



1) Compute the following limits. If they do not exist or are infinite, check if the side limits exist.

(a) [5 points]  $\lim_{x \rightarrow 1} \frac{x^3 - x}{x^2 - x + 1}$

(b) [5 points]  $\lim_{x \rightarrow -\infty} \frac{x^3 - 1}{x^2 - 100x + 1000}$

(c) [10 points]  $\lim_{x \rightarrow 1} \frac{x^2 - 2x + 1}{|x - 1|}$  [**Hint:** You might need side limits.]

(d) [10 points]  $\lim_{x \rightarrow 1} \frac{1}{x - 1} + \frac{1}{(x - 1)(x - 2)}$

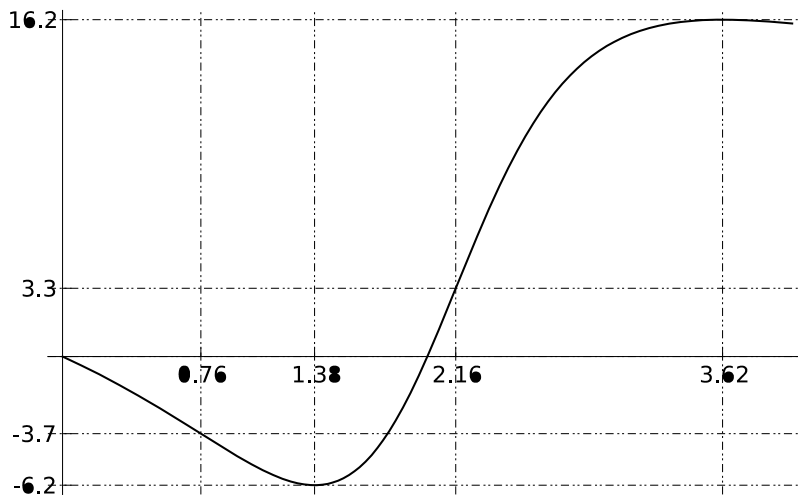
2) [15 points] Compute the following derivative (using the formulas, no need for limits).

$$\frac{d}{dx} \left( \frac{x \cdot \sin(x) - e^x}{x^2 + \sqrt{x}} \right)$$

**No need to simplify!** Note that you might get less partial credit if you skip steps and get the wrong answer. [No penalty if the answer is correct.]

**3)** [15 points] Compute the derivative of  $f(x) = \sqrt{2x+1}$ . **You cannot use any formulas we haven't seen in class! You must use limits!**

4) [20 points] The graph of the position  $s$  of particle moving along a straight line with respect to time  $t$  for  $t \in [0, 4]$  is given below.



Determine [for  $t \in [0, 4]$ ]:

