- H.W #2 Due Today at midnight

  #10 speed = $\frac{\text{Total Distance}}{\text{Total time}}$

- Clicker points on webCT
  (Roster downloaded last week)

- Exam Monday Feb 11
  Do Lots of problems
  "old" exam will be made
  available next week
  start at 8:00 if you wish

- H.W #3 available

- Read 3.1-3.4

Interactive Question

Two balls are thrown straight up. The first is thrown with twice the initial speed of the second. Ignore air resistance. How much higher will the first ball rise?

A) √2 times as high.
B) Twice as high.
C) Three times as high.
D) Four times as high.
E) Eight times as high

$a = -g$

$v_{01} = 2v_{02}$

$v^2 = v_0^2 + 2a\Delta y$

$0 = v_0^2 - 2g\Delta y$

$\Delta y = v_0^2/2g$

$$\frac{\Delta y_1}{\Delta y_2} = \frac{(v_{01})^2/2g}{(v_{02})^2/2g} = \frac{v_{01}^2}{v_{02}^2}$$

$$\frac{(2v_{02})^2}{(v_{02})^2} = 4$$

Interactive Question

Two rocks are dropped into two different deep wells. The first one takes three times as long to hit bottom as the second one. Ignore air resistance. How much deeper is the first well than the second?

A) $\sqrt{3}$ times as deep.
B) Three times as deep.
C) Four and a half times as deep.
D) Six times as deep.
E) Nine times as deep.

$a = -g \quad v = 0$

$t_1 = 3t_2$

$y = y_0 + v_0 t + \frac{1}{2} a t^2$

$y_1 = -\frac{1}{2} g t_1^2$

$\frac{y_1}{y_2} = \frac{-\frac{1}{2} g t_1^2}{-\frac{1}{2} g t_2^2} = \frac{t_1^2}{t_2^2}$

Interactive Question

Ball A is dropped from the top of a building. One second later, ball B is dropped from the same building. Neglecting air resistance, as time progresses the *difference* in their speeds

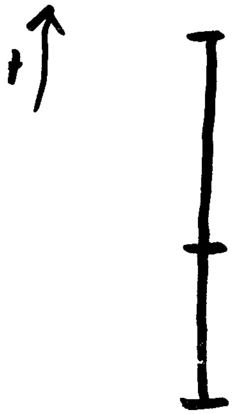
A) increases.
B) remains constant.
C) decreases.
D) depends on the size of the balls.

Interactive Question

Ball A is dropped from the top of a building. One second later, ball B is dropped from the same building. Neglecting air resistance, as time progresses the *distance* between them

A) increases.
B) remains constant.
C) decreases.
D) depends on the size of the balls.

EX) An object is dropped from an unknown height. You NOTICE that it takes 0.2 s to fall the last 3.0 m. At what height was object dropped?



$t_1 = ?$ $y_1 = ?$

$v_1 = 0$ $a = -9.8\,m/s^2$

$t_2 = 0$ $y_2 = 3.0\,m/s^2$

$v_2 = ?$

$t_3 = 0.2\,s$ $y_3 = 0$

$v_3 = ?$

$$y = y_0 + v_0 t + \frac{1}{2} a t^2 \qquad t_0 = 0$$

what if $t_0 \neq 0$

$$y_1 = y_0 + v_0 (t - t_0) - \frac{1}{2} g (t - t_0)^2$$

$$y_2 = y_3 + v_3 (t_2 - t_3) - \frac{1}{2} g (t_2 - t_3)^2 \quad (y_3 = 0,\ t_2 = 0)$$

