MATH UN1101

CALCULUS I (SECTION 5) - SPRING 2019

HOMEWORK 2 (DUE FEB 04)

Each part (labeled by letters) of every question is worth 2 points. There are 15 parts, for a total of 30 points. You are encouraged to discuss the homework with other students but you must write your solutions individually, in your own words.

(1) Compute the following limits. If the limit does not exist, state why. Briefly show and explain work.

(a)
$$\lim_{x\to 3} \frac{x^2-6x+7}{x-3}.$$
(Hint: complete the square.)

(b)
$$\lim_{z\to 2} \frac{\sqrt{4z+1}-3}{z-2}$$

(c)
$$\lim_{t\to -2} \frac{8-|t|^3}{2+t}$$
(Hint: use the identity $x^3+y^3=(x+y)(x^2-xy+y^2)$.)

(d)
$$\lim_{x\to 0} x\cos\left(\frac{1}{x^2}\right)$$

(e)
$$\lim_{z\to 0^+} \frac{1}{1-\ln(z)}$$

(f)
$$\lim_{x\to\infty} \frac{(x+\sin x)(x^2+2)}{(2x+1)^2(x+3)}$$

(g)
$$\lim_{t\to -\infty} \frac{e^t-e^{-t}}{e^{2t}+e^{-2t}}.$$
(Hint: as $t\to-\infty$, terms like e^{-t} are the fastest-growing ones. Also, remember that e^{2t} grows much faster than e^t.)

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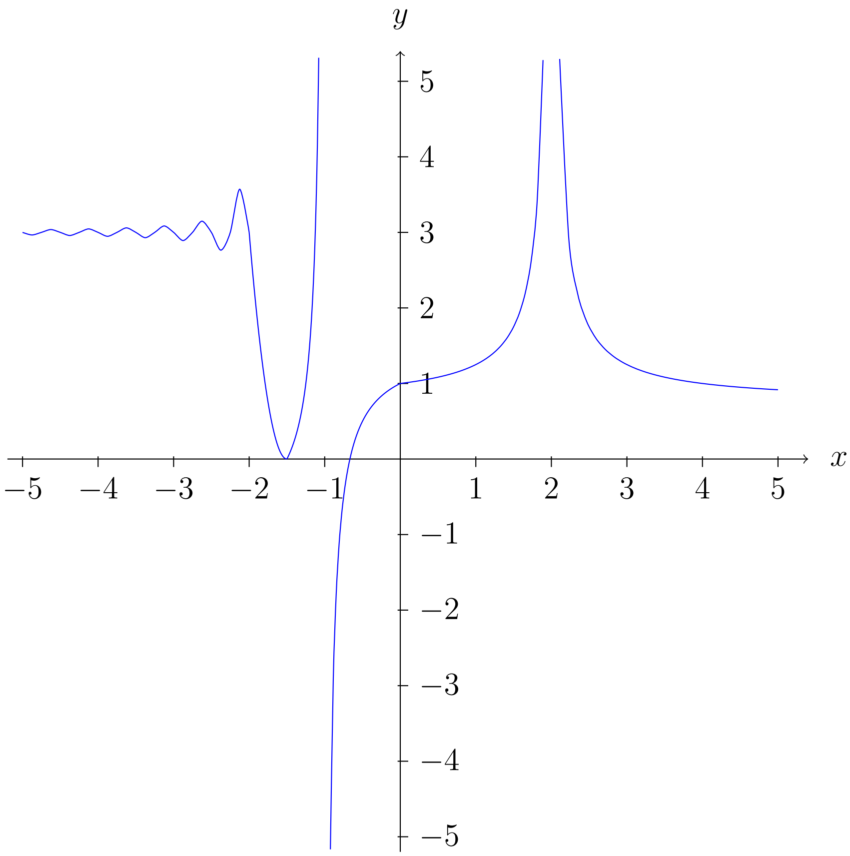
(2) For the following function f, whose graph is given, state the following.



(a) The equations of all horizontal asymptotes.
(b) The equations of all vertical asymptotes, and their left and right limits.

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(3) Annoyed by your calculus homework, you crumple it into a ball and throw it into an infinitely deep hole. To develop a mathematical model for its speed $v(t)$ as a function of the time t since you threw it, you have placed highly accurate sensors at every meter of the hole, which tell you the exact time your homework passes them.

Depth (m)	Time (s)
0.000	0.0000
1.000	0.4508
2.000	0.8408
3.000	1.2022
4.000	1.5497
5.000	1.8902
6.000	2.2272
7.000	2.5624
8.000	2.8967
9.000	3.2305

(Note: unlike in the last homework, this data comes from a physically realistic model.)

(a) Using the data above and each of the following secant lines, estimate the speed of your homework the instant it reaches depth 1.000m.
   (i) The secant line between depths 1.000m and 9.000m.
   (ii) The secant line between depths 1.000m and 5.000m.
   (iii) The secant line between depths 1.000m and 2.000m.

(b) Which of the above do you expect to be the most accurate estimation of the speed of your homework the instant it reaches depth 1.000m? Briefly explain why.

(c) Using the data above and a secant line, give the most accurate estimate possible for how deep your homework is at time 1.0000s. Briefly explain how you got the answer.

(d) Describe the speed of your homework as a function of time as follows. What is the initial speed? How does the speed increase/decrease as time goes on? (Don't worry too much about the exactness/precision of your answer; a qualitative description is fine.)