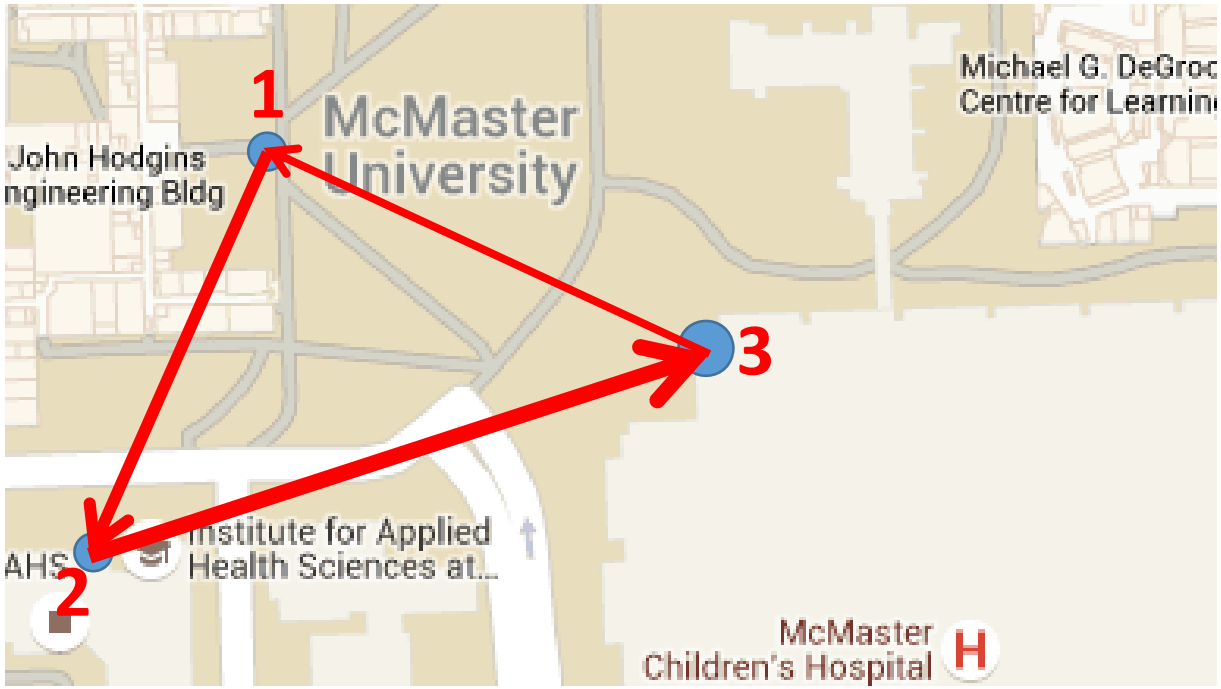
Animal Locomotion

http://youtu.be/Xf7adknGGck

§ Distance vs Displacement

Take a Hike!: Walk from Health sciences bldg. over to JHE (130 m), then to Tim Hortons in Mo-Mac (120 m), then back to class (180 m)

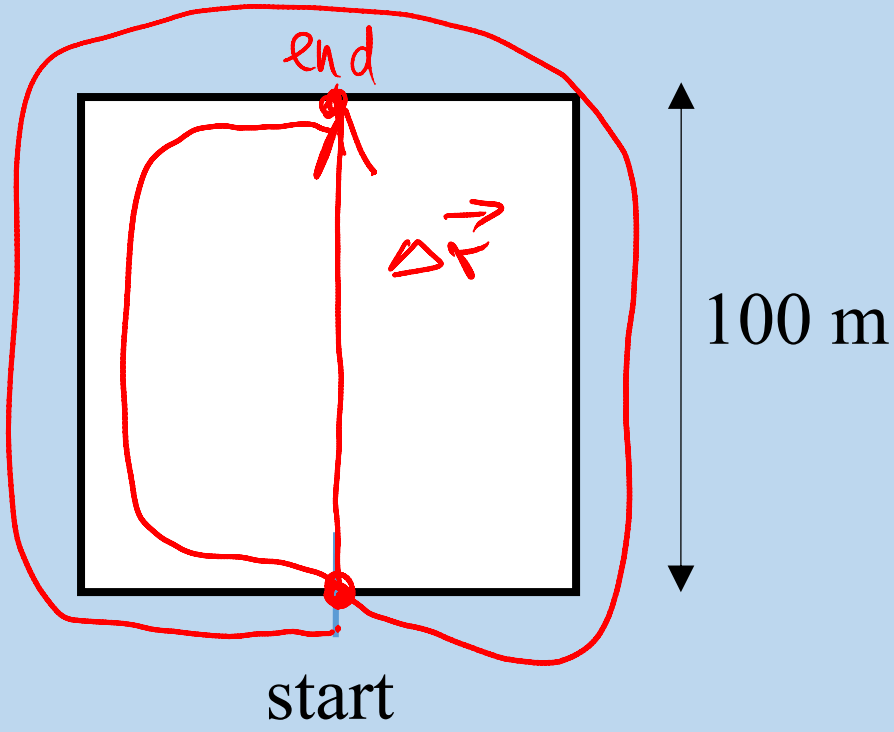
- What total distance did you walk? $d = 430\ m$
- What was your total displacement? $\Delta\vec{r} = 0\ m$