$$y_2 = -v_3 t_3 - \frac{1}{2} g (-t_3)^2$$

$$\boxed{v_3 = \frac{-y_2 - \frac{1}{2} g t_3^2}{t_3}}$$

$$\frac{-3.0\,m - \frac{1}{2} g (0.2\,s)^2}{0.2\,s} = \underline{-16\,m/s}$$

$$v_3^2 = v_1^2 + 2a(y_3 - y_1)$$

$$v_3^2 = 0 - 2g(0 - y_1)$$

$$v_3^2 = 2 g y_1$$

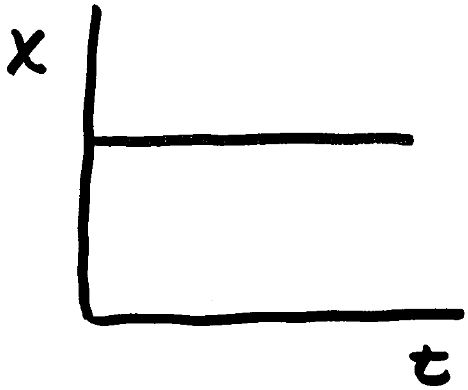
$$y_1 = \frac{v_3^2}{2g} = \frac{(-16\,m/s)^2}{2 \cdot 9.8\,m/s^2} = \underline{13\,m}$$

Analyzing motion on a Graph

- Look carefully at what the axes represent

- Look carefully at what is constant and what is changing

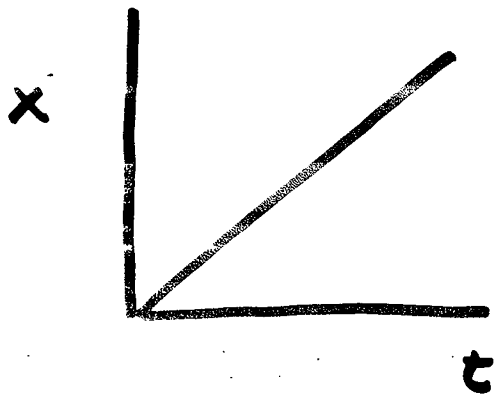
- what does the slope represent?



$V_{avg} = 0$

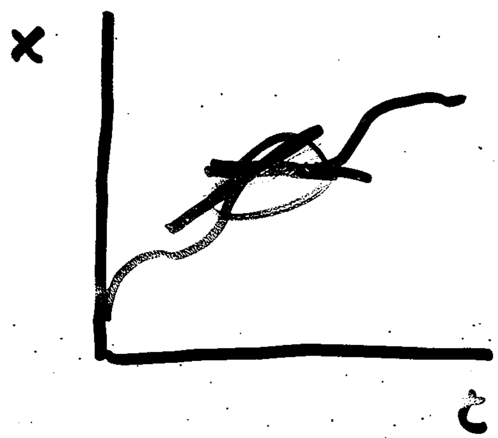
slope = 0

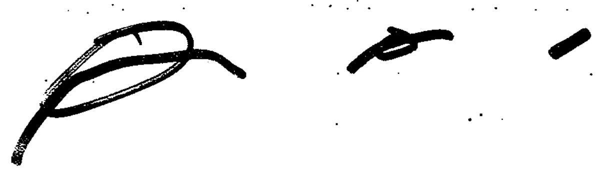
$\frac{\Delta x}{\Delta t}$ = slope = V_{avg}



