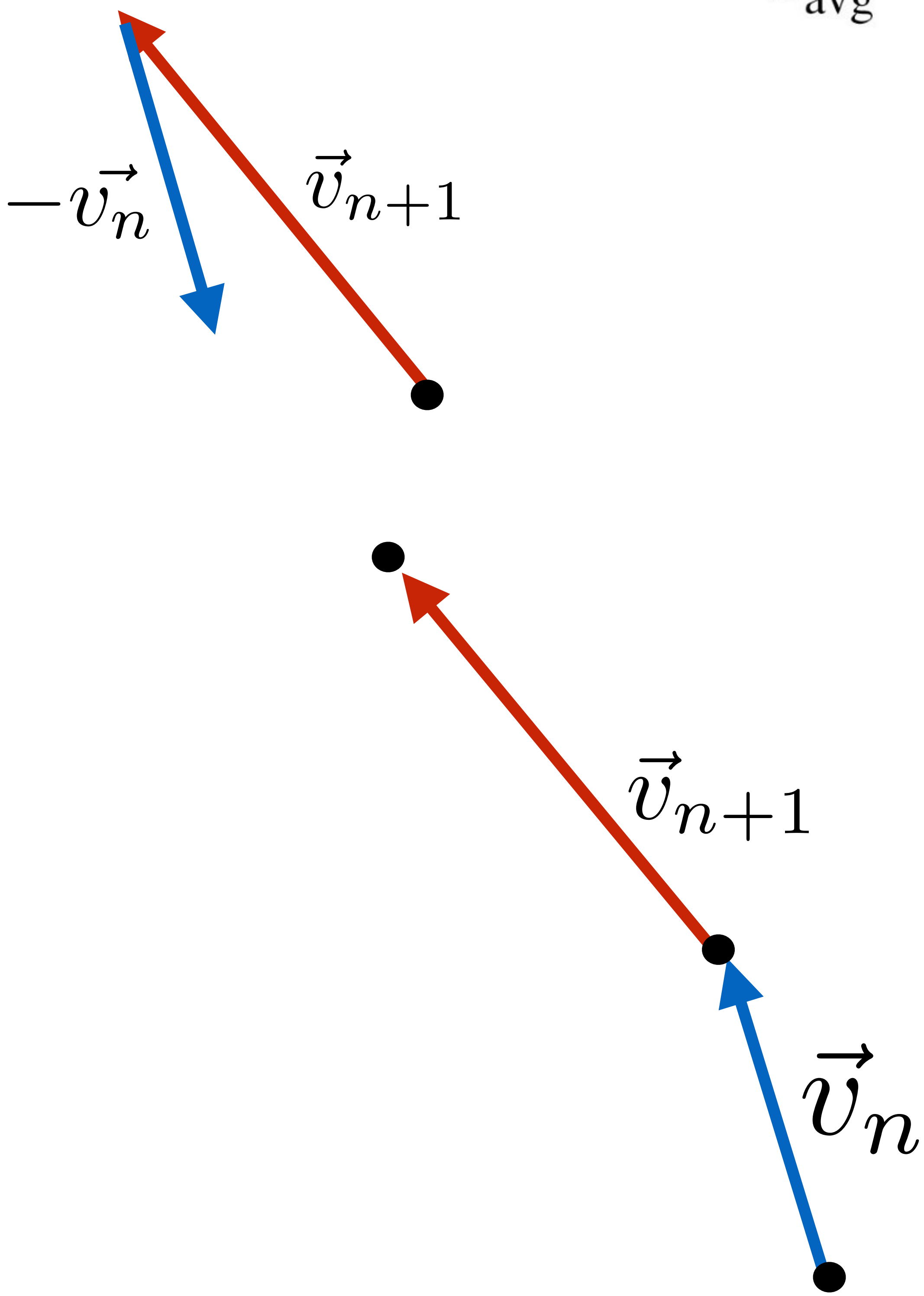

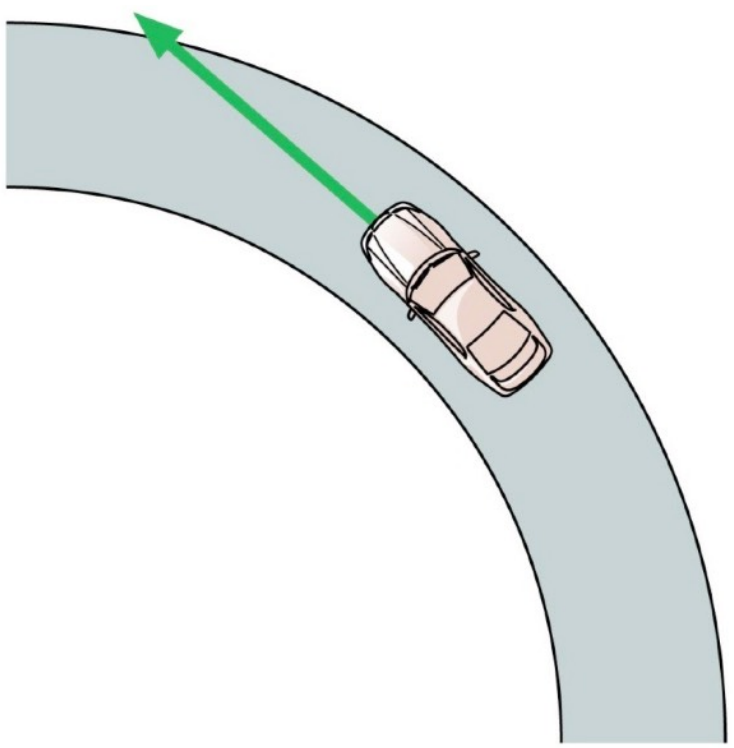

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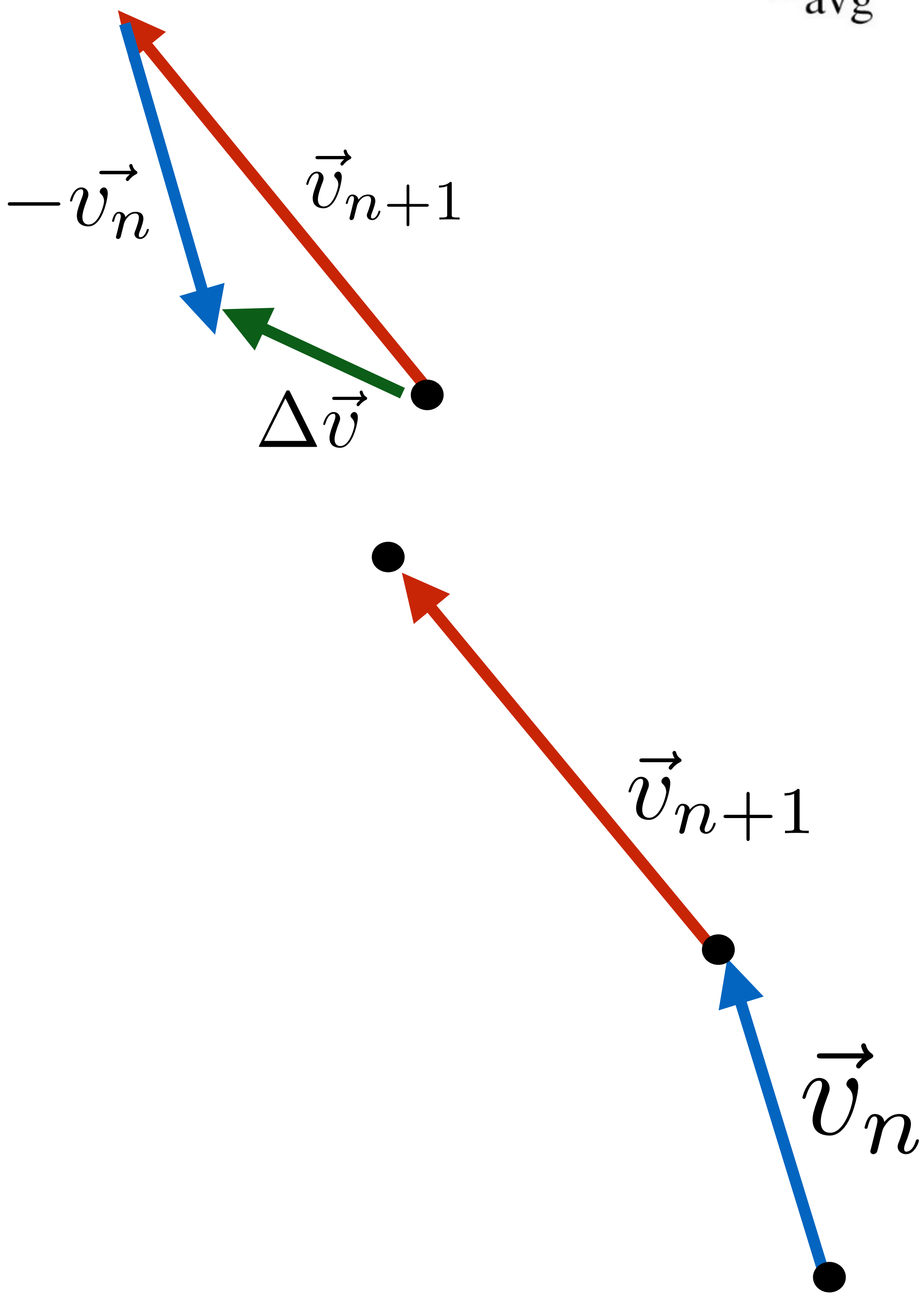