Clicker Quiz – 2D Motion

A jogger runs around a city block that is 100 m between stop signs. Starting at her apartment, she runs one and a half laps. What is her ***displacement*** from her starting point?

A. 0 m
B. 100 m
C. 200 m
D. 500 m
E. 600 m



Clicker Quiz

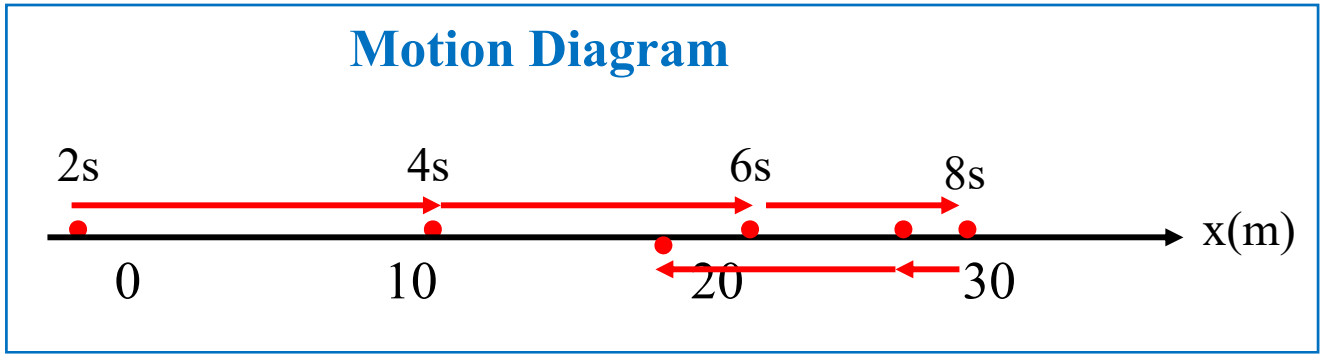
- When an object moves, is there anything that can be said, ***in general***, about distance vs. displacement?

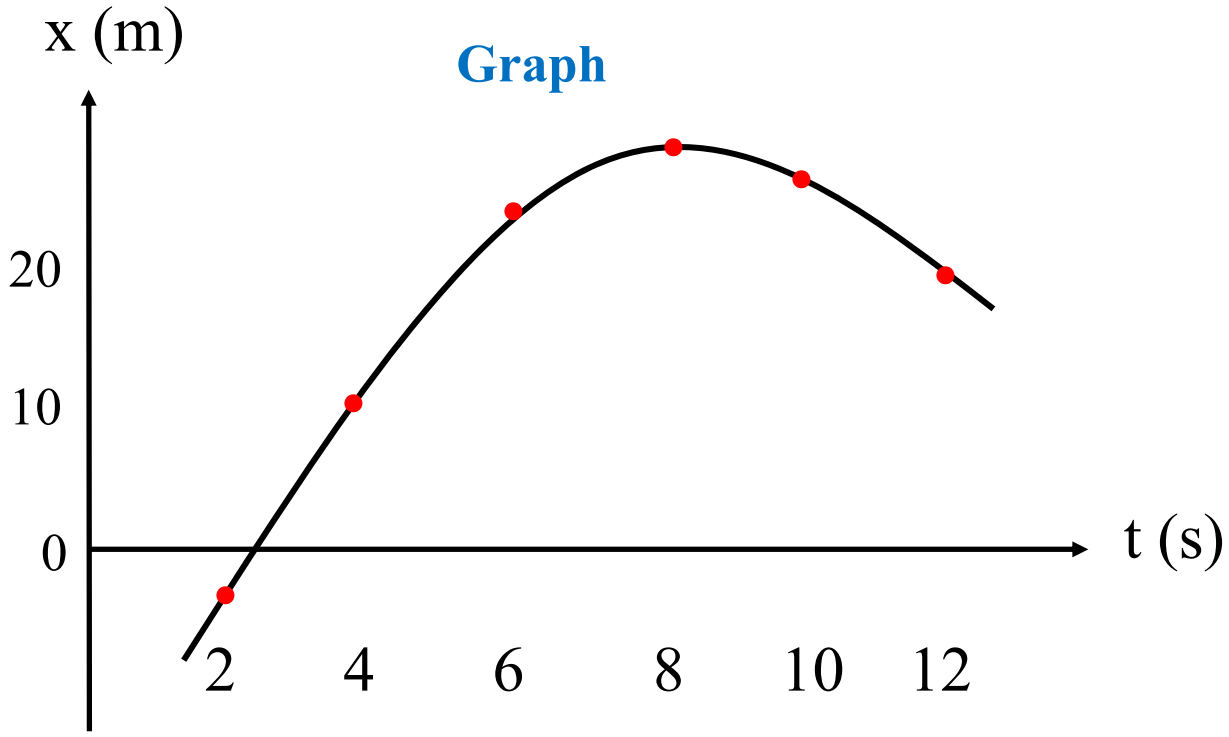
The magnitude of the DISPLACEMENT is ___ the DISTANCE.

