Main Ideas in Class Today

- Graphing helps you better understand the motion
  - Position
  - Velocity
  - Acceleration

Practice Problems: Few odd ones for graphing 2.6, 2.8, 2.20, 2.29, 2.31, 2.33, 2.37, 2.39, Conceptual Problem 2.9

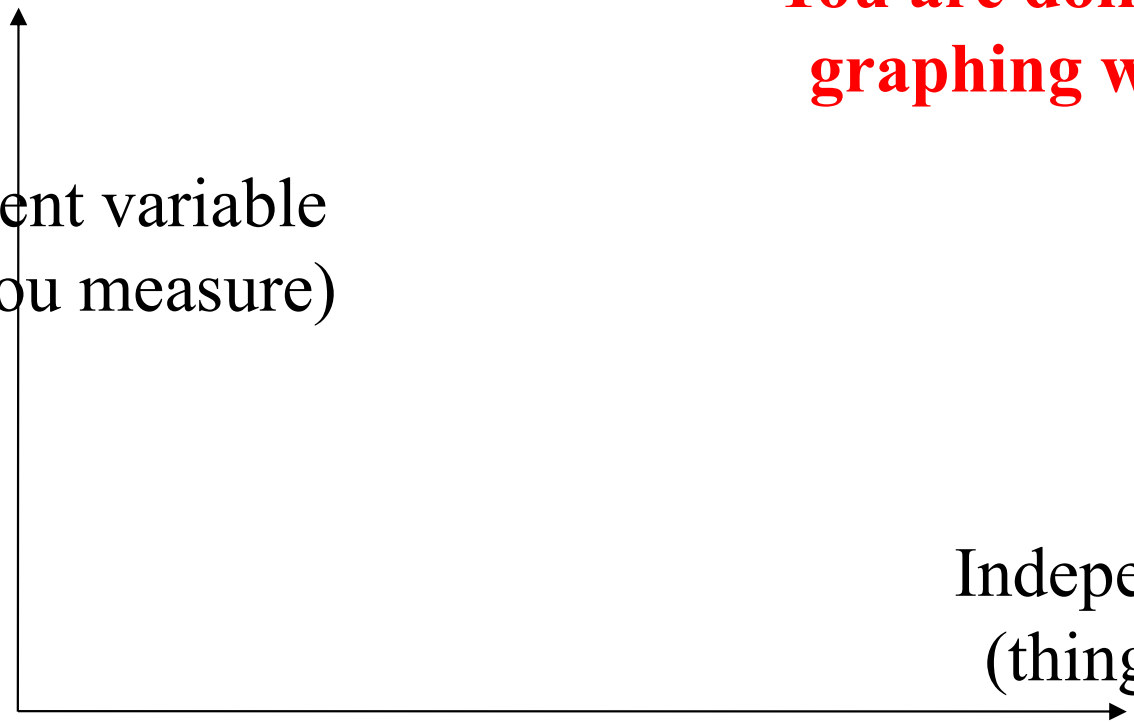
Graphing Position, Velocity and Acceleration

y axis = position, velocity or acceleration

+

Dependent variable
(thing you measure)

You are doing hands on graphing work in lab

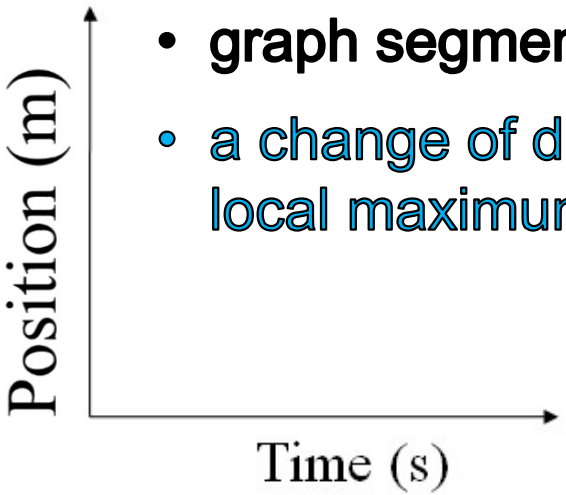


Independent variable
(thing you control)

x axis = Time (s)

