HORIZONTAL

To Find…

- How many times it changed direction
  - Think of critical numbers
    1. Find the derivative {v(t)}
    2. Set v(t) = 0
    3. Use a number line
  - Where the signs change on the number line, the function changes direction. Remember: negative numbers are not included in the function
- When it is increasing
  - When the derivative is positive {v(t) > 0 }
  - Set v(t) = 0
  - Use number line (positive = increasing)
- Speed
  - Same rule applies: absolute value of v(t)
- When v is increasing
  - Where acceleration is positive {a(t) > 0 }
  - Set a(t) = 0
  - Use number line (positive = increasing)
- When speed is increasing
  - When v(t) and a(t) have the same sign
    - Going up, pulled down = speed is decreasing
    - Going down, pulled down = speed is increasing
  - Use the number line of v(t) and the number line of a(t) stacked on top of each other to see where the signs line up
- The total distance on an interval
  - Plug interval numbers into the original [s(t)] function
  - Plug the locations where it *changed direction* into the original [s(t)] function
  - Add up total units travelled
    - Keep signs in mind! Visualize a number line.
      - For example: -87.5 → +20 = 107.5 units total travelled

Remember:
When the derivative is positive, the function is increasing.
When the derivative is negative, the function is decreasing.
When the second derivative is positive, the function is increasing and concave up.
When the second derivative is negative, the function is decreasing and concave down.

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3. Optimization

Steps:

1. What is being maximized or minimized?
2. Write the equation of this variable.
3. Plug in given information.
4. Solve for 1 variable if 2 exist in the equation.
5. Find the derivative and set it equal to 0 (use distance formula if needed).
6. Check using the second derivative

a. If you're looking for a max: 2nd derivative = negative (concave down)

b. If you're looking for a min: 2nd derivative = positive (concave up)