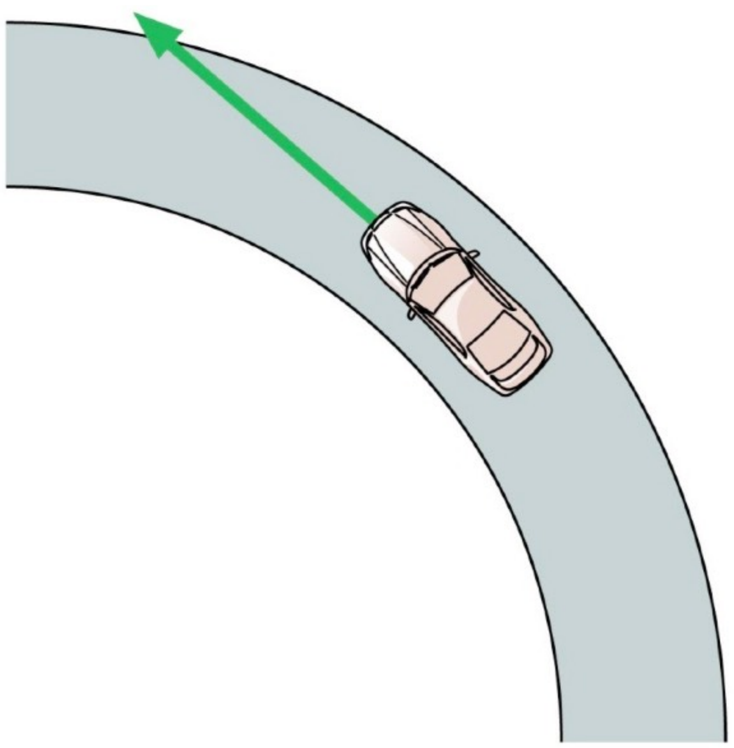

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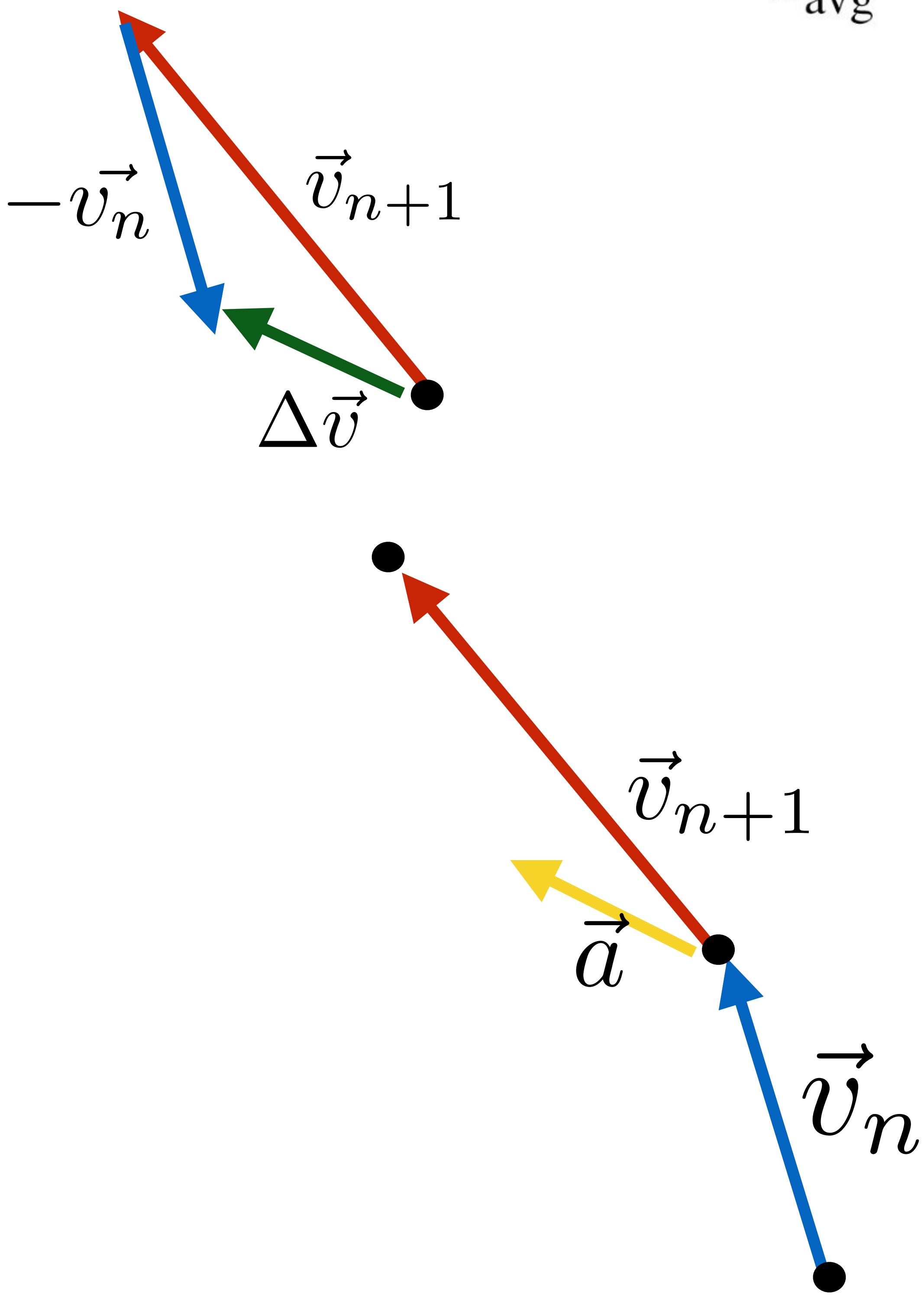