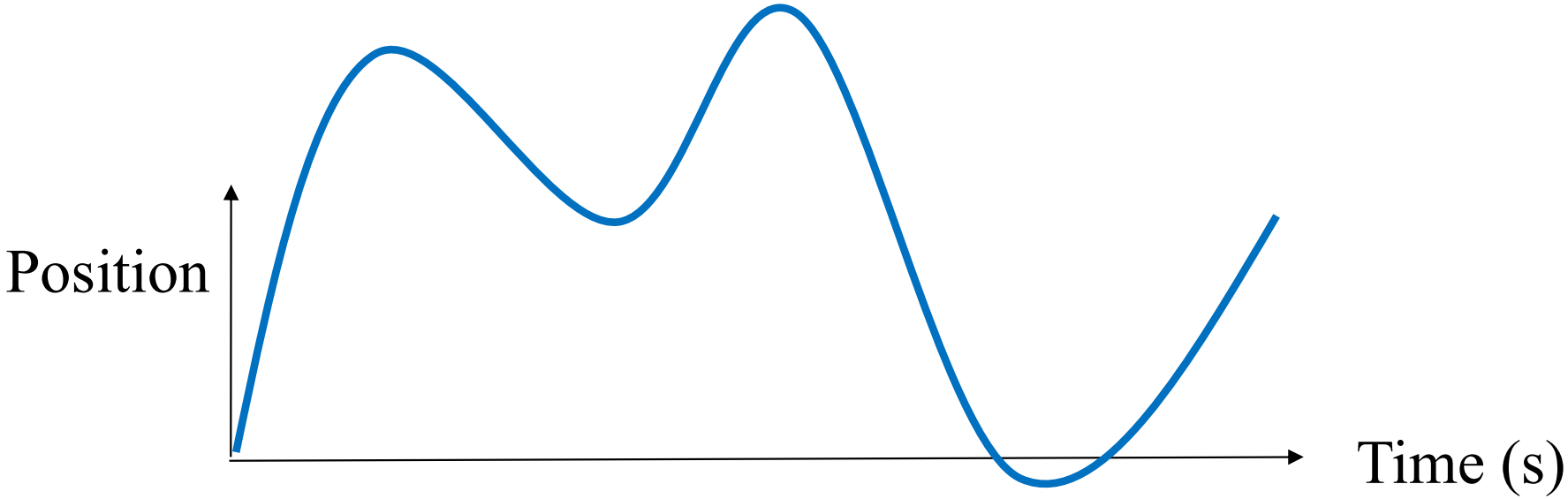
Position – Time Graphs Summarized

- horizontal graph segments (--) indicate that the object is "at rest"
- graph segments moving upward (/) imply movement in positive direction
- graph segments moving downward (\) imply movement in the negative direction
- slope of position-time graph at any instant is the instantaneous velocity
- straight line graph segments (/ or \ or --) indicate constant speed
- curving graph segments indicate changing speed (acceleration)
- graph segments becoming steeper indicate an increase in speed
- graph segments becoming less steep indicate a decrease in speed
- a change of direction is indicated whenever the graph goes through a local maximum or minimum point



This curve represents the position versus time.

Do we know anything about the direction(s) of motion over the shown time period?



A: The object changes direction once.

B: The object changes direction twice.

C: The object changes directions three times.

D: The object changes directions four times.

E: The object does not change direction.

Q04

Graphing

The blue line shows the position of a person at different times.

When do they go the fastest?