A. Either greater than or equal to
B. Always greater than
C. Always equal to
D. Either smaller than or equal to
E. Always smaller than

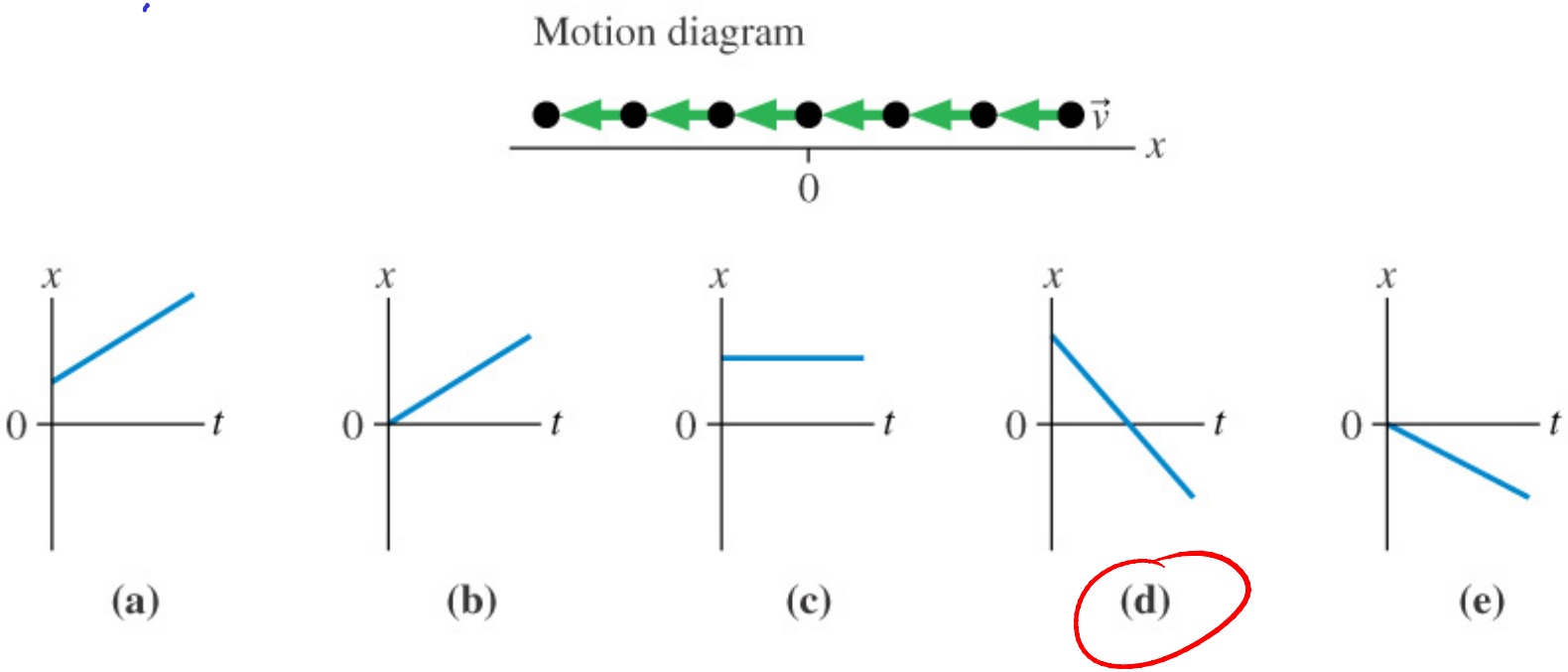
§ Plotting motion on a position-time graph

t(s)	x (m)
2	-2
4	10
6	24
8	29
10	27
12	19





Which position-versus-time graph represents the motion shown in the motion diagram?