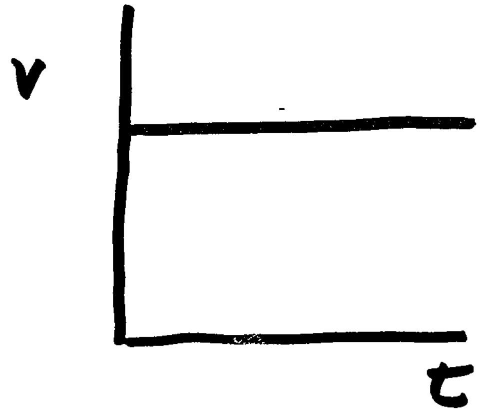
slope = constant

V_{avg} = constant





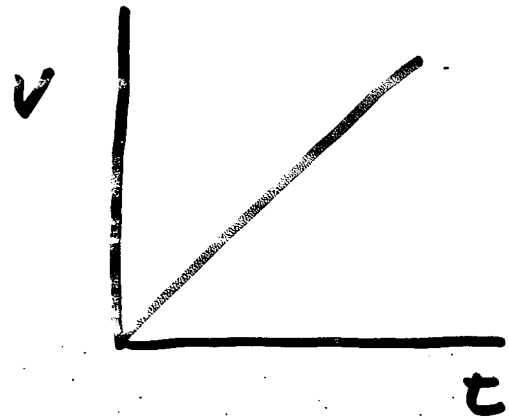
tangent is velocity



$a = 0$

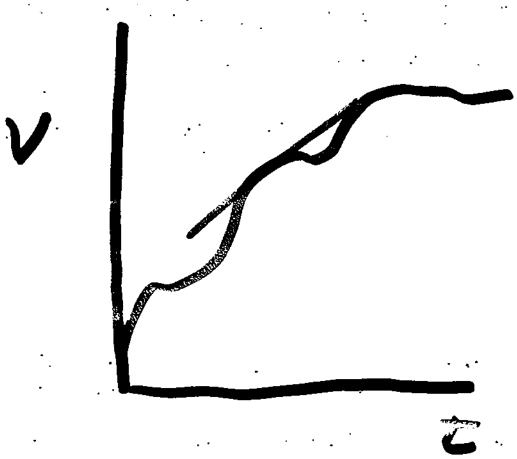
slope = 0

$\text{Slope} = \frac{\Delta v}{\Delta t} = a$