Calculate:

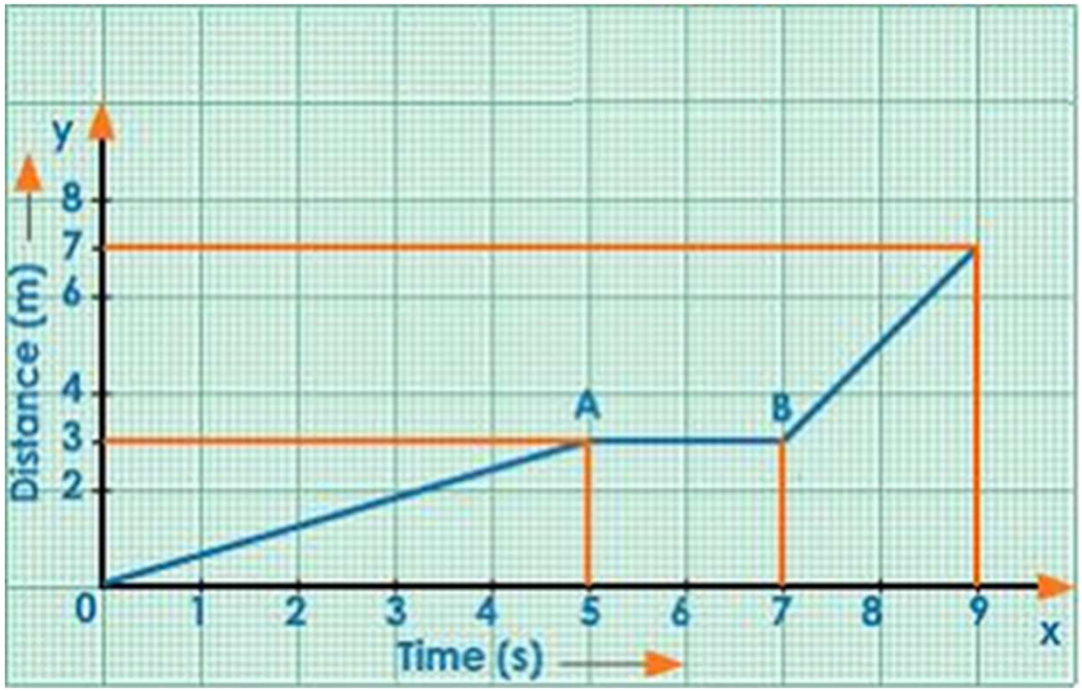
(i) the velocity of the person as they moves for 0 to 5 s

(ii) Instantaneous velocity at 3s

(iii) 5 to 7 s

(iv) 7 to 9 s

(v) Average velocity 0 to 9 s



(i) Velocity of the person as they move from 0 to 5 s = Slope of OA

$= \frac{3-0}{5-0}$ = 0.6 m/s Does this velocity change over that range?

(iii) Velocity from 5 to 7 s = Slope of AB

$= \frac{3-3}{7-5}$ = 0 m/s

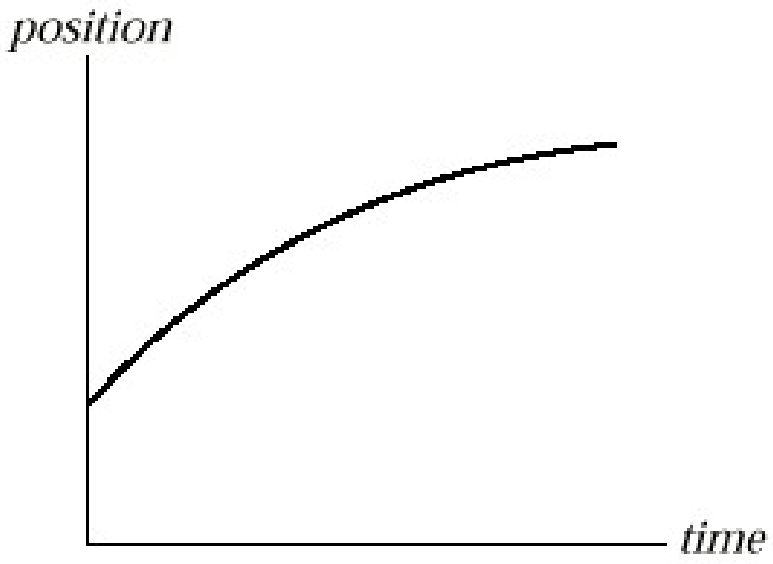
It's the same idea for calculating acceleration from velocity graphs

(iv) Velocity from 7 to 9 s $= \frac{7-3}{9-7}$ = 2 m/s

(v) Average velocity from 0 to 9 s= distance/time=7m/9s=7/9 m/s

Harder if ask from 2.5s to 8 s, shall we try?