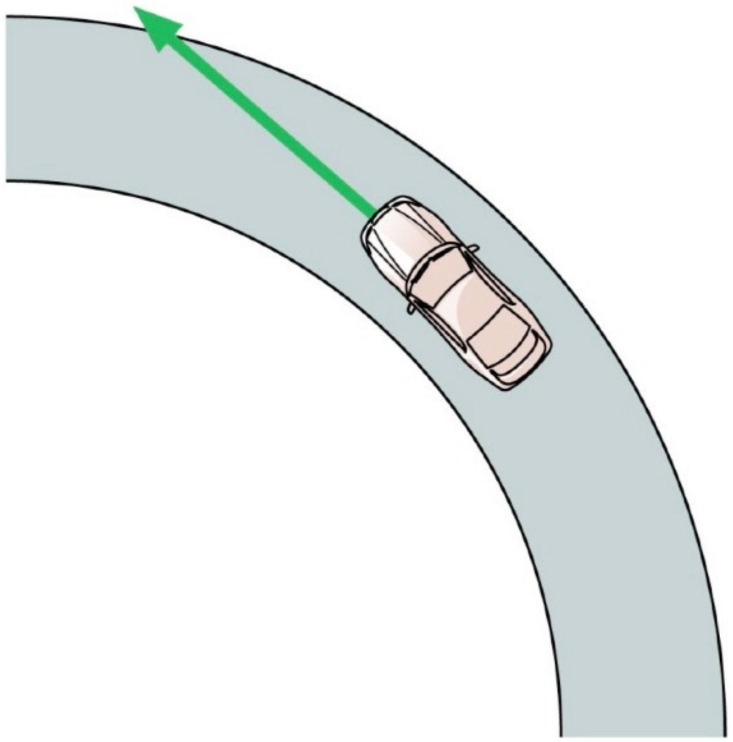

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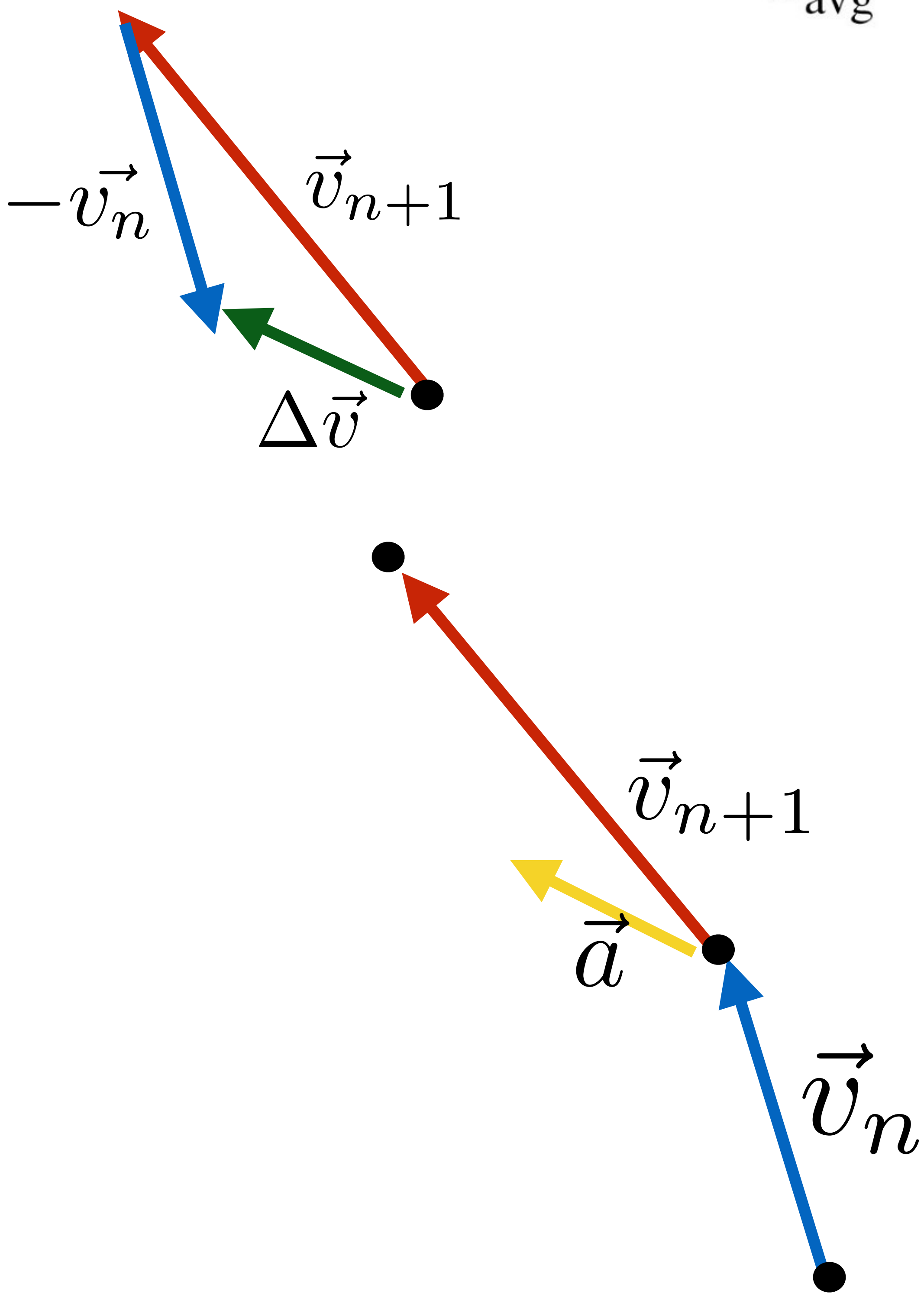
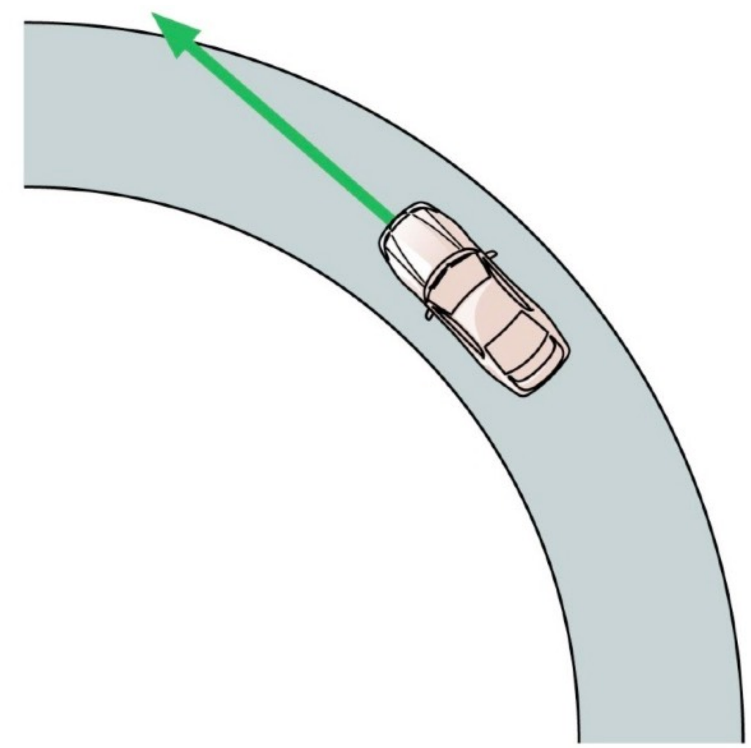
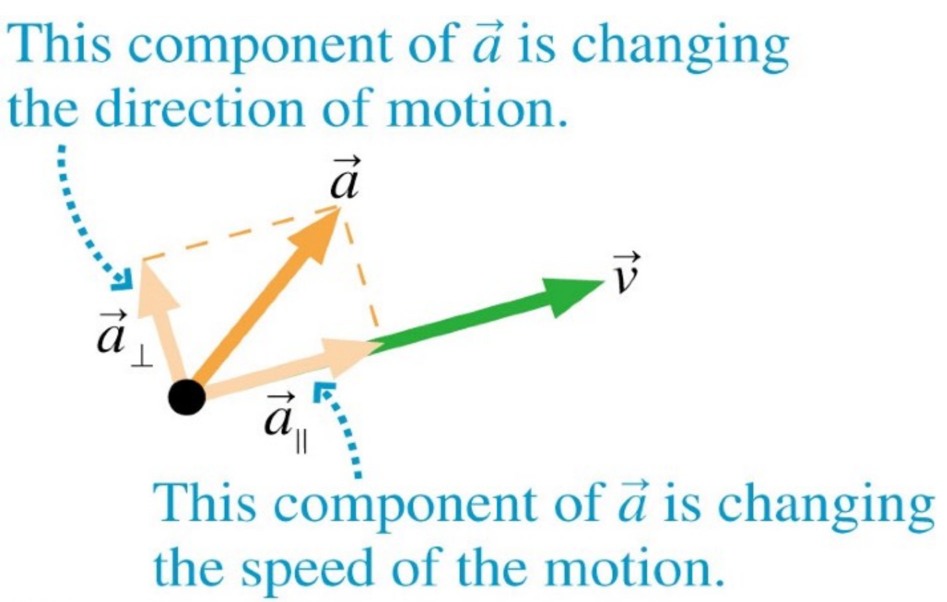




