Physics A - PHY 2048C

Equations of Motion

09/11/2019

My Office Hours:
Thursday 2:00 - 3:00 PM

212 Keen Building

Warm-up Questions

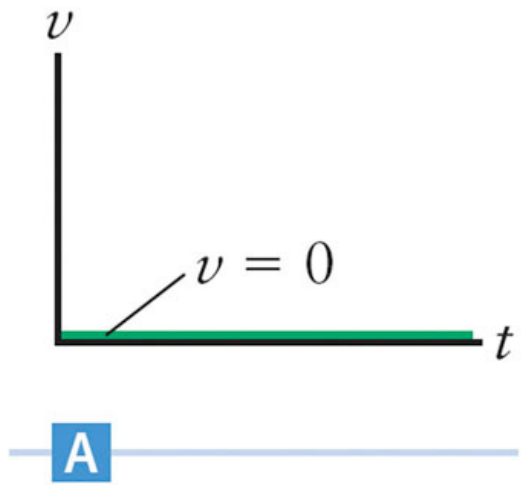
1. How is acceleration defined?
2. A projectile is launched at an angle of 30°.

   Is there any point on the trajectory where $\vec{v}$ and $\vec{a}$ are parallel to each other?
3. Is the velocity of the projectile zero at its maximum height?
4. How can something that is moving at a constant speed still be accelerating?

Example: Velocity = 0

The velocity is zero.

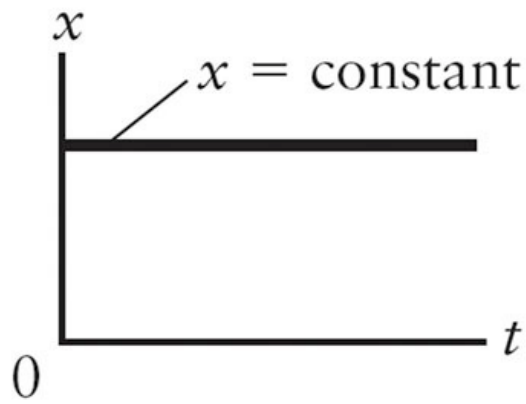
➜ On the graph, the line is at $v = 0$.



A

The position is constant:

- Not moving, no change in position.
- On the graph, just a horizontal line.



B

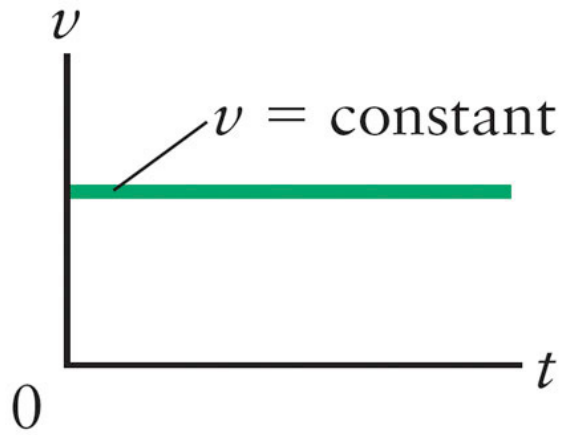
Example: Velocity $\neq 0$

The velocity is not zero.

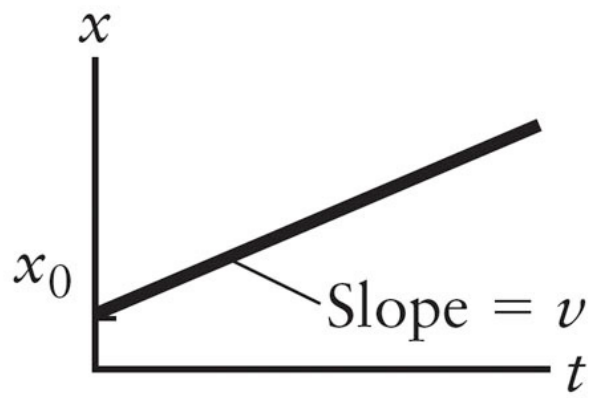
➜ On the v-t graph, the line is at $v = \text{constant}$ value: $v = v_0$.

The position is changing steadily:

- Same Δx each second: $\Delta x = v \cdot \Delta t$ or $x = x_0 + v \cdot t$.
- On the graph, an upward sloping straight line.
- Slope of the x-t curve is equal to the value of velocity.



A



B

Example: Constant Acceleration

The acceleration is a constant:

- On the *a*-*t* graph, a straight horizontal line: $v = v_0 + a \cdot t$.
- Value depends on the total force exerted on (and mass of) the object.