A train car moves along a long straight track. The graph shows the position as a function of time for this train. The graph shows that the train:

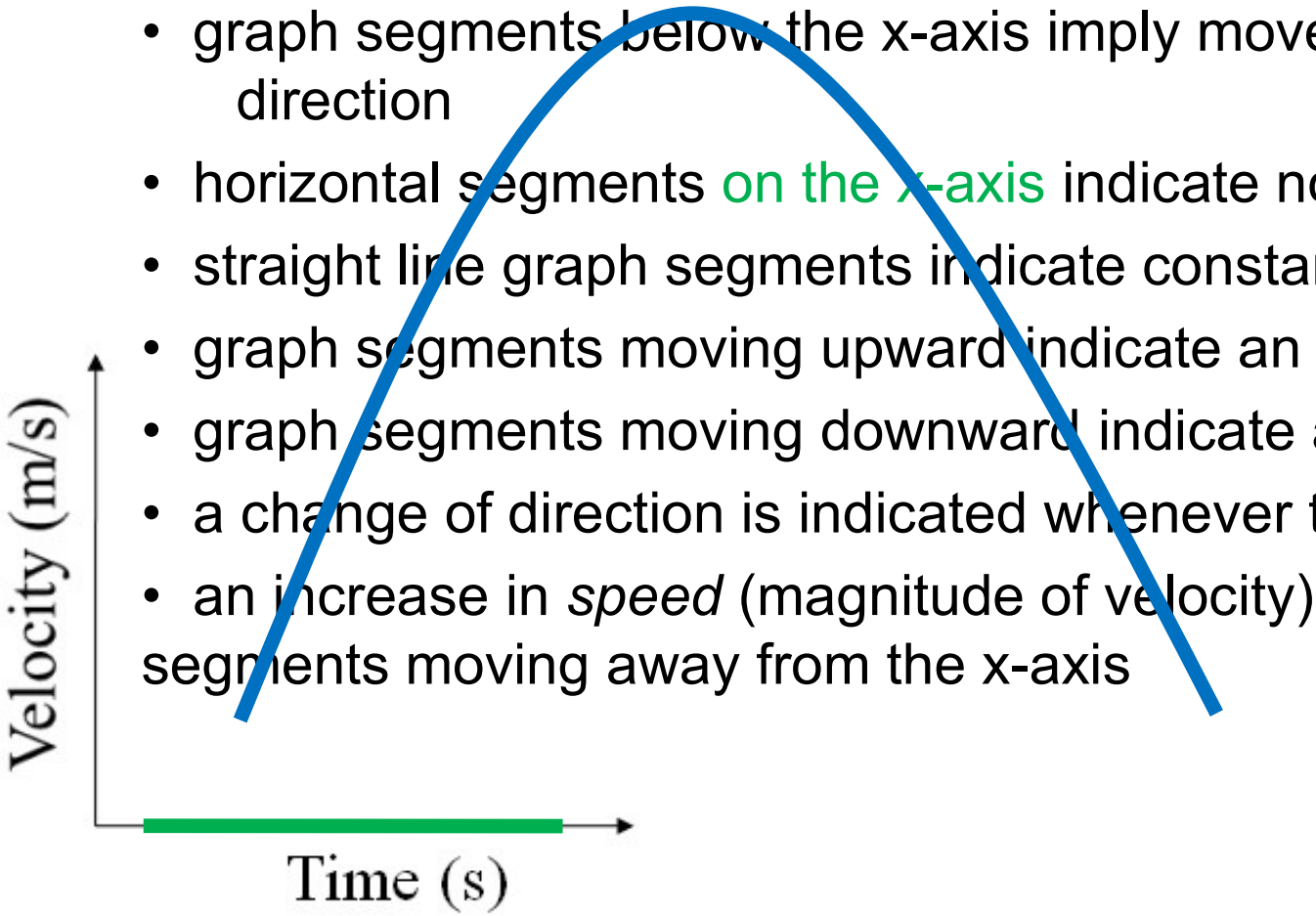


A. speeds up all the time.
B. slows down all the time.
C. speeds up part of the time and slows down part of the time.
D. moves at a constant velocity.

