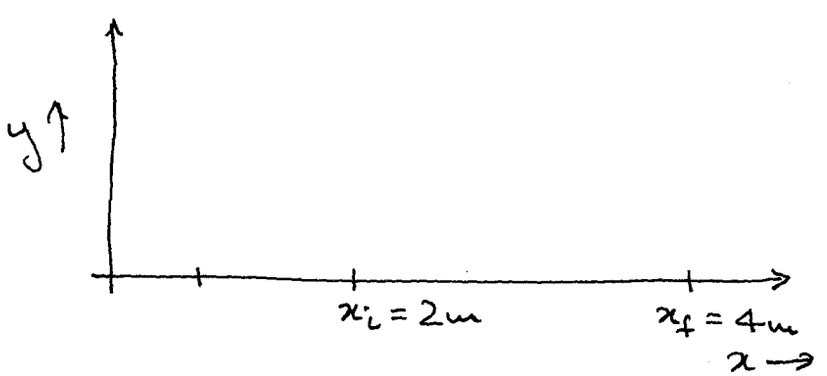
Class quiz - Problem given in lecture slides stopping distance is greater than 20 ft.

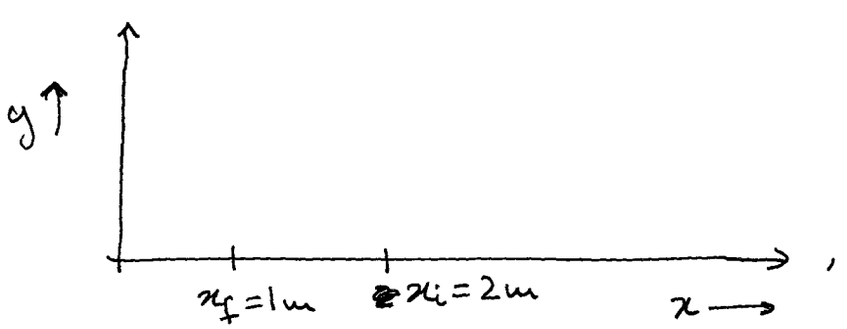
DEMO . - Cart on an inclined plane.

1-D motion

Position vs. time



Displacement $\Delta x = x_f - x_i = 4 - 2 = 2m$

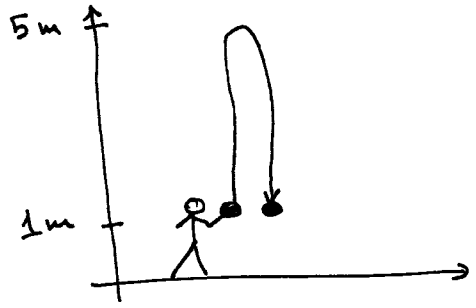


$\Delta x = 1 - 2 = -1m$

Displacement $\neq$ distance

↓ vector ↓ scalar

for 1-D motion negative and positive signs show the direction of displacement.

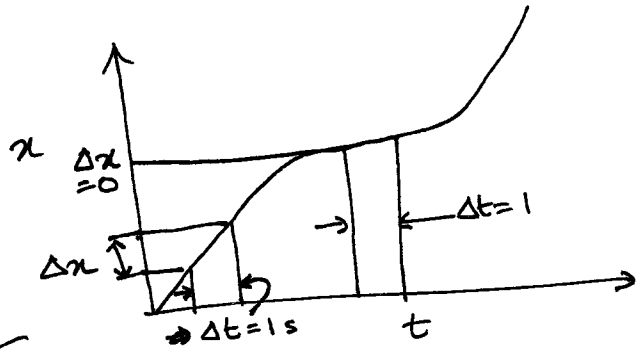


$\Delta y = y_f - y_i = 1 - 1 = 0$ m

displacement = 0.

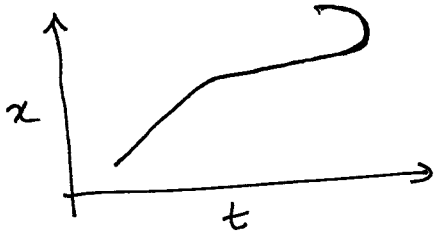
Distance = $2|1-5| = 8$ m

Position vs. time graphs



rate of change of Δx changes with time.

In class question



cannot have graph like this because time is going backwards.

Define Average velocity.

Average velocity $v_{av} = \dfrac{x_f - x_i}{t_f - t_i} = \dfrac{\Delta x}{\Delta t}$

if x vs. t curve is <u>not a straight line</u>

then v_{av} changes with time.

If you need velocity at a particular moment

define <u>instantaneous velocity</u> $v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}$

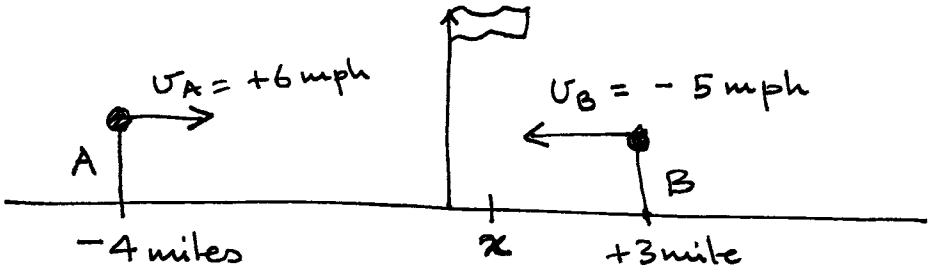
v = slope of x vs. t graph at an instant of time

v is a vector.

|instantaneous velocity| = instantaneous speed.

2-14 Runner A is 4 miles west of flagpole

⇒ position of A is −4 miles because all positions west of flagpole are negative



Runner A is running due east ⇒ his displacement is positive. (e.g. if runner A moves east from −4 miles to −2 miles then his displacement is $x_f - x_i = -2 - (-4)$ = 2 miles)

⇒ Runner A's velocity is positive because

$$v = \frac{\Delta x}{\Delta t} > 0 \quad (\Delta x > 0 \text{ when displacement is towards east and } \Delta t > 0 \text{ always})$$

⇒ $v_A = +6$ mph

following the same argument, initial position of runner B is 3 miles east of the flagpole = +3 miles

And ~~runner B~~ runner B is running due west ⇒ displacement for B is negative

⇒ $v_B = -5$ mph.

Let the 2 runners meet at some point x.

Runner A takes time t_A to reach x.

$$v_A = \frac{\Delta x_A}{t_A} \Rightarrow t_A = \frac{\Delta x_A}{v_A} = \frac{x-(-4)}{6} = \frac{x+4}{6}$$

Runner B takes time t_B to reach x.

$$v_B = \frac{\Delta x_B}{t_B} \Rightarrow t_B = \frac{\Delta x_B}{v_B} = \frac{x-3}{-5}$$

$$t_A = t_B \Rightarrow \frac{x+4}{6} = \frac{x-3}{-5}$$

$$\Rightarrow -5x - 20 = 6x - 18$$

$$\Rightarrow 11x = -2 \Rightarrow x = -\frac{2}{11} \text{ miles.}$$ They meet $\frac{2}{11}$ miles west of the flagpole.