Analyzing the acceleration vector

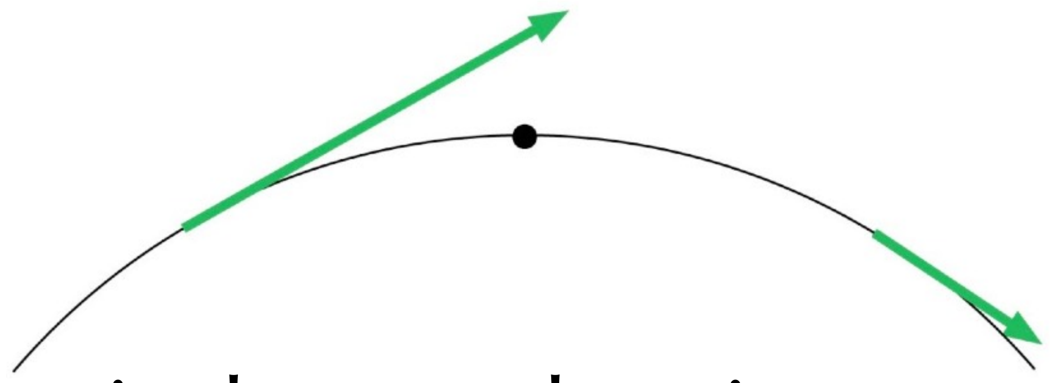


$\vec{a}_\parallel$ is the piece of the acceleration that causes the object to change <u>speed</u>.

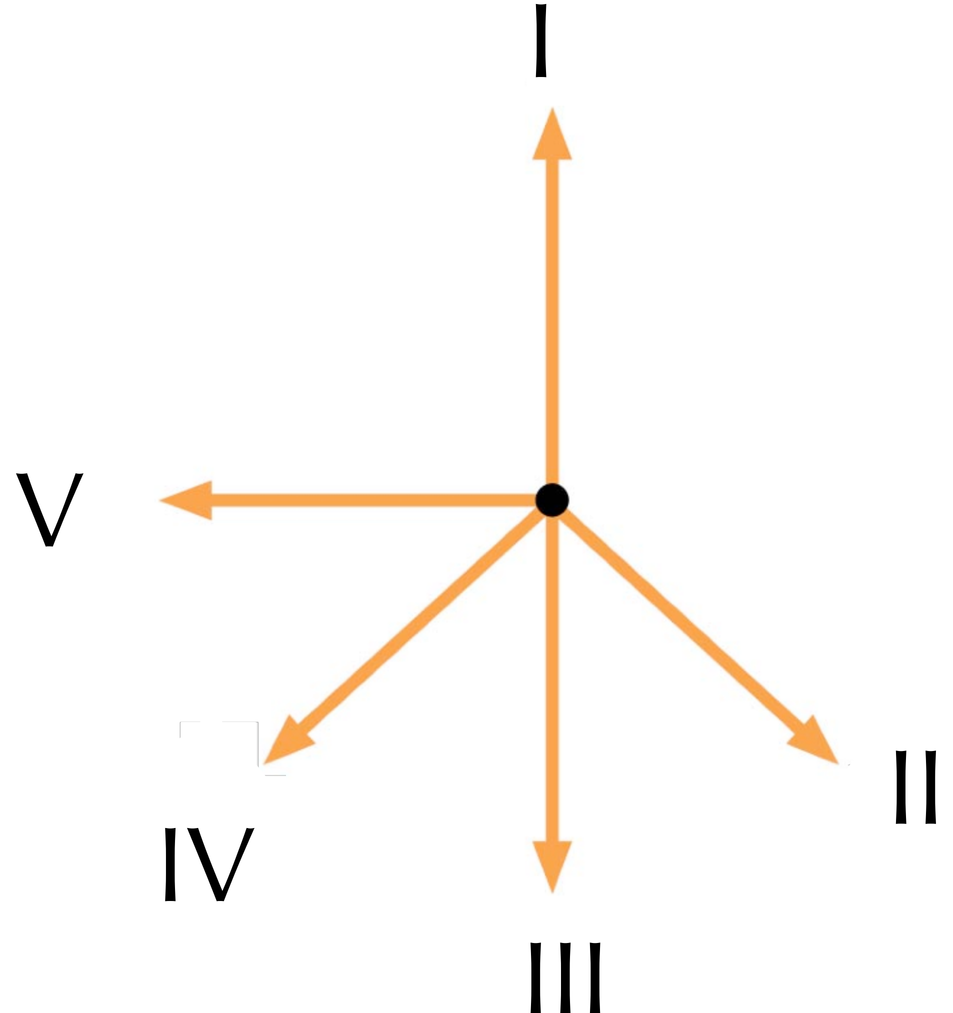
$\vec{a}_\perp$ is the piece of the acceleration that causes the object to change <u>direction</u>.

Quiz

A car is slowing down as it drives over a circular hill.



Which of these is the acceleration vector at the highest point?



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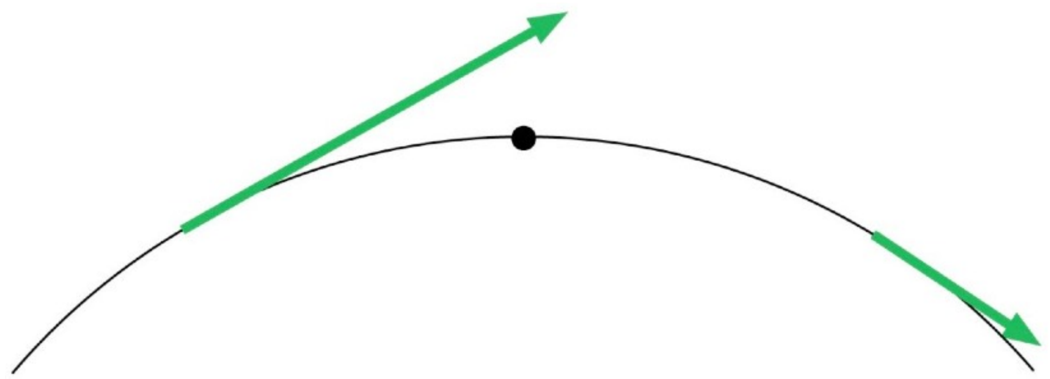

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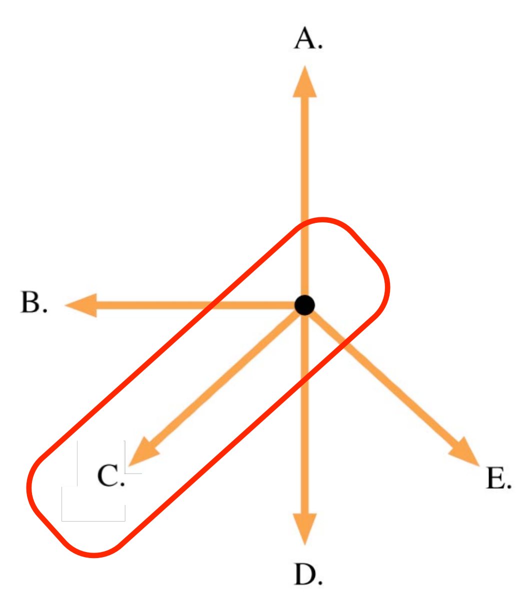