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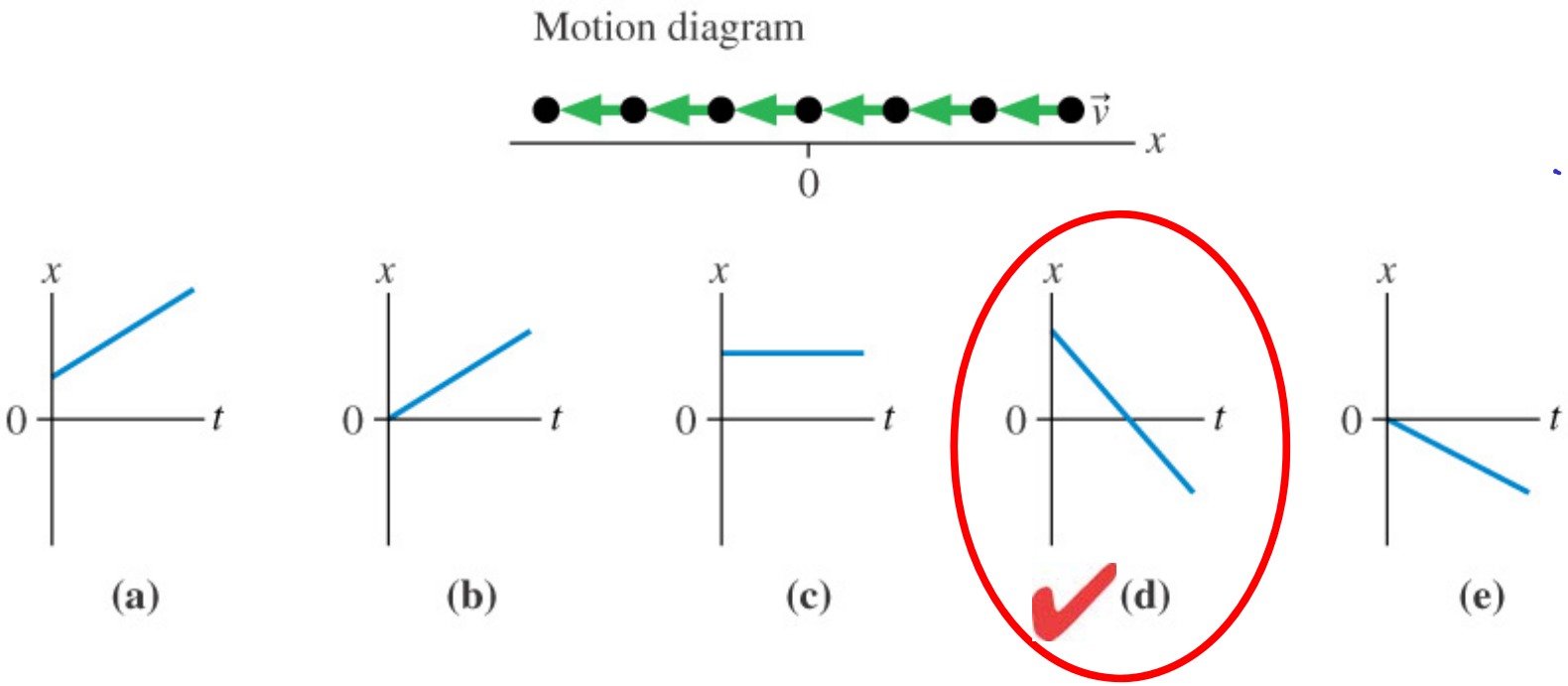