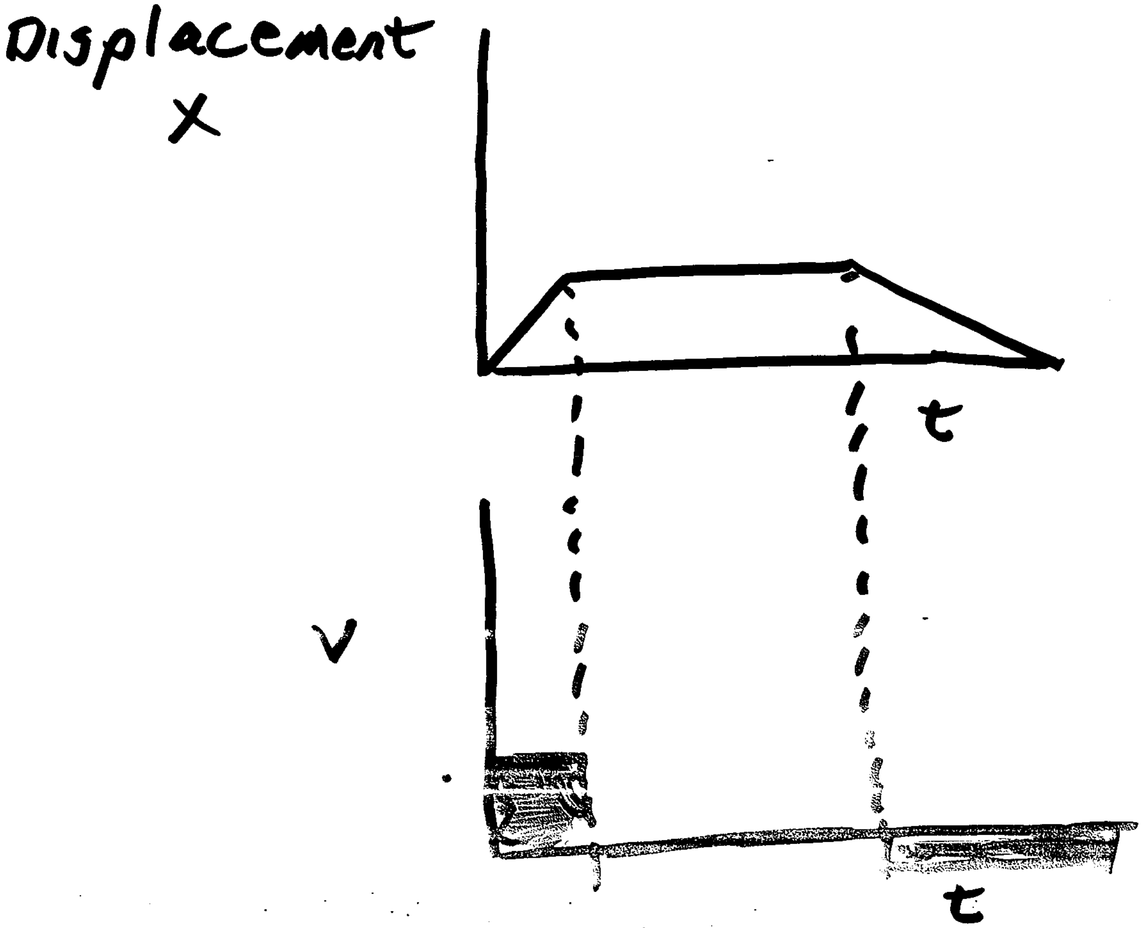


Const slope

Const a



a = tangent



If constant velocity, what is distance travelled in time t?

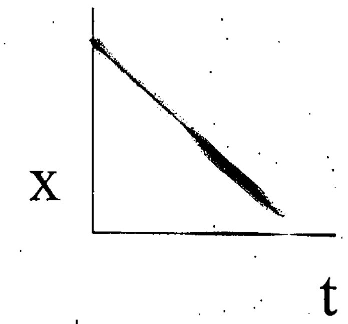
$$V_{avg} = \frac{\Delta x}{\Delta t} \Rightarrow \Delta x = V_{avg} \Delta t$$