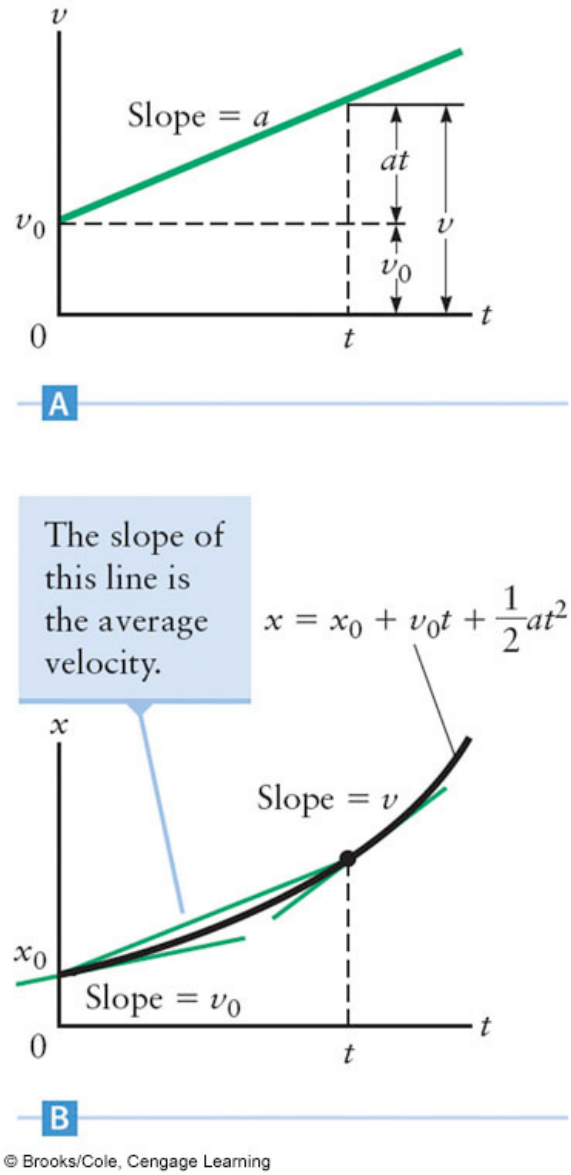
The velocity is changing:

- On the *v*-*t* graph, this is an upward sloping straight line.

The position is changing:

- On the *x*-*t* graph, a curved line is observed:

$$x = x_0 + v_0 \cdot t + \frac{1}{2} a \cdot t^2.$$



Equations of Motions

Equations to Describe Motion with Constant Acceleration:

$$v = v_0 + a\,t \tag{1}$$

$$x = x_0 + v_0\,t + \frac{1}{2}\,a\,t^2 \tag{2}$$

$$v^2 = v_0^2 + 2\,a\,(x_f - x_0)\,, \tag{3}$$

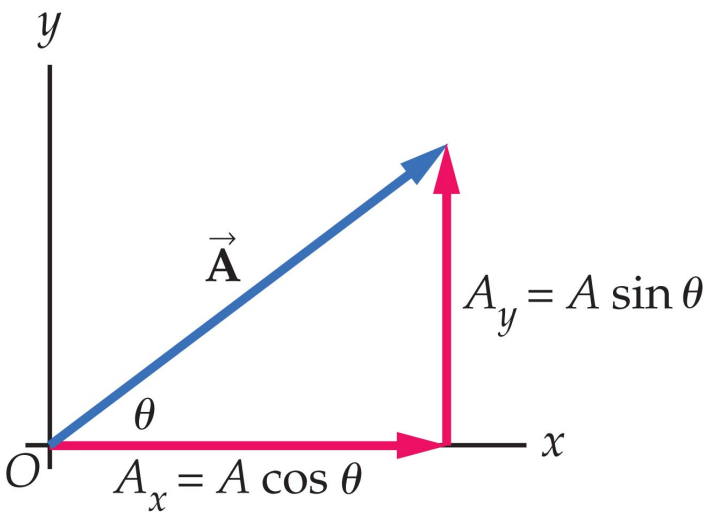
where v_0 is the velocity at some initial time $t = 0$, x_0 is the position at some initial time $t = 0$. Equation (3) eliminates time t from the equation.

Which equation should be used depends on what information you are given in a particular problem and what you are asked to find.

Reminder

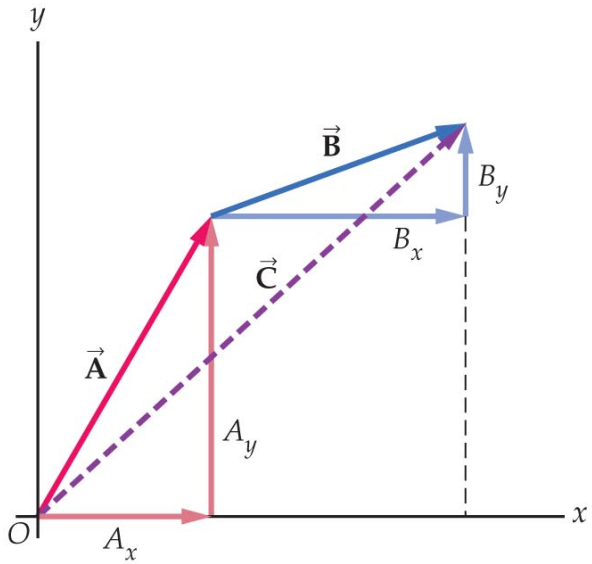
Vectors in Physics

Vector Components

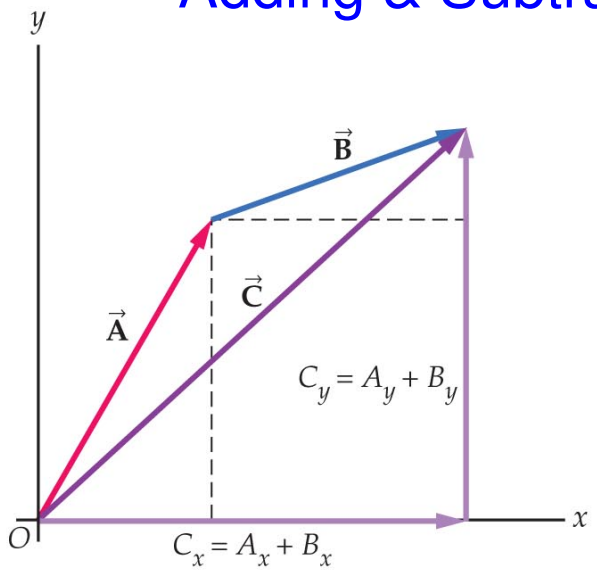


(a)

Adding & Subtracting Vectors



(a)



(b)