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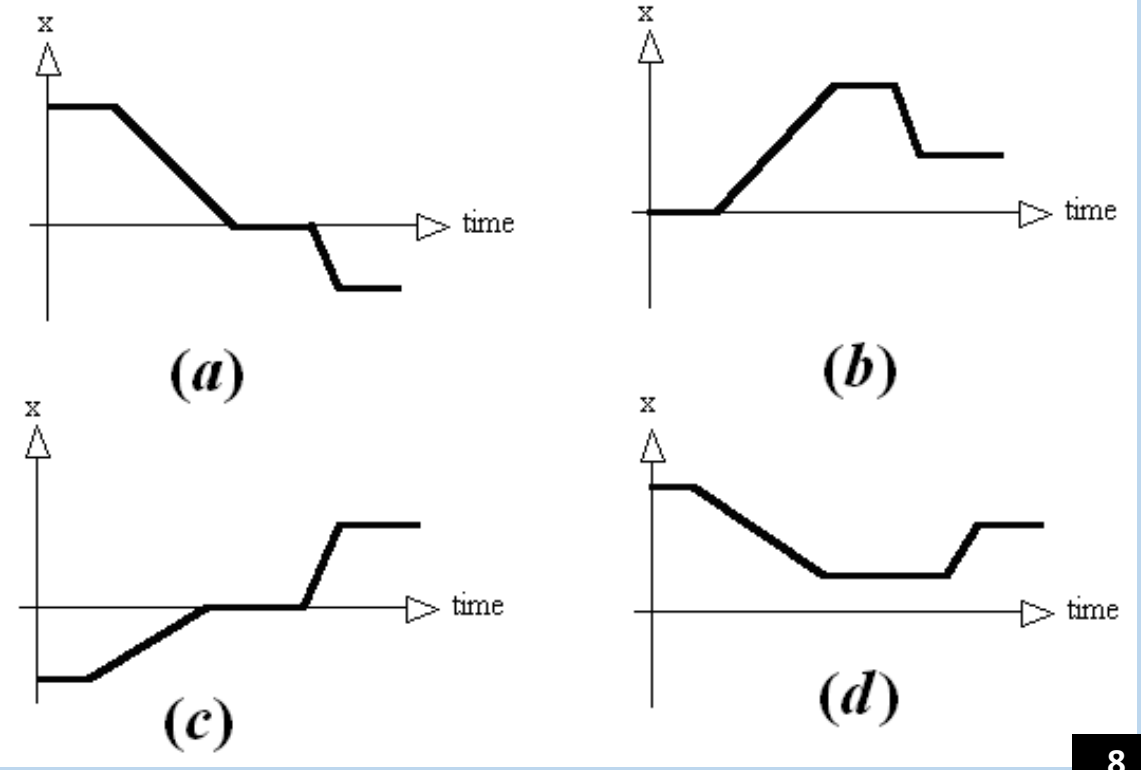
Clicker Quiz

- A person initially at point **C** on the x-axis stays there for a little while and then strolls along the x-axis to point **A**, stays there for a moment and then runs to point **B** and remains there.