Q05

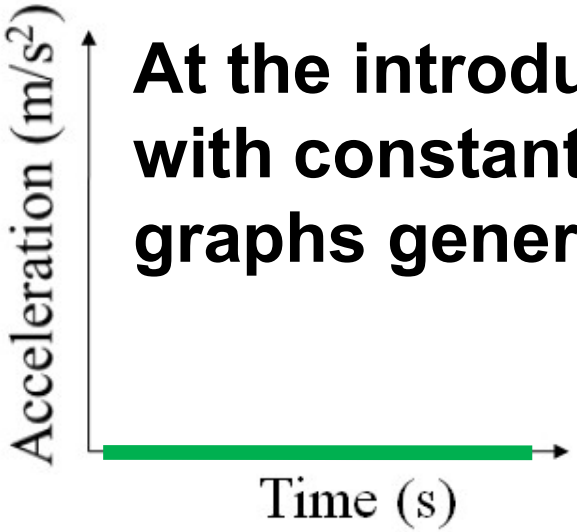
Velocity – Time Graphs Summarized

- the slope of a velocity-time graph is the acceleration
- horizontal graph segments indicate that the object has constant velocity
- graph segments above the x-axis imply movement in the positive direction
- graph segments below the x-axis imply movement in the negative direction
- horizontal segments on the x-axis indicate no movement
- straight line graph segments indicate constant acceleration (--, / or \)
- graph segments moving upward indicate an increase in velocity (/)
- graph segments moving downward indicate a decrease in velocity (\)
- a change of direction is indicated whenever the graph crosses the x-axis
- an increase in *speed* (magnitude of velocity) is indicated by graph segments moving away from the x-axis



Acceleration – Time Graphs Summarized

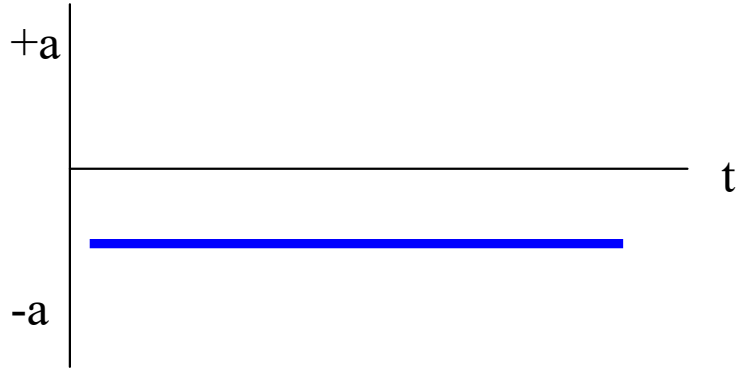
- horizontal graph segments indicate that the object has constant acceleration
- a horizontal graph segment on the x-axis indicates that the object has constant velocity (zero acceleration)
- graph segments above the x-axis imply increasing velocities
- graph segments below the x-axis imply decreasing velocities
- no changes in direction may be inferred from these graphs



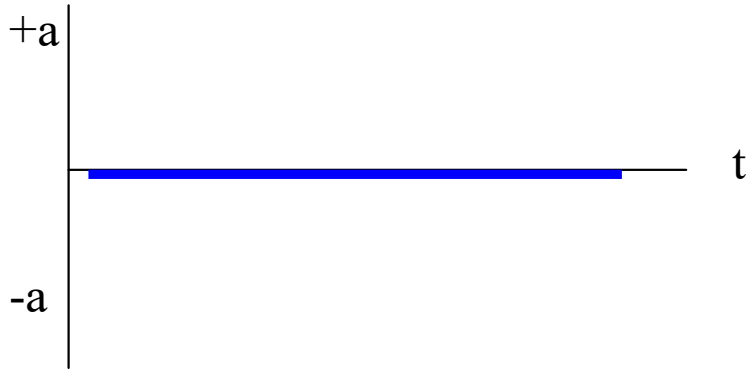
At the introductory physics level, we typically only deal with constant acceleration situations, so acceleration graphs generally consist of horizontal segments only.

