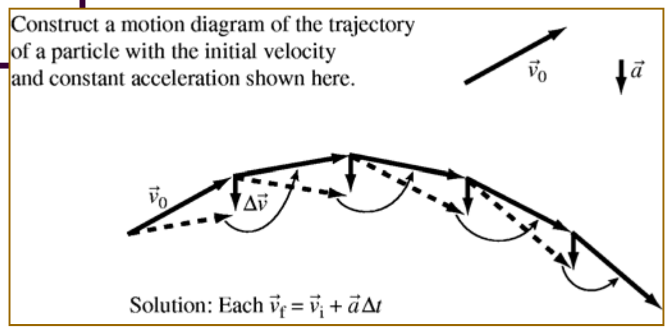
PHYS 210 - General Physics I

- Instantaneous acceleration
- Problem solving
- Motion at a constant acceleration
- Projectiles

20 Sep 19



How about instantaneous acceleration?

Acceleration (in 1-D) is defined by

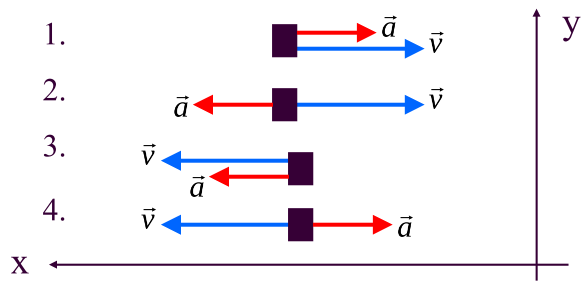
$$\vec{a} = \frac{d\vec{v}}{dt}$$

Acceleration is the time rate of change of velocity

Using $\vec{a} = d\vec{v}/dt$, we can interpret $\vec{a}$ as the slope on a graph of v vs. t.

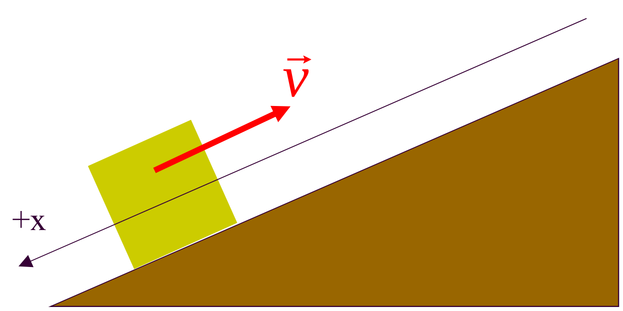
Direction of Acceleration Vector

- Depends on coordinate system!



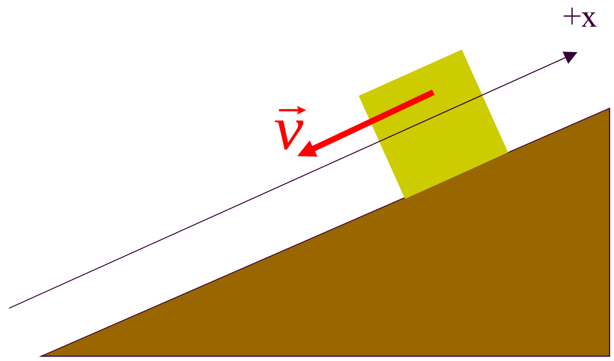
But First ….

- What is the direction of the acceleration if the block has been shoved & released and is moving up the incline?



And ….

- What is the direction of the acceleration if the block has been pushed & released and is moving down the incline?



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Equations for constant acceleration

x or y for distances?

Note missing quantity:

Table 2.2

$v_{fs} = v_{is} + a_s \Delta t$	$\Delta s \equiv s_f - s_i$
$v_{fs}^2 = v_{is}^2 + 2a_s \Delta s$	Δt
$s_f = s_i + v_{is}\Delta t + \frac{1}{2}a_s(\Delta t)^2$	v_{fi}
$s_f = s_i + \frac{1}{2}(v_{fs} + v_{is})\Delta t$	a_s
$s_f = s_i + v_{fs}\Delta t - \frac{1}{2}a_s(\Delta t)^2$	v_{is}

Equations for constant acceleration

x or y for distances

$v_{fx} = v_{ix} + a_x \Delta t$	$v_{fy} = v_{iy} + a_y \Delta t$
$v_{fx}^2 = v_{ix}^2 + 2a_x \Delta x$	$v_{fy}^2 = v_{iy}^2 + 2a_y \Delta y$
$x_f = x_i + v_{ix}\Delta t + \frac{1}{2}a_x(\Delta t)^2$	$y_f = y_i + v_{iy}\Delta t + \frac{1}{2}a_y(\Delta t)^2$
$x_f = x_i + \frac{1}{2}(v_{fx} + v_{ix})\Delta t$	$y_f = y_i + \frac{1}{2}(v_{fy} + v_{iy})\Delta t$
$x_f = x_i + v_{fx}\Delta t - \frac{1}{2}a_x(\Delta t)^2$	$y_f = y_i + v_{fy}\Delta t - \frac{1}{2}a_y(\Delta t)^2$

BUT NOT ALWAYS!

x often for horizontal, y for vertical

try this:

- Problem :
- An automobile driver increases her speed at a constant rate of $0.67 m/s^2$ from 5 m/s to 25 m/s. Calculate the time it took to do this.
- How far did the driver travel?

Things to keep in mind when solving motion problems

Do it!

- Draw a picture/sketch
- Draw and label some coordinate axes
- Use appropriate variables to identify quantities (with signs that match your coordinate system) from the beginning!
- Write down the skeleton formula
- Do the algebra, THEN plug in numbers
- Plug in numbers with units
- Question your answer!

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Equations for constant acceleration

BUT NOT ALWAYS!

x or y for distances

$$v_{fx} = v_{ix} + a_x \Delta t \qquad v_{fy} = v_{iy} + a_y \Delta t$$

$$v_{fx}^2 = v_{ix}^2 + 2a_x \Delta x \qquad v_{fy}^2 = v_{iy}^2 + 2a_y \Delta y$$

$$x_f = x_i + v_{ix}\Delta t + \frac{1}{2}a_x(\Delta t)^2 \qquad y_f = y_i + v_{iy}\Delta t + \frac{1}{2}a_y(\Delta t)^2$$

$$x_f = x_i + \frac{1}{2}(v_{fx} + v_{ix})\Delta t \qquad y_f = y_i + \frac{1}{2}(v_{fy} + v_{iy})\Delta t$$

$$x_f = x_i + v_{fx}\Delta t - \frac{1}{2}a_x(\Delta t)^2 \qquad y_f = y_i + v_{fy}\Delta t - \frac{1}{2}a_y(\Delta t)^2$$

x often for horizontal, y for vertical

Example:

- A car traveling 56.0 km/hr is 44.0 m from a deer in the road. The driver sees the deer, and after a 1.25 s reaction time, slams on the brakes. The car hits the deer 2.00 s later.

A. What is the magnitude of the car's constant acceleration?

B. How fast is the car going on impact?

Note : 1 km/hr = 0.278 m/s

Enjoy your Weekend!