- **Which graph correctly depicts this motion?**



Clicker Quiz

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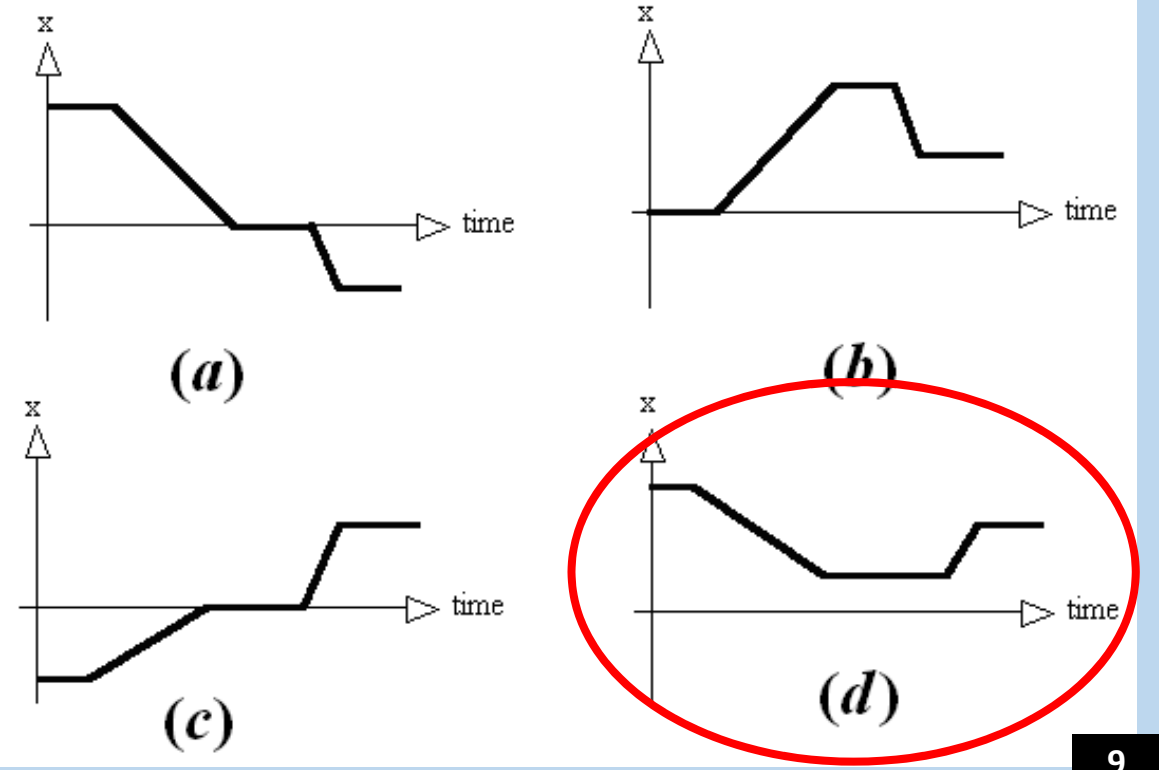
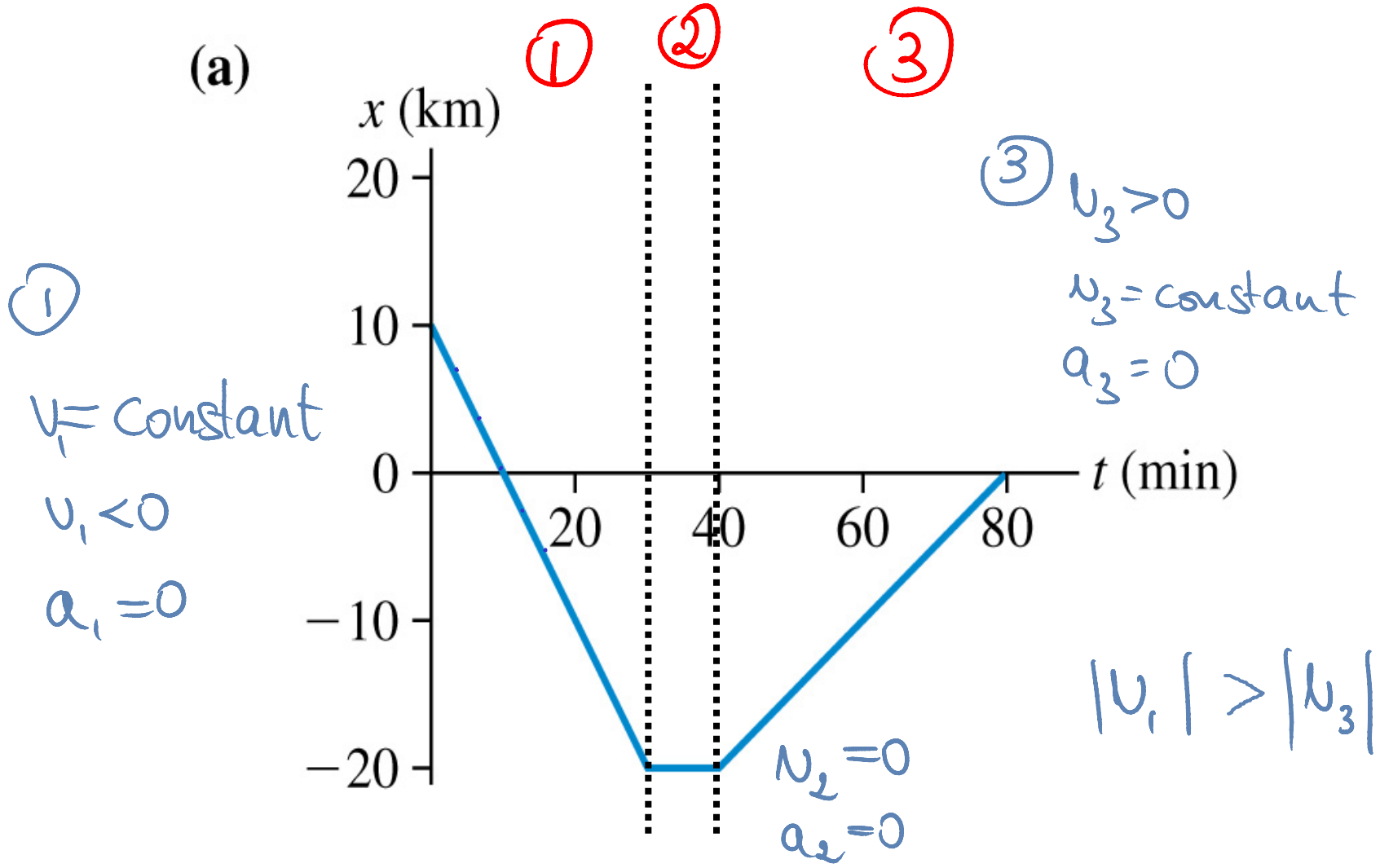