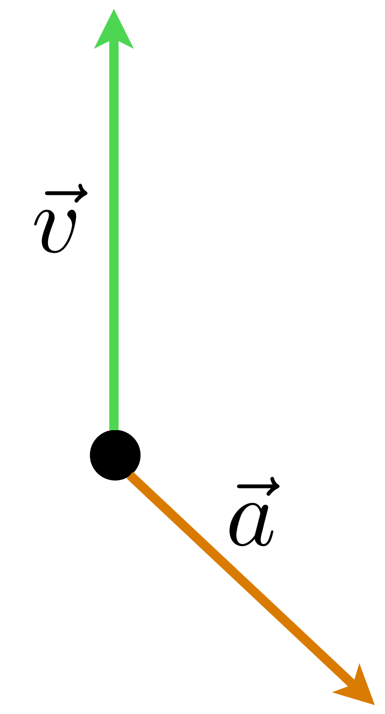
Quiz

At this instant, is the object in the figure speeding up, slowing down, or traveling at constant speed.

a) speeding up

b) slowing down

c) constant speed



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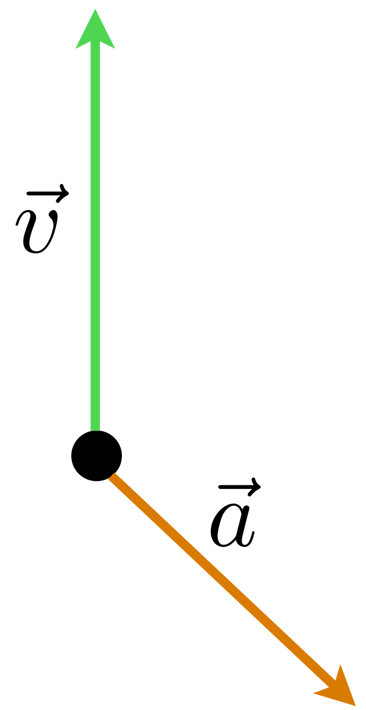


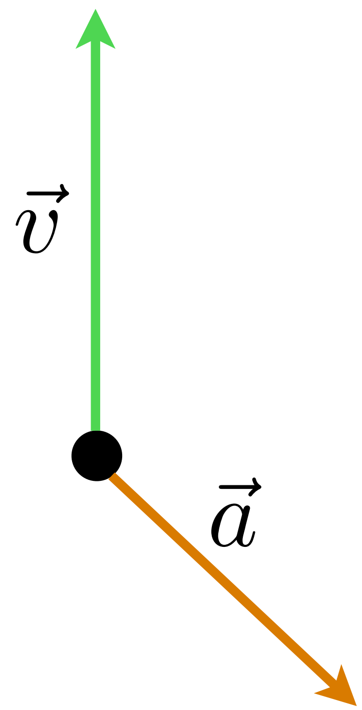
Quiz

At this instant, is the object in the figure curving to the left, curving to the right, or driving straight?

a) curving right

b) curving left

c) driving straight



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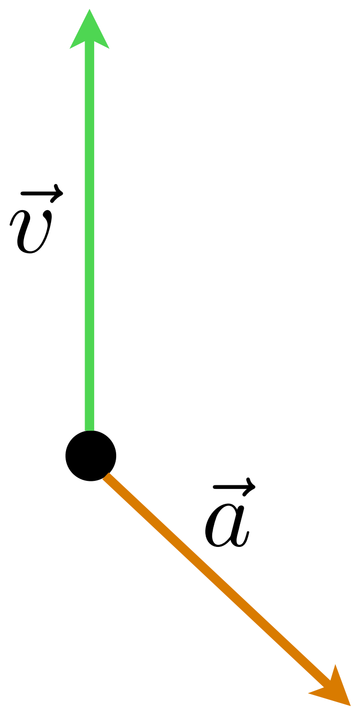
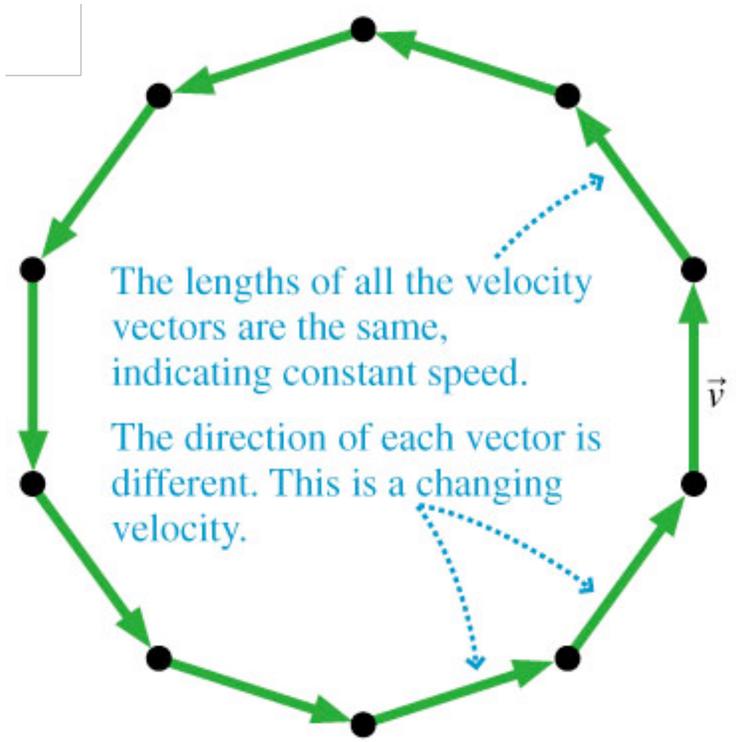
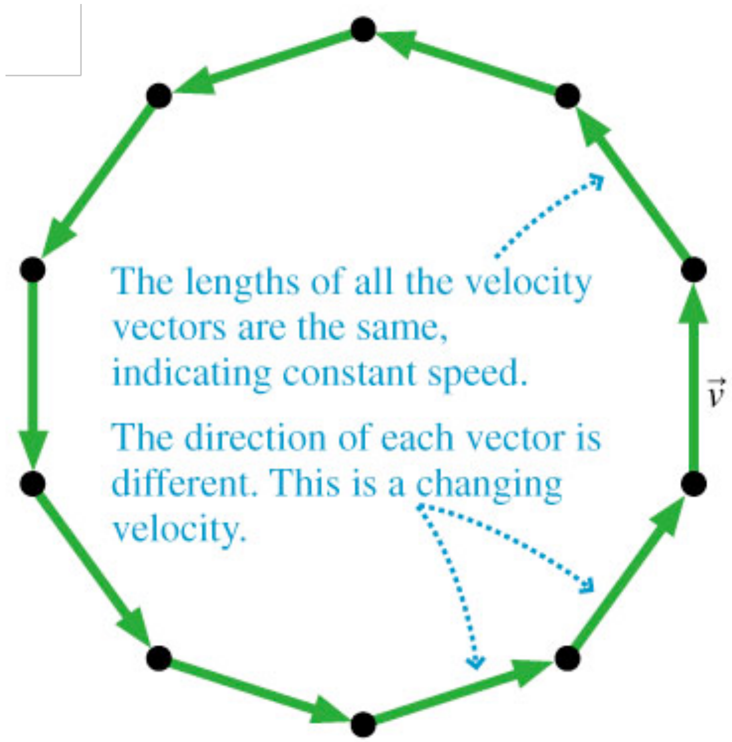
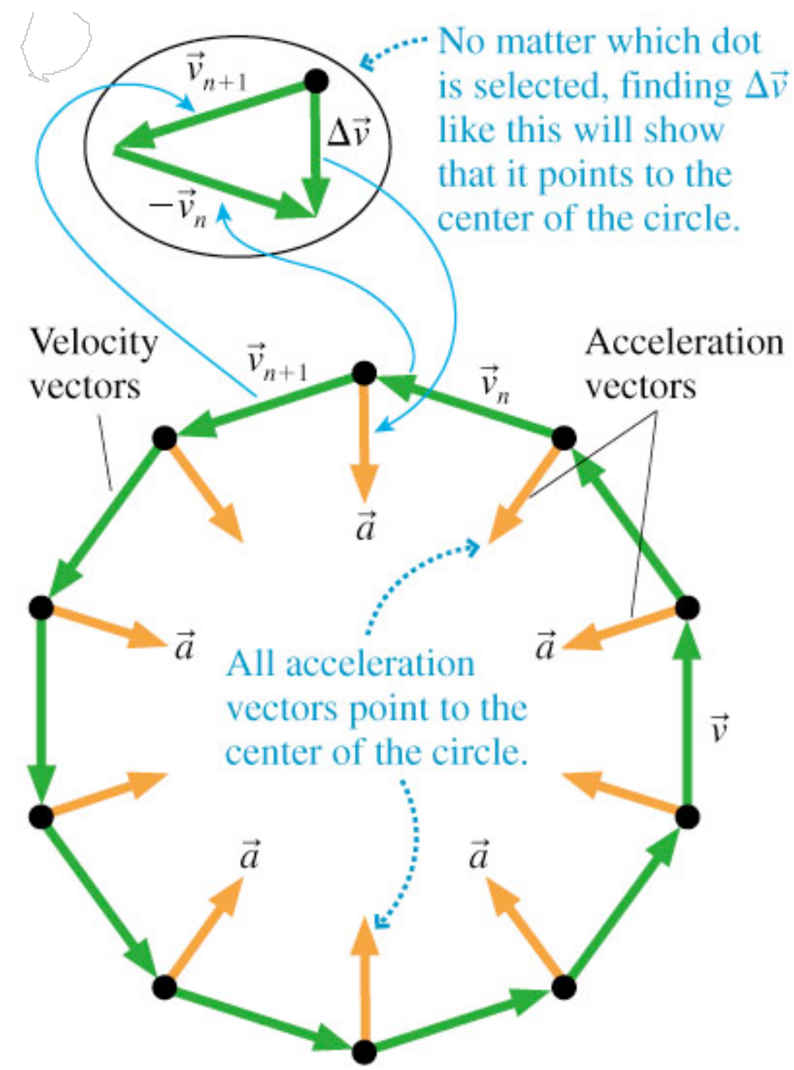