<u>AREA</u> under velocity vs time graph

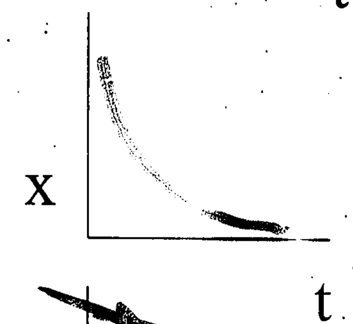
→ <u>Displacement</u>

An object is dropped from a building. What graph describes its motion

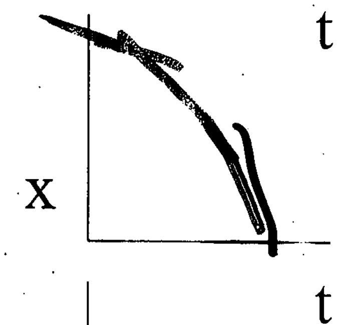
A



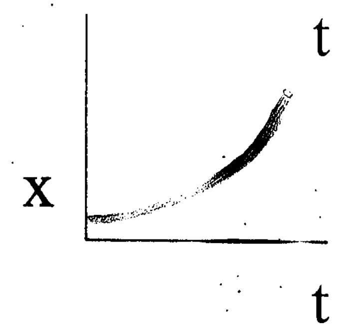
B



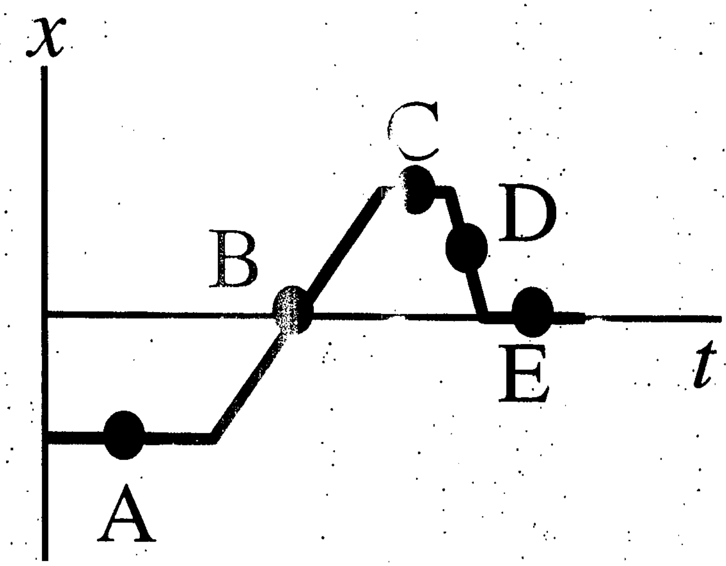
C



D

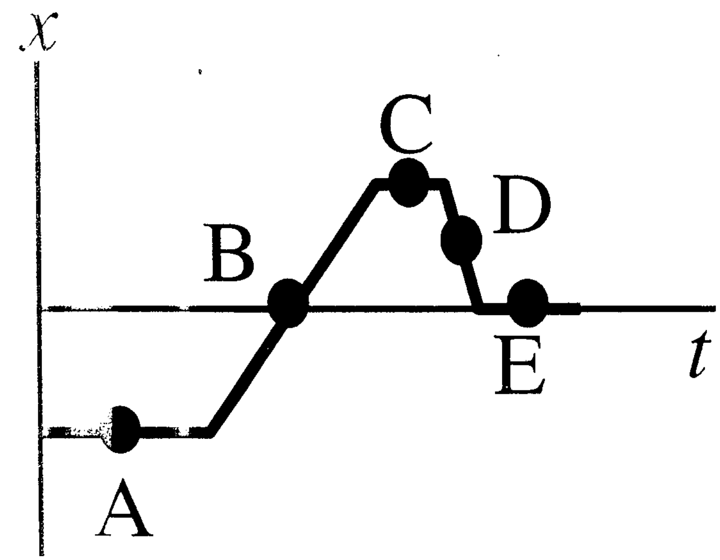


Consider the plot of x vs t at the right, at which point(s) is the motion fastest?



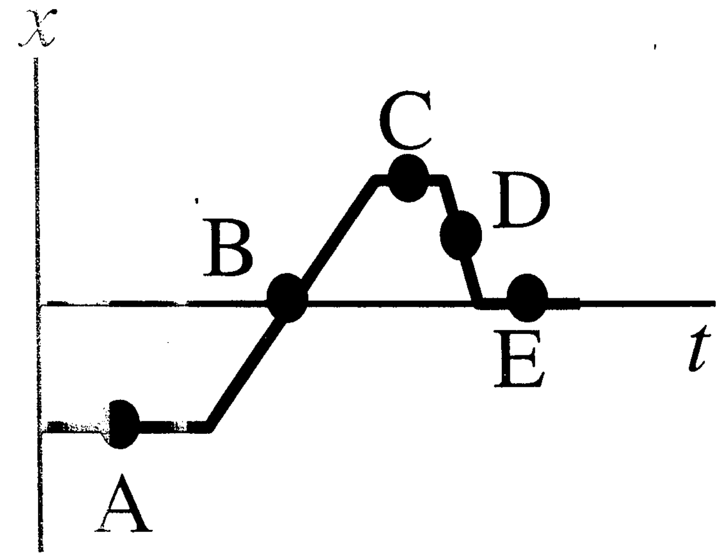
A) A
B) B
C) C
D) D
E) E

Consider the plot of x vs t at the right, at which point(s) is the object turning around?



