Example 1 (numerical). pre req. continuous ← able to find f′

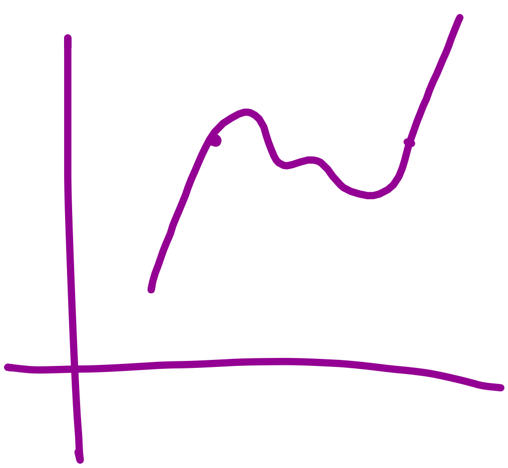
The data in the table below give selected values for the velocity, in meters/minute, of a particle moving along the x-axis. The velocity v is a differentiable function of time t.

Time t (min)	0	2	5	6	8	12
Velocity $v(t)$ (meters/min)	-3	2	3	5	7	5

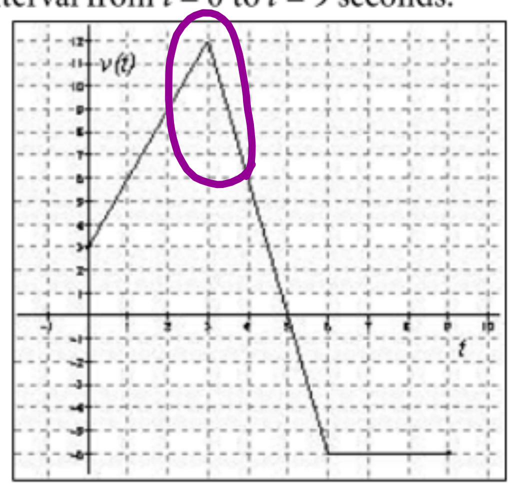
Avg acc. $\frac{5}{2}$ $\frac{1}{3}$ 2 1 $-\frac{1}{2}$

4. Let $a(t)$ denote the acceleration of the particle at time t. Is there guaranteed to be a time $t = c$ in the interval $0 \le t \le 12$ such that $a(c) = 0$? Justify your answer.

since Avg accl. for $[6,8]$ was 1 m/m^2 & for $[8,12]$ was $-\frac{1}{2}$ m/min^2, there must time $t=c$, where $a(c)=0$



Example 2 (graphical).
The graph below represents the velocity v, in feet per second, of a particle moving along the x-axis over the time interval from $t = 0$ to $t = 9$ seconds.



$[2,3]$

$v' = 3$

$[3,4]$

$v' = -6 \therefore v' \neq -\frac{3}{2}$

5. Is there guaranteed to be a time t in the interval $2 \le t \le 4$ such that $v'(t) = -3/2$ ft/sec^2? Justify your answer.

1. A particle moves along the x-axis so that its position at time t is given by $x(t) = t^2 - 6t + 5$. For what value of t is the velocity of the particle zero?

(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

$$x' = v = 2t - 6 = 0$$

$$t = 3$$

4. A particle moves along the y-axis so that its position at any time t, for $0 \le t \le 5$, is given by $y(t) = t^4 - 18t^2$. In which interval(s) is the particle speeding up?

(A) $0 < t < \sqrt{3}$

(B) $0 < t < \sqrt{3}$ and $3 < t < 5$

(C) $3 < t < 5$

(D) $\sqrt{3} < t < 3$ and $3 < t < 5$

(E) $\sqrt{3} < t < 3$

① v & a have the same sign.

② v(t) = y is moving away from t-axis.

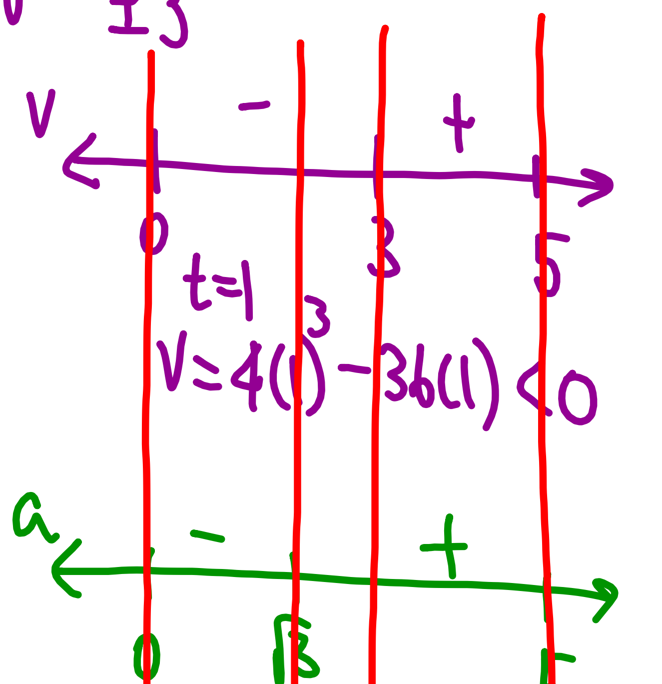
$$y' = 4t^3 - 36t \rightarrow 4t(t^2 - 9) = 0$$

$$0 \qquad \pm 3$$

$$y'' = 12t^2 - 36$$

$$\rightarrow 12(t^2 - 3) = 0$$

$$t = \pm\sqrt{3}$$



$t = 1$

$V = 4(1)^3 - 36(1) < 0$

$t = 3$

$a = 12(3)^2 - 36 > 0$

Speed up

$[0, \sqrt{3}]$ or $[3, 5]$