An object is **speeding up uniformly in the *positive* direction**. Which of the following represents this motion?

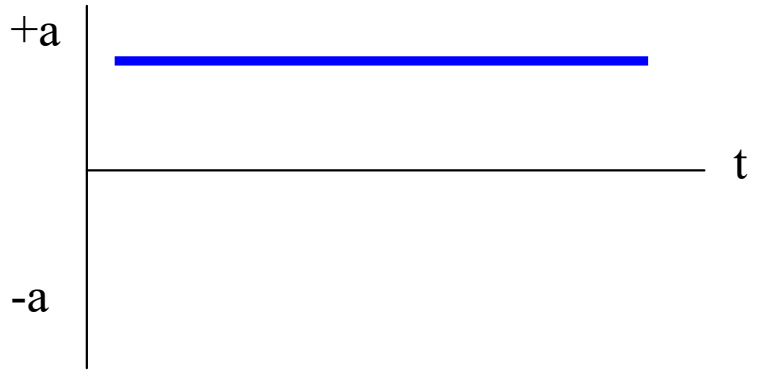
A.



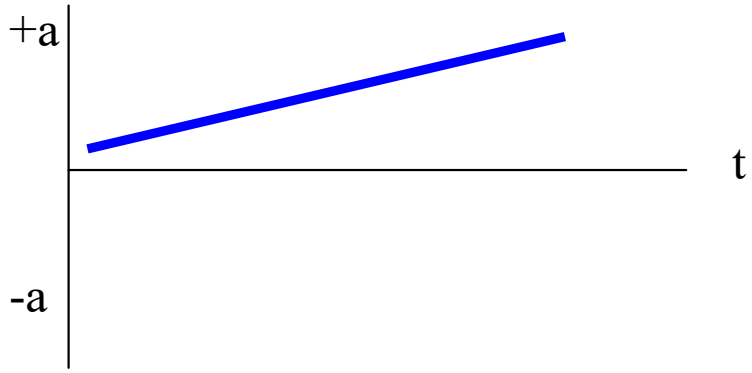
B.



C.



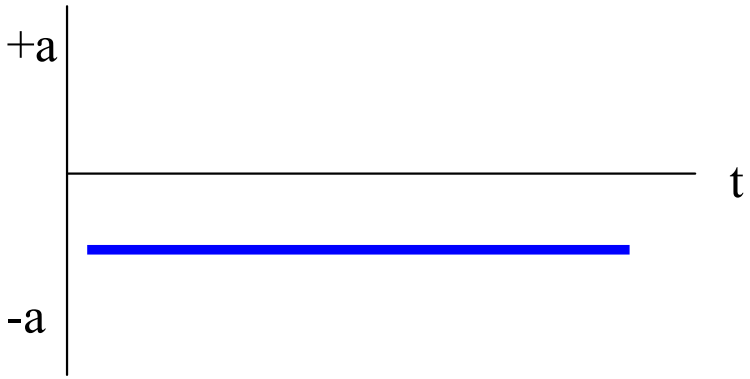
D.



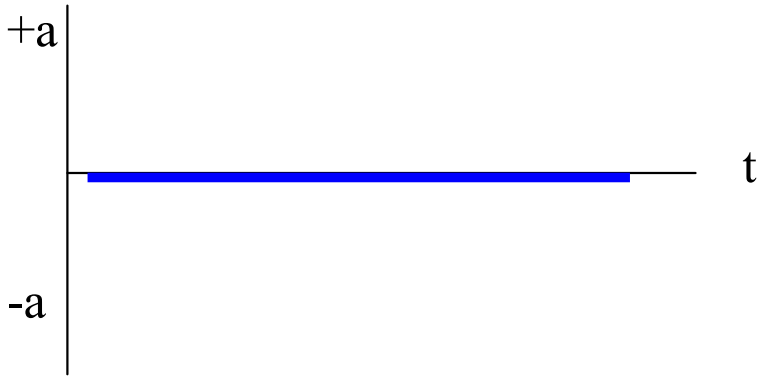
Q06

An object is **speeding up uniformly in the *negative* direction**. Which of the following represents this motion?