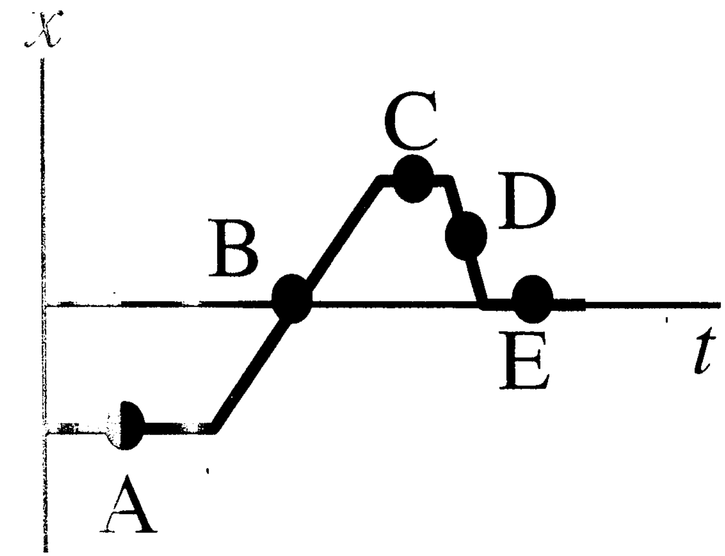
A) A
B) B
C) C
D) D
E) E

Consider the plot of x vs t at the right, at which point(s) is the object moving at a constant non-zero velocity?



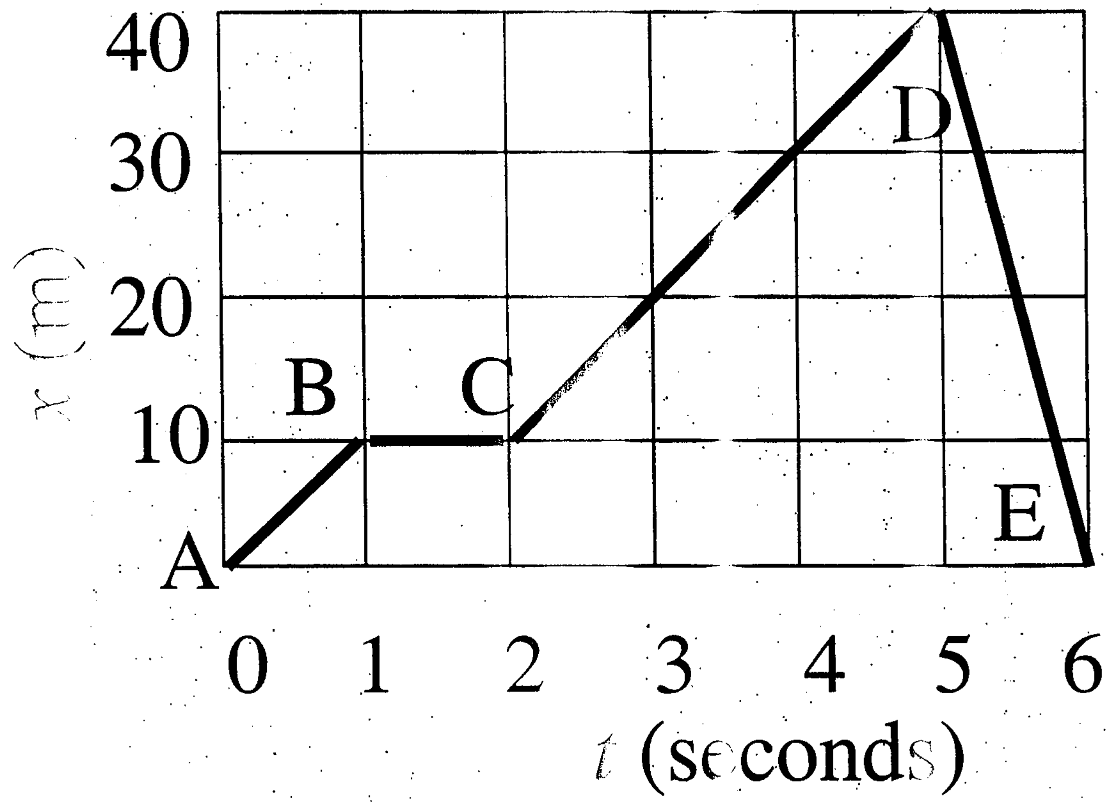
A) A and C
B) A, C and D
C) C only
D) D only
E) B and D

Consider the plot of x vs t at the right, at which point(s) is the object moving in the negative x direction?



A) A
B) B
C) C
D) D
E) E

An object is moving along a straight line. The graph at the right shows its position from the starting point as a function of time.



In what section of the graph does the object have the fastest speed?

