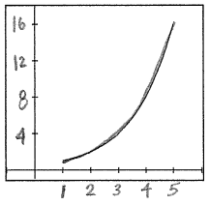
§3.6A: Particle Motion Day 2
"I WILL …
…identify components of a graph's speed, velocity, and acceleration."

I. Speed, Velocity, and Tangent Lines

A. _____ is the absolute value of velocity. It is measured of how fast something is moving with the regard of direction

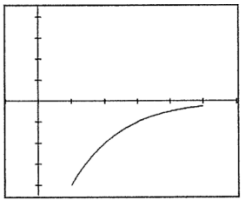
B. The effect of how an absolute value function has it on the graph is that it reflects all values that are below and above on the $x$-axis

Ex 1: For each situation, the graph is differentiable when giving velocity as a function of time $[1,5]$ along the selected values of the velocity. In this graph, each horizontal mark represents 1 $unit$ and each vertical mark represents 4 $units$. Plot the speed graph on the same coordinate plane as velocity.



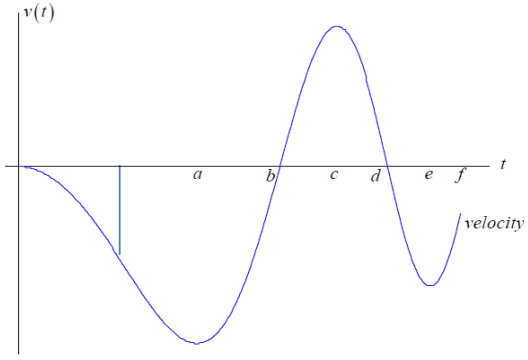

| Time | Velocity |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 4 |
| 4 | 8 |
| 5 | 16 |

Ex 2: For each situation, the graph is differentiable when giving velocity as a function of time $[1,5]$ along the selected values of the velocity. In this graph, each horizontal mark represents 1 $unit$ and each vertical mark represents 4 $units$. Plot the speed graph on the same coordinate plane as velocity.



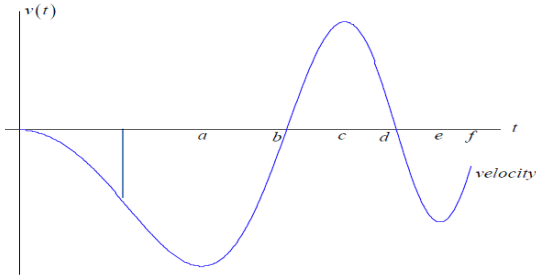
| Time | Velocity |
|---|---|
| 1 | −16 |
| 2 | −8 |
| 3 | −4 |
| 4 | −2 |
| 5 | −1 |

Ex 3: Given this graph below of $v(t)$, fill out the table below for intervals $[0,a]$ and $[c,d]$



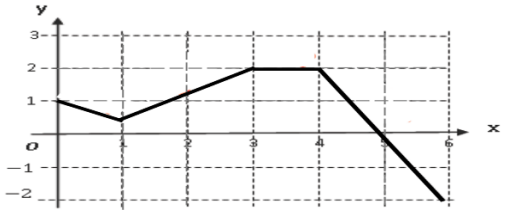

| Interval | Velocity Pos/Neg | Acce. Pos/Neg | Speed Inc/Dec |
|---|---|---|---|
| $[0,a]$ | | | |
| $[c,d]$ | | | |

Your Turn: Given this graph below of $v(t)$, fill out the table below. Then, identify the values of $t$ at which the speed obtains its local and absolute maximum(s). When do, the minimum speeds occur? When are they?




| Interval | Velocity Pos/Neg | Acce. Pos/Neg | Speed Inc/Dec |
|---|---|---|---|
| $[a,b]$ | | | |
| $[b,c]$ | | | |

Ex 4: A particle $P$ (position) moves along the $x$-axis over the time interval from $t = 0$ and $t = 6$ seconds where $x$ stands for feet and $y$ is in seconds.