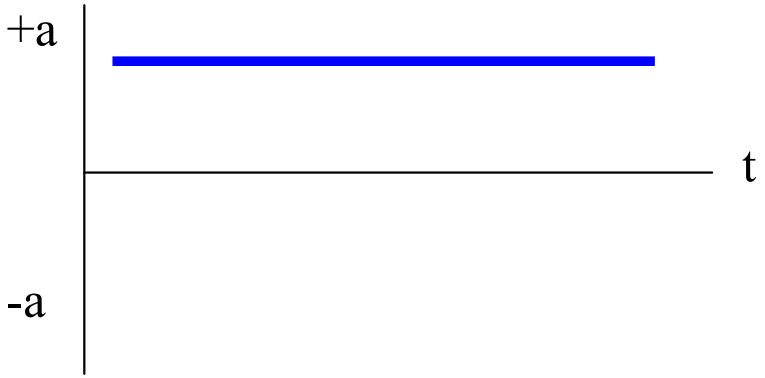
A.



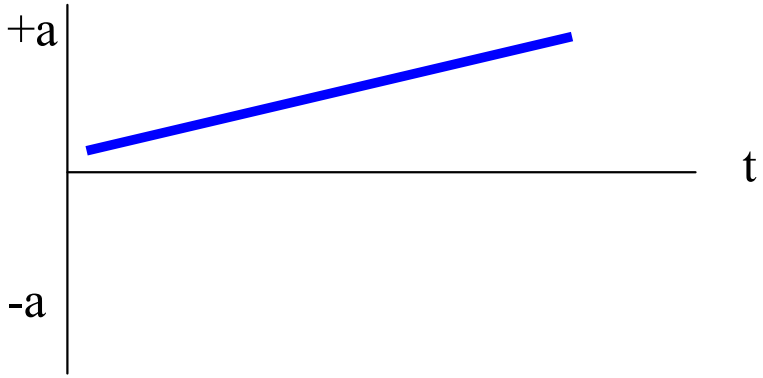
B.



C.



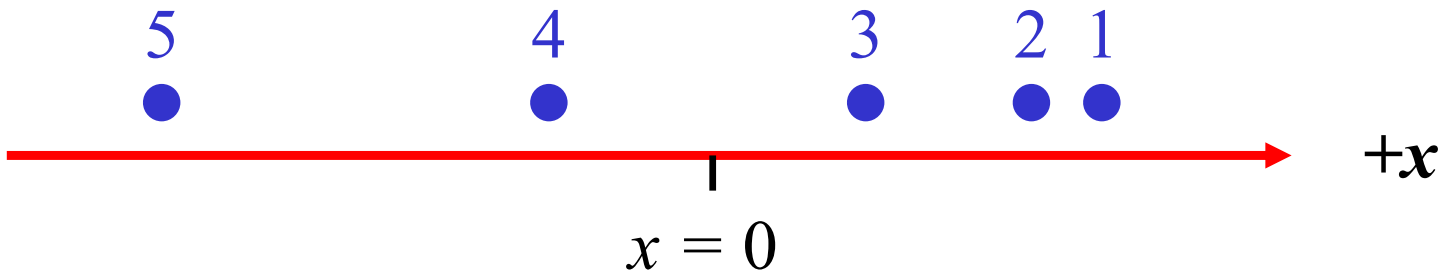
D.



Q07

Not a graphing question, but the next part will be

This is a motion diagram of an object moving along the x-direction with constant acceleration. Starting with 1, the dots 1, 2, 3, … show the position of the object at equal time intervals Δt.



At the time labeled 3, what are the signs of the object's velocity v_x and acceleration a_x?