Ferris wheel

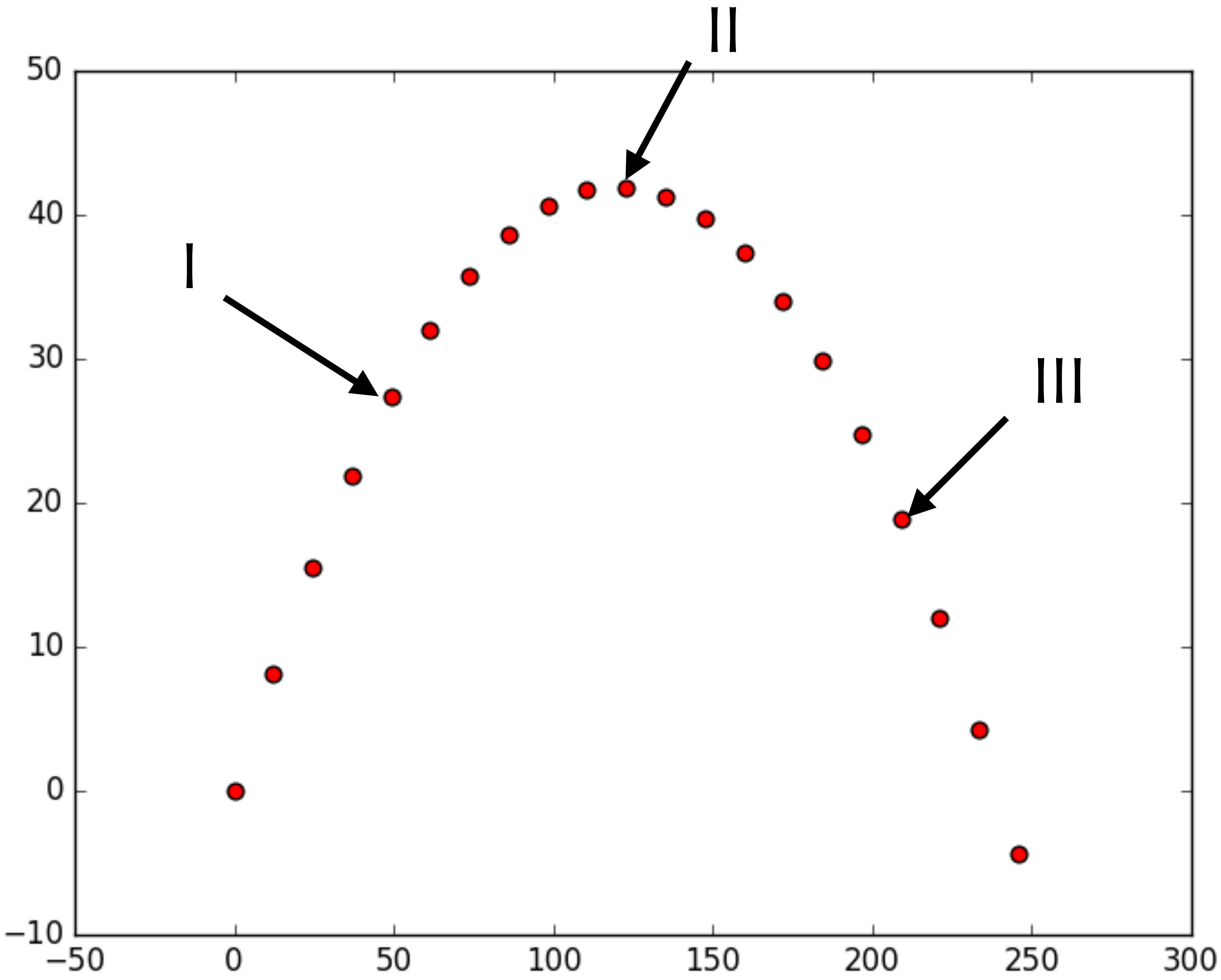


Ferris wheel

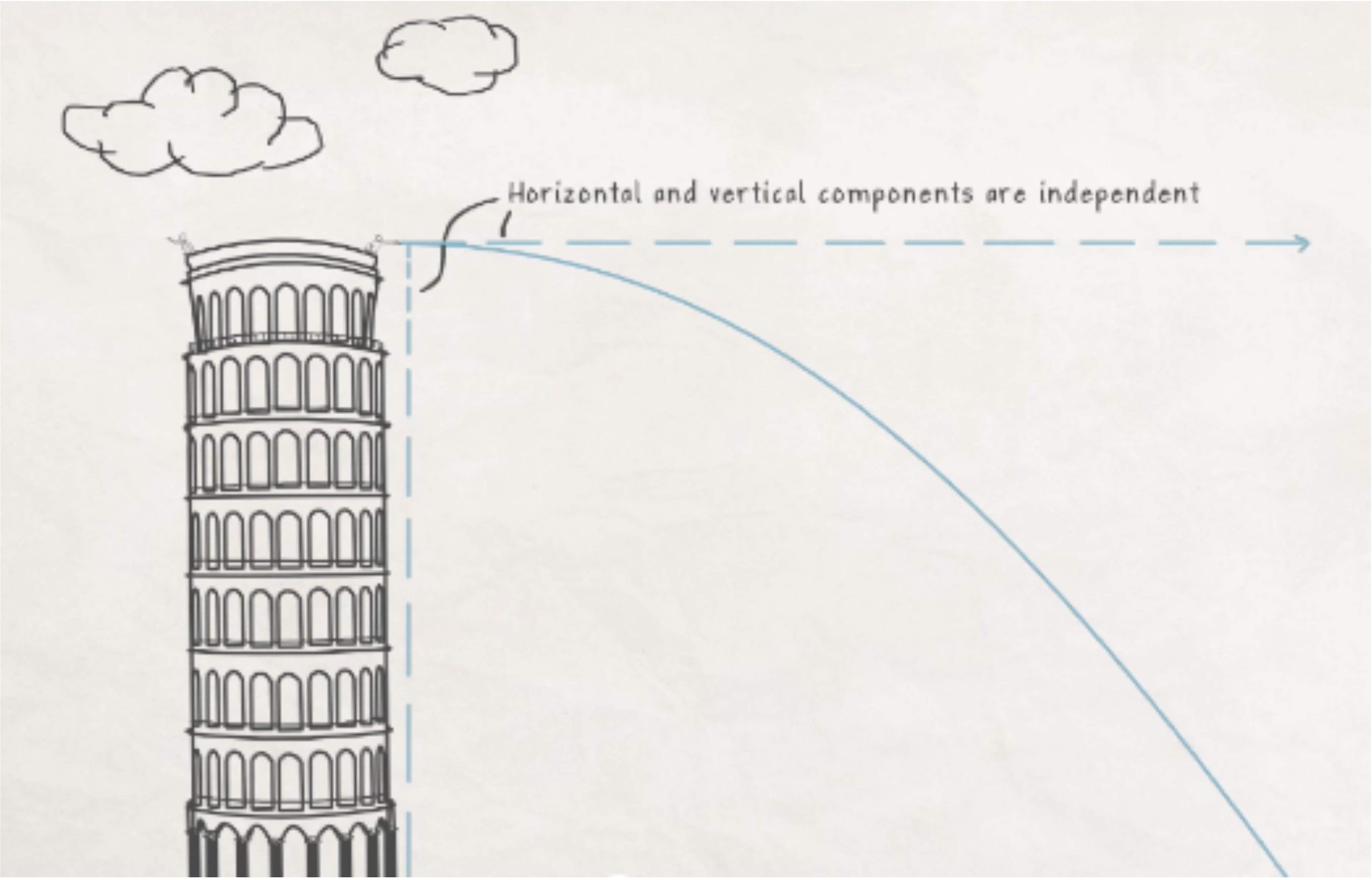




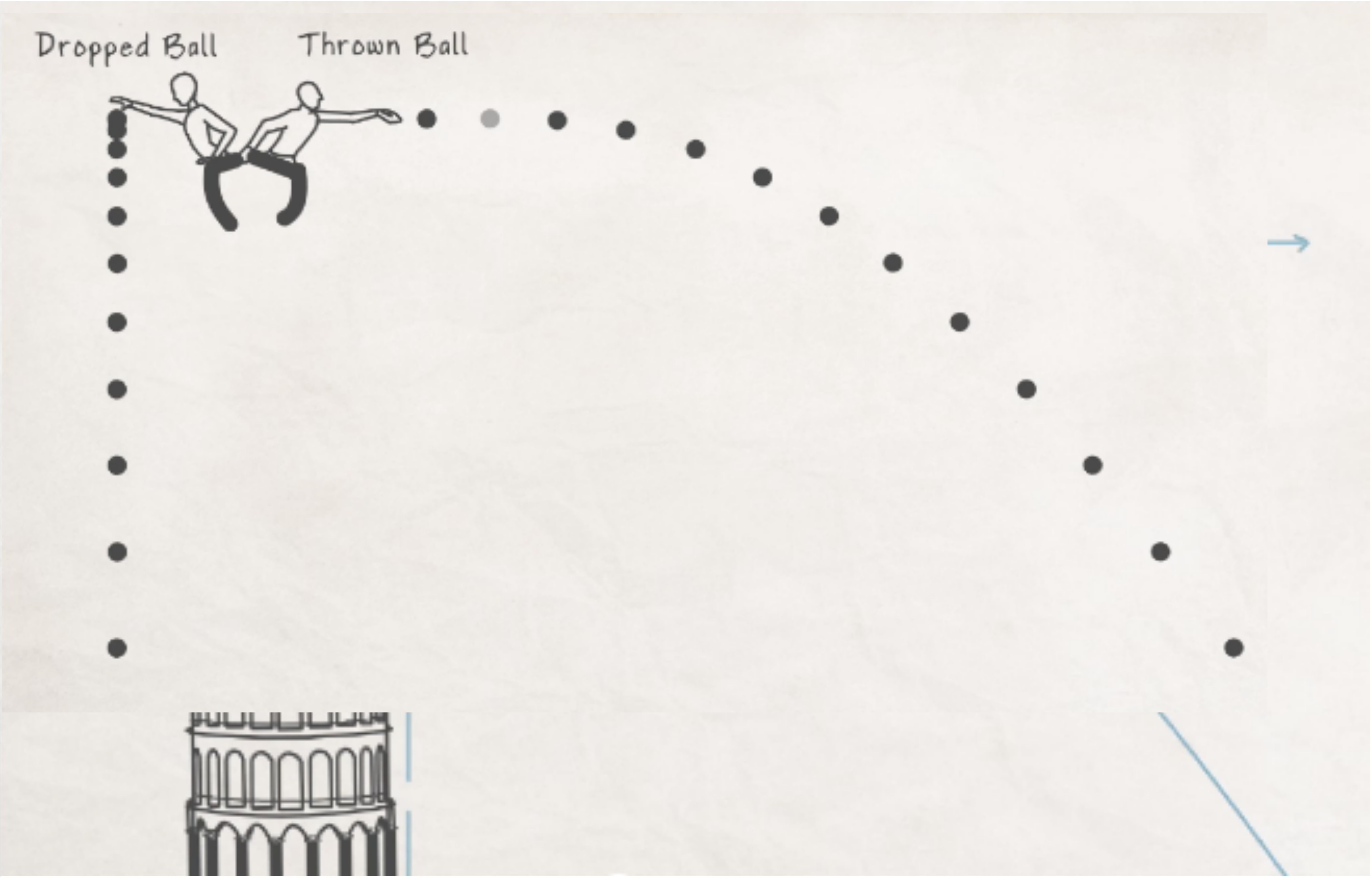
Projectile Motion



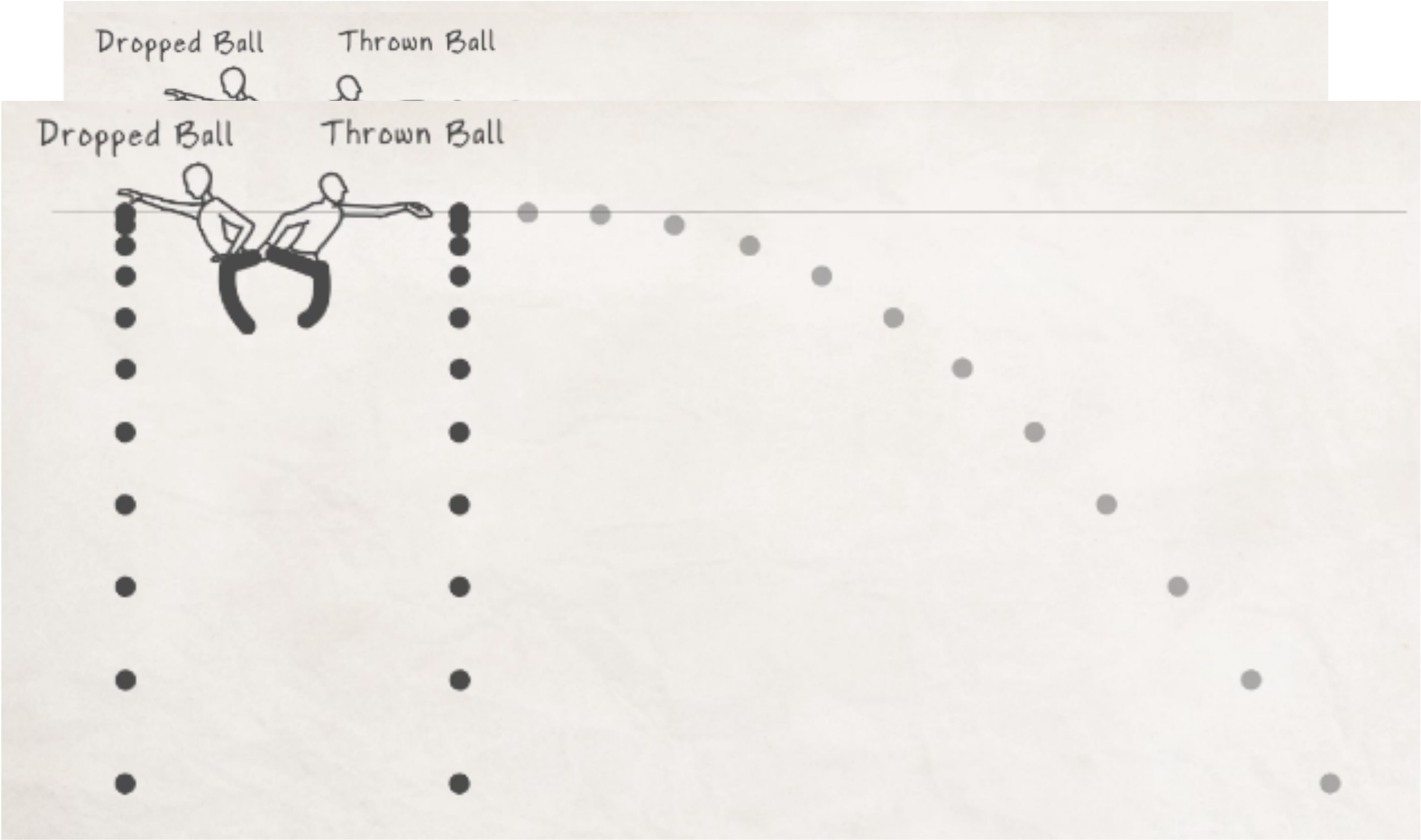
Video Quiz



Video Quiz



Video Quiz



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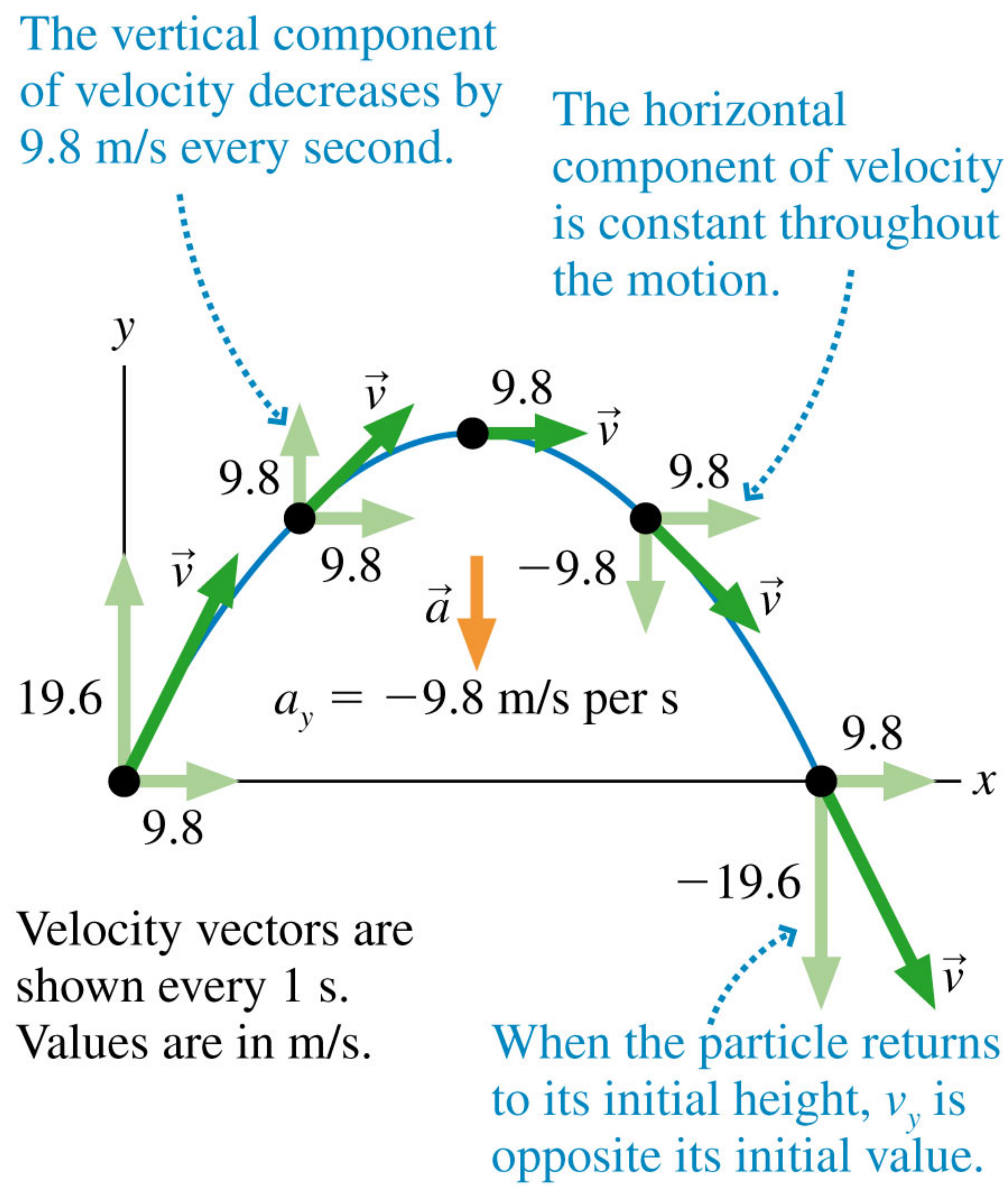

Projectile Motion applet

Constant acceleration

If the acceleration $\vec{a} = a_x \hat{i} + a_y \hat{j}$ is constant, then the two components a_x and a_y are both constant

$$x_f = x_i + v_{ix}\Delta t + \frac{1}{2}a_x \Delta t^2$$