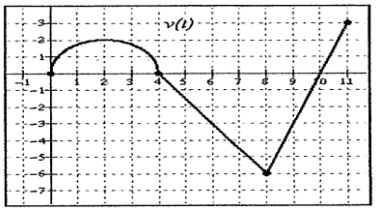

(a) Over what time interval is the particle moving to the left? Explain.

(b) When is the first time that $P$ reverses direction?

(c) When does $P$ move at its greatest speed? Explain.

(d) Is there guaranteed to be a time $t$ in the interval, $[0,\ 3]$ such $that\ v(t) = \frac{3}{8}\frac{ft}{sec}$? Justify answer.

Ex 5: The graph below represents the velocity, $v(t)$, in feet per second, of a particle moving along the $x$-axis over the time interval from $t = 0$ & $t = 11$ seconds. It consists of a semicircle and two line segments.



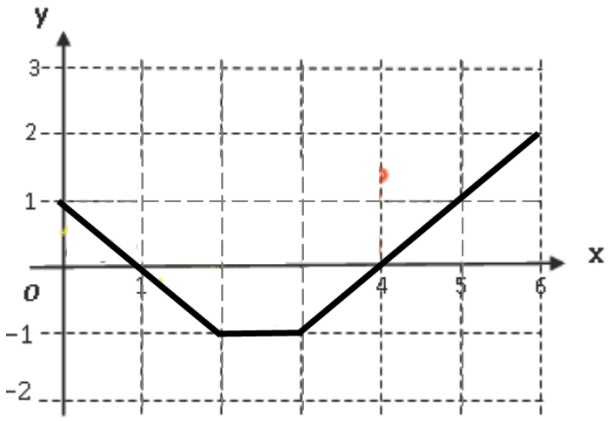

(a) At what time $[0,\ 11]$, is the speed of the particle the greatest?

(b) At which times, $t = 2$, $t = 6$, or $t = 9$ where the acceleration the greatest? Explain.

(c) Over what time intervals is the particle moving left? Explain.

(d) Over what time intervals is the speed of the particle decreasing? Explain.

Your Turn: A particle $P$ (position) moves along the $x$-axis over the time interval from $t = 0$ and $t = 6$ seconds where $x$ stands for feet and $y$ is in seconds. This graph shows velocity.




(a) Over what time interval is the particle moving to the left? Explain.

(b) Over what time intervals is the speed of the particle decreasing? Explain.

(c) Is there guaranteed to be a time $t$ in the interval, $[0, 2]$ where the particle is at rest? Explain.

Ex 6: The data below in the table gives the selected values of velocity, in meters/minute, of a particle moving along the $x$-axis. The velocity $v$ is 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 |

(a) If $t = 0$, is the particle moving to the right or left? Explain the answer.

(b) Is there a time during the interval $[0, 12]$ minutes when the particle is at rest? Explain answer.

(c) Use the data from the table to approximate $v'(10)$ and explain the meaning of $v'(10)$ in terms of the motion of the particle.

Your Turn: Rocket $A$ has positive velocity $v(t)$ after being launched upward from an initial height of 0 feet at time $t = 0$ seconds. The velocity of the rocket is recorded for selected values of $t$ over the interval $0 \leq t \leq 80$ seconds, as shown in the table.

| $t\ (secs)$ | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
|---|---|---|---|---|---|---|---|---|---|
| $v(t)$ $(ft/sec.)$ | 5 | 14 | 22 | 29 | 35 | 40 | 44 | 47 | 49 |

(a) Find the average acceleration of rocket A over the interval $[0, 80]$ seconds. Indicate the units of measurement.

(b) Is there a time during the interval $[0, 12]$ minutes when the particle is at rest? Explain answer.

(c) Use the data from the table to approximate $v'(45)$ and explain the meaning of $v'(45)$ in terms of the motion of the particle.

Assignment: Worksheet