Time Graphs



Velocity

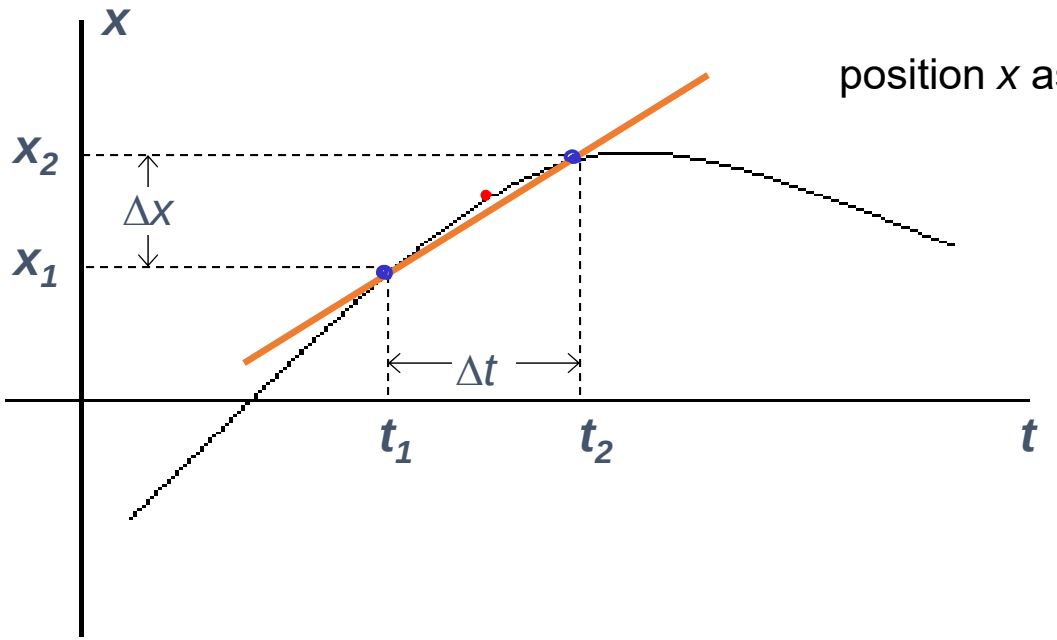
average **speed**: $\text{average speed} = \dfrac{\text{distance traveled}}{\text{time interval spent traveling}}$

"How fast?"

average **velocity**: $\vec{v}_{avg} = \dfrac{\Delta \vec{r}}{\Delta t}$

"How fast and in which direction?"