A) AB

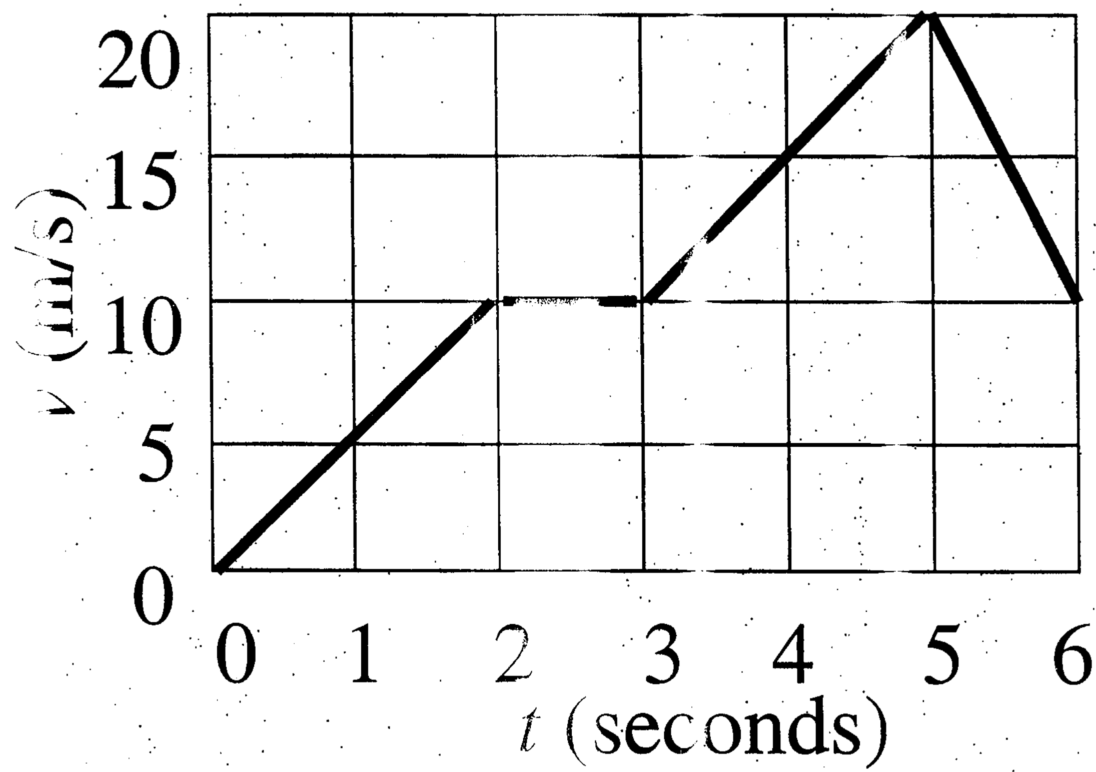
B) BC

C) CD

D) DE

E) AB and CD

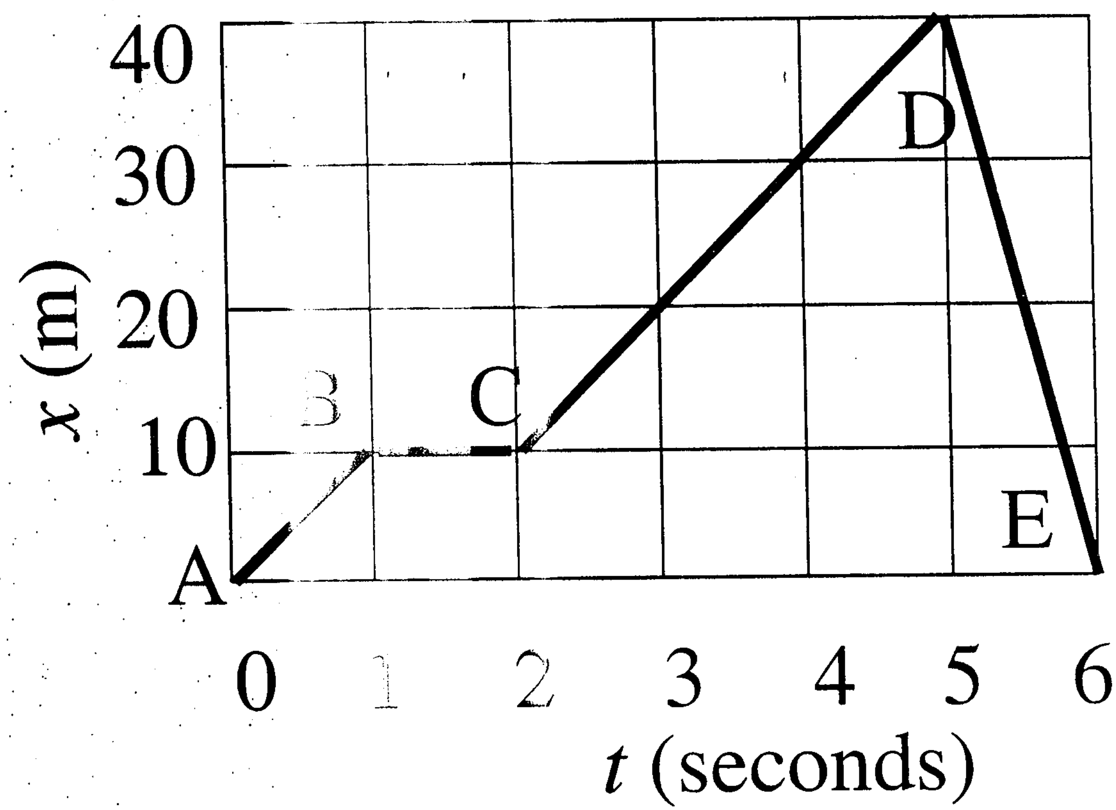
An object is moving along a straight line. The graph at the right shows its velocity as a function of time.



During which interval(s) of the graph does the object travel ***equal distances in equal times***?

A) 0 to 2 s
B) 2 s to 3 s
C) 3s to 5 s
D) 0 to 2 s and 3 s to 5 s
E) 0 to 2 s, 3 s to 5 s, and 5 s to 6 s

