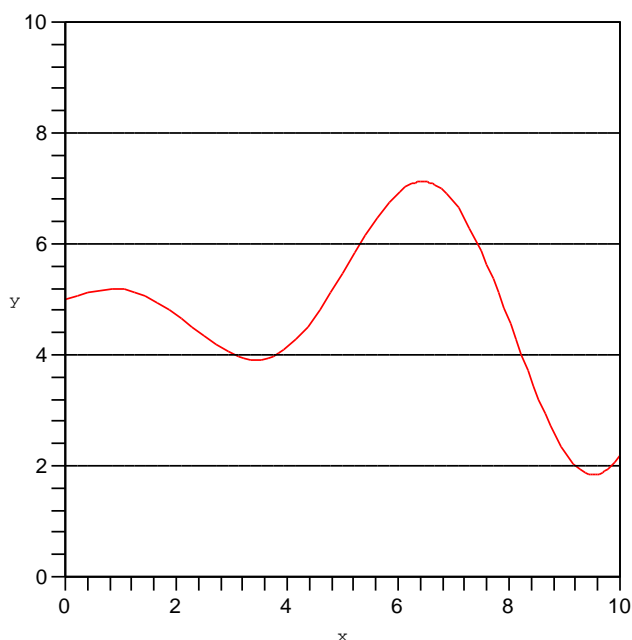


The graph gives the position $P(t)$ of a highway patrol car on the Mass Pike in miles east of Worcester, where t is minutes after 12:00 noon.

Let $V(t)$ be the car's velocity at time t .



1. Where is $V(t)$ positive? negative? zero?

V is positive where P is increasing: on $[0, 1]$, $[3.6, 6.4]$, $[9.5, 10]$

V is negative on $[1, 3.6]$, $[6.4, 9.5]$

V is zero at $x = 1$, $x = 3.6$, $x = 6.4$, $x = 9.5$.

2. When does the car change directions from driving east to west? from west to east?

At exactly those times when V is zero. From east to west is when P goes from increasing to decreasing, so at $t = 1$ and $t = 6.4$.

From west to east is when position goes from decreasing to increasing, so at $x = 3.6$ and $x = 9.5$.

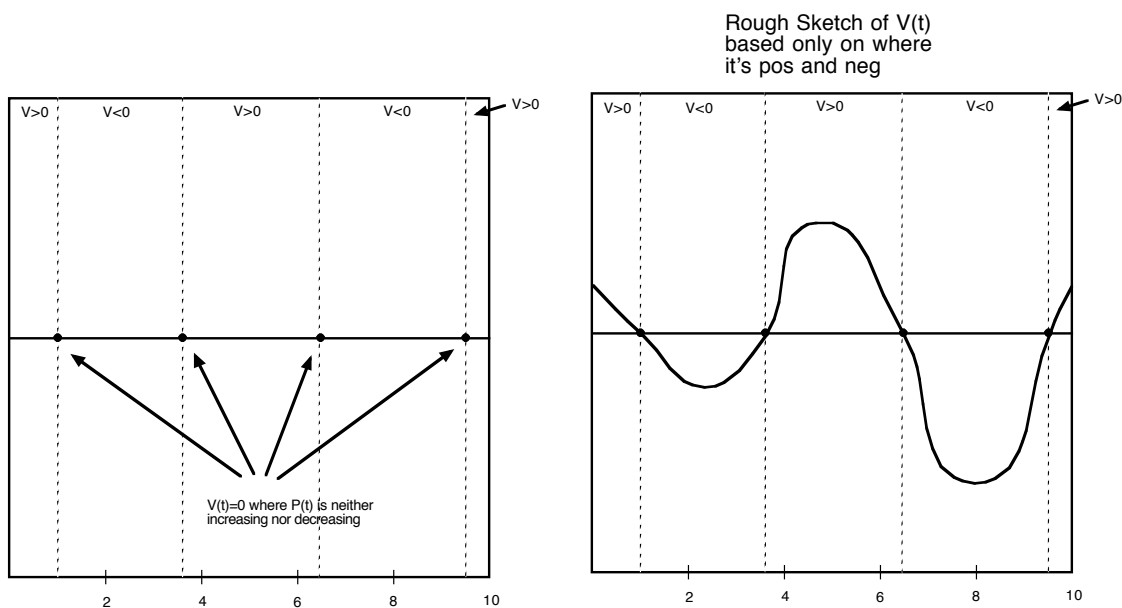
3. Use this information to *sketch* a graph $V(t)$.

I could do just a rough sketch, knowing only where $V(t)$ is positive, where it's zero, and where it's negative. First, I would just label my graph with what I know, and then I'd try to roughly connect the dots:

V is positive where P is increasing: on $[0, 1]$, $[3.6, 6.4]$, $[9.5, 10]$

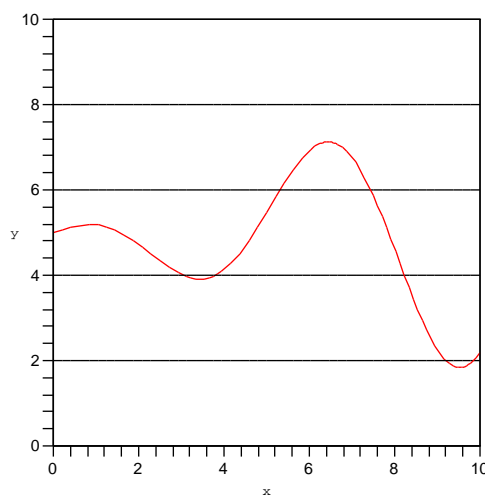
V is negative on $[1, 3.6]$, $[6.4, 9.5]$

V is zero at $x = 1$, $x = 3.6$, $x = 6.4$, $x = 9.5$.



Or I could add more detail: In addition to the above, I also know that the **positive** velocity is increasing when the slope is getting steeper upward, decreasing when the slope is getting flatter.

Negative velocity is different. Since a number like -1 is larger than a number like -20 , negative velocity "increases" when it gets closer to zero. In other words, negative velocity is increasing when the car *feels* as if it's slowing down. This would correspond to the downward slope of the position graph getting flatter.



Therefore,

Velocity is increasing $[2, 3.6], [3.6, 5], [8, 9.5], [9.5, 10]$

Velocity is decreasing $[0, 1], [1, 2], [5, 6.4], [6.4, 8]$

Velocity is increasing $[2, 3.6], [3.6, 5], [8, 9.5], [9.5, 10]$

Velocity is decreasing $[0, 1], [1, 2], [5, 6.4], [6.4, 8]$

Less rough sketch, taking into account where $V(t)$ changed from increasing to decreasing.