Displacement : $\Delta x \equiv x_2 - x_1$



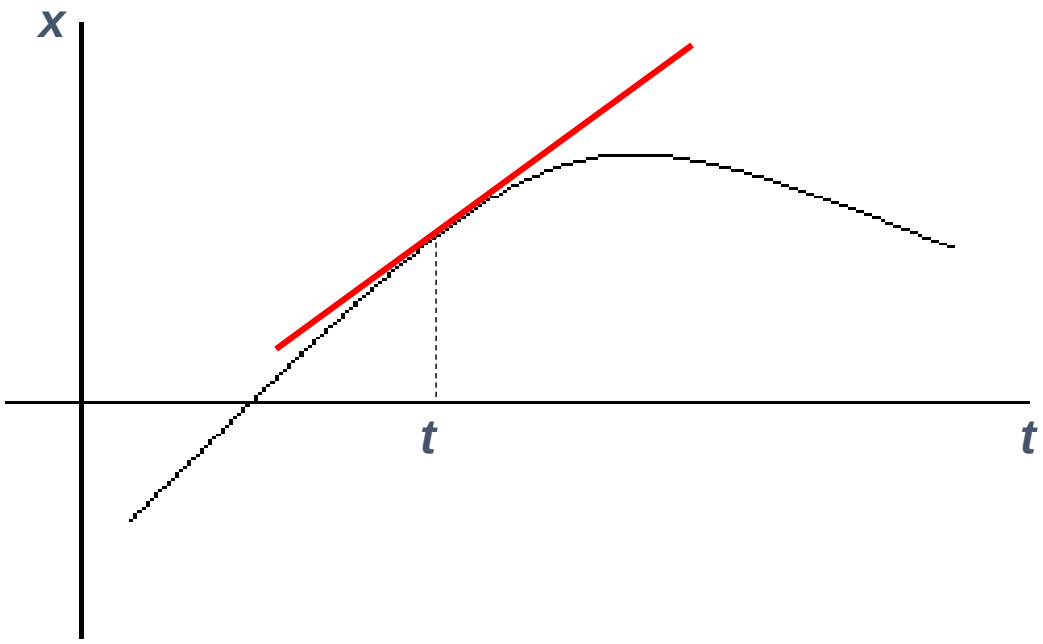
position *x* as a function of time *t*

Average velocity : $\bar{v} \equiv \Delta x / \Delta t$ (**slope of the secant line**)

Instantaneous velocity

average over an 'infinitesimal' time interval :

$$t_2 \to t_1\ ,\ \Delta t \to 0\ \text{ and }\ \frac{\Delta x}{\Delta t} \to \frac{dx}{dt} \equiv v$$



v is the slope of the tangent to the *x* vs. *t* graph.

Physically, *v* is the rate of change of *x*, ***hence dx/dt.***

§

Clicker Quiz

You go out for a jog – you travel at 8 km/h for 2 hour, 6 km/h for 2 hours and then 4 km/h for 1 hour. What is your average speed?

A. 6 km/h
B. Less than 6 km/h
C. Greater than 6 km/h
D. Not enough information

$$d = 8\,\frac{km}{h} \cdot 2h + 6\,\frac{km}{h} \cdot 2h + 4\,\frac{km}{h} \cdot 1h$$

$$= 32\ km$$

$$\Delta t = 2h + 2h + 1h = 5h$$

$$v_a = \frac{d}{\Delta t} = \frac{32\ km}{5h} = 6.4\,\frac{km}{h}$$

§ Speed vs Velocity

You are walking down Main St. At 1:05 pm, you are 40 m east of campus. At 1:09 pm you are 60 m west of campus. What is your *average* velocity over the trip?

Let's define [east] as the positive direction

$x_1 = 40\ m\ (east) = +40\ m$ $\qquad t_1 = 1:05$

$x_2 = 60\ m\ (west) = -60\ m$ $\qquad t_2 = 1:08$

$$\vec{v} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{(-60\ m) - (+40\ m)}{1:09 - 1:05} = \frac{-100\ m}{4\ min} = -25\ \frac{m}{min}$$

$$= -0.42\ \frac{m}{s}$$

Acceleration

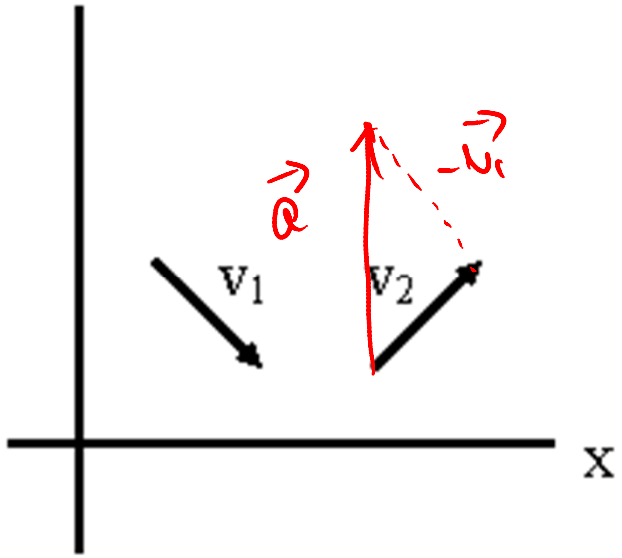
is the *rate of change of velocity*

Average Acceleration: $\bar{a} \equiv \frac{\Delta v}{\Delta t} \equiv \frac{v_2 - v_1}{t_2 - t_1}$

Instantaneous Acceleration: $a \equiv \frac{dv}{dt}$

RI-9. A particle is moving with <u>constant</u> acceleration. Its velocity vector at two different times is shown below. What is the direction of the acceleration?

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t}$$



A)

D) B)

C)

E) Some other direction