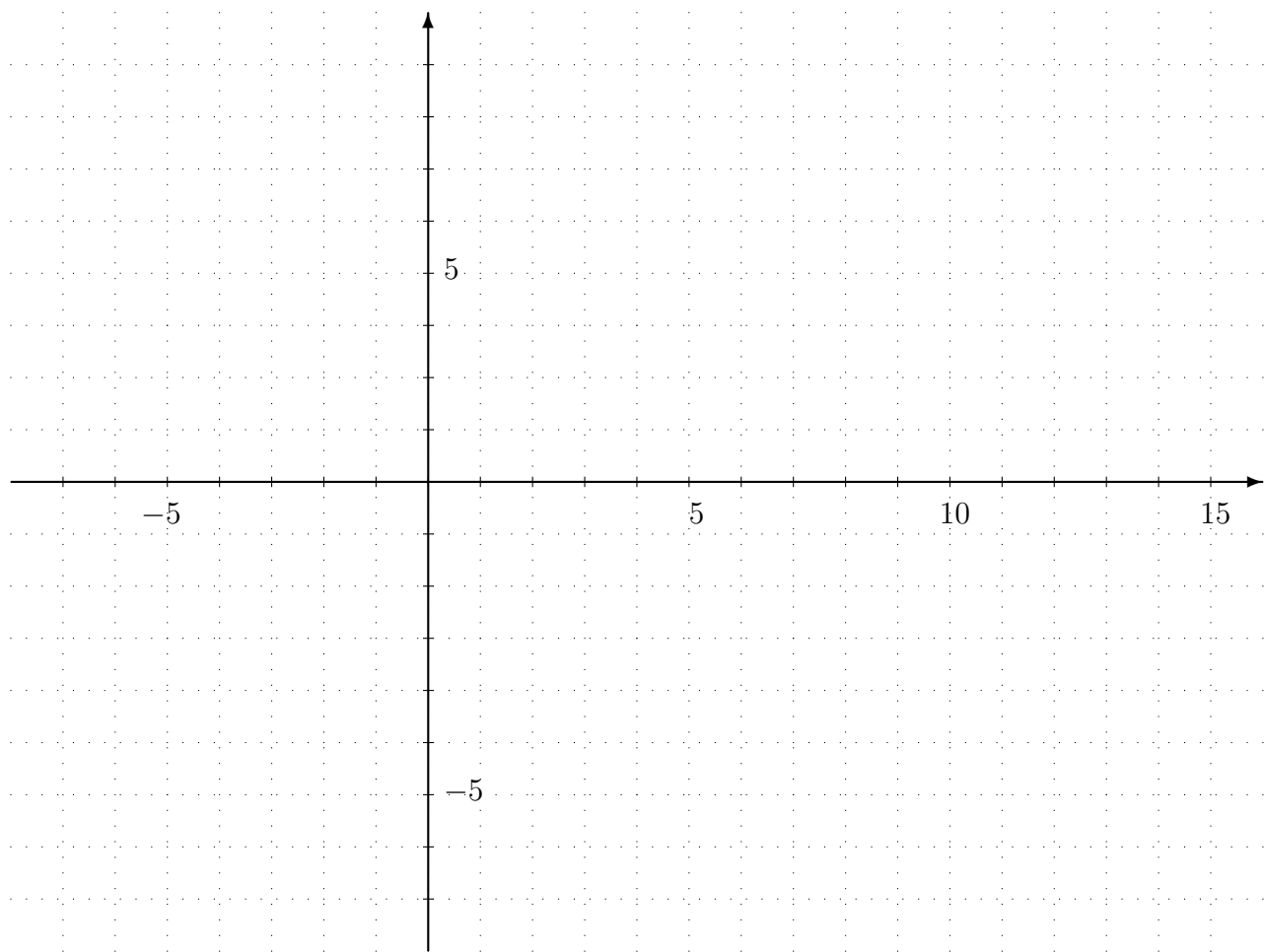
- (a) Fill the table below with “+” if the corresponding function (velocity or acceleration of the particle) is positive in the respective interval and with “-” if the function is negative.

	$(0, 0.76)$	$(0.76, 1.38)$	$(1.38, 2.16)$	$(2.16, 3.62)$	$(3.62, 4)$
velocity					
acceleration					

- (b) When was the velocity maximal and when was it minimal?

5) [20 points] Sketch the graph of a function  $f(x)$  which satisfies all of the following conditions:

- $f(0) = f'(-2) = f'(1) = f'(9) = 0$ ;
- $\lim_{x \rightarrow \infty} f(x) = 0$ ,  $\lim_{x \rightarrow 6} f(x) = -\infty$ ;
- $f'(x) < 0$  on the intervals  $(-\infty, -2)$ ,  $(1, 6)$ , and  $(9, \infty)$ ;
- $f'(x) > 0$  on the intervals  $(-2, 1)$  and  $(6, 9)$ ;
- $f''(x) > 0$  on the intervals  $(-\infty, 0)$  and  $(12, \infty)$ ;
- $f''(x) < 0$  on the intervals  $(0, 6)$  and  $(6, 12)$ .



**Scratch:**