$$v_{fx} = v_{ix} + a_x \Delta t$$

$$v_{fx}^2 = v_{ix}^2 + 2a_x \Delta x$$

$$y_f = y_i + v_{iy}\Delta t + \frac{1}{2}a_y \Delta t^2$$

$$v_{fy} = v_{iy} + a_y \Delta t$$

$$v_{fy}^2 = v_{iy}^2 + 2a_y \Delta y$$

Projectile Motion Demo

You try one

A sailboat is traveling east at 5.0 m/s. A sudden gust of wind gives the boat an acceleration $\vec{a} = (0.80\ \mathrm{m/s^2}, 40^\circ\ \mathrm{north.\ of\ east})$ What are the boat's speed and direction 6.0 s later when the gust subsides

Let's try a problem!

A model rocket is launched from rest with an upward acceleration of 6.00 m/s^2 and, due to a strong wind, a horizontal acceleration of 1.50 m/s^2. How far is the rocket from the launch pad 6.00 s later when the rocket runs out of fuel?

Example Problem

A rifle is aimed horizontally at a target 50 m away. The bullet hits the target 2.0 cm below the aim point.

What was the bullet's flight time?

Example Problem

A rifle is aimed horizontally at a target 50 m away. The bullet hits the target 2.0 cm below the aim point.

What was the bullet's flight time?

What was the bullet's speed as it left the barrel?