A. $v_x < 0, a_x = 0$

B. $v_x < 0, a_x > 0$

C. $v_x < 0, a_x < 0$

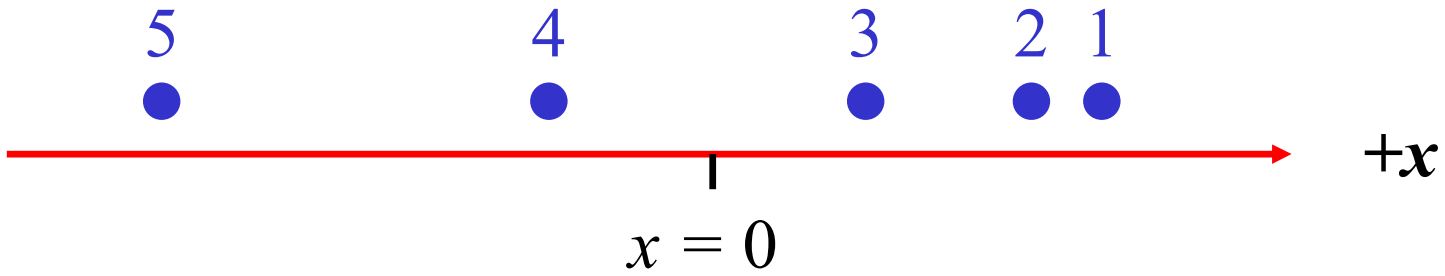
D. $v_x > 0, a_x > 0$

E. $v_x > 0, a_x < 0$

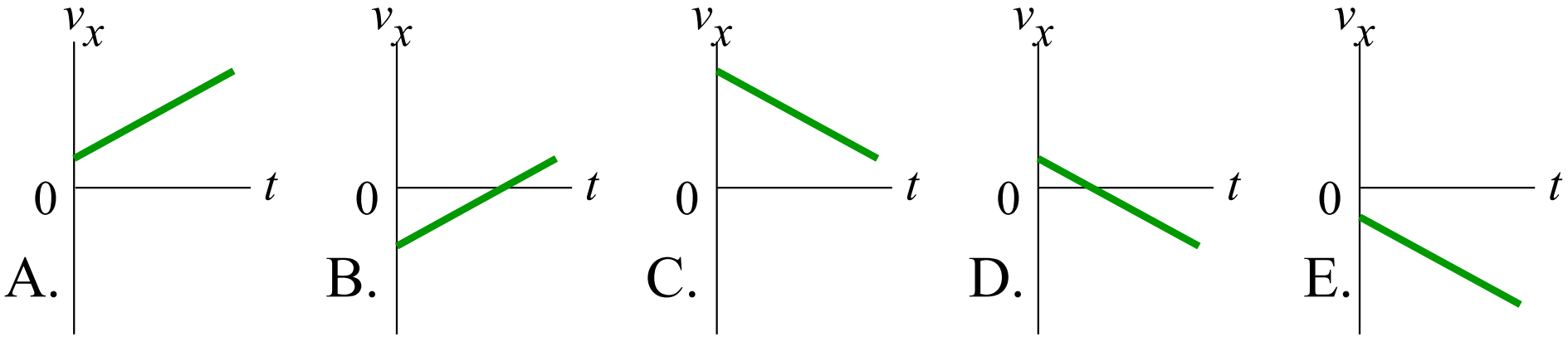
Q08

Q09

This is a motion diagram of an object moving along the x-direction with constant acceleration. Starting with 1, the dots 1, 2, 3, … show the position of the object at equal time intervals Δt.



Which of the following *velocity versus time* graphs best matches the motion shown in the motion diagram?



What you learn from graphs?

Type of graph	Slope gives:	Change of direction
Position vs Time	Velocity	At maximum or minimum
Velocity vs Time	Acceleration	When curve crosses axis
Acceleration vs Time	---	Can't determine

Integration (calculus) lets you find the area under a curve (which does give information), but we won't be doing that

Clicker Answers

Chapter/Section: Clicker #=Answer

4=D, 5=B, 6=C, 7=A, 8=C, 9=E