An object is moving along a straight line. The graph at the right shows its position from the starting point as a function of time.



What was the instantaneous velocity of the object at $t = 4$ seconds?

A) +6.0 m/s

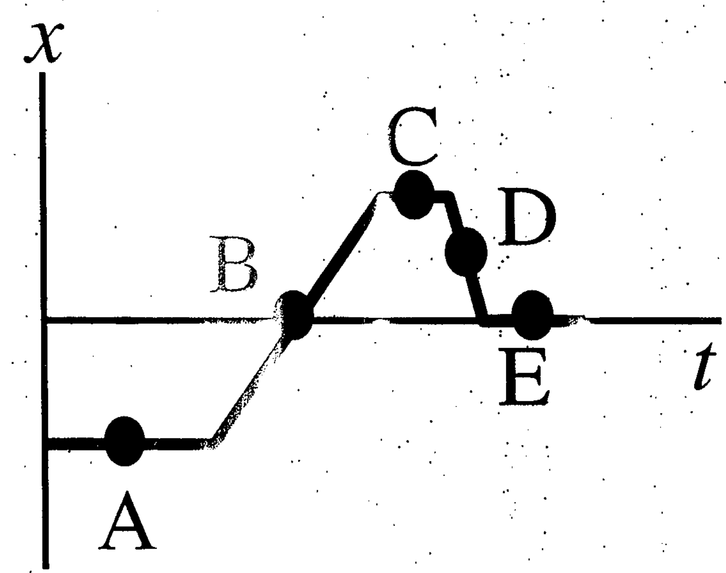
B) +8.0 m/s

C) +10.0 m/s

D) +13.3 m/s

E) +40 m/s

Consider the plot of x vs t at the right, at which point(s) is the motion slowest?



A) A
B) B
C) D
D) E
E) More than one of the above answers