

Answer the problems on **separate** paper. You do not need to rewrite the problem statements on your answer sheets. Do your own work. Show **all relevant steps** which lead to your solutions. Attach this question sheet to the front of your answer sheets.

- Consider the function $c(t) = \frac{0.12t}{t^2 + t + 3}$. This function models the concentration of a drug in the blood stream t hours after injection of the drug.
 - (9 pts) Construct a linearization for the function at $t = 4$.
 - (3 pts) Use the linearization constructed in step a. to estimate the change in concentration over the time period from 4 hours after injection to 4.5 hours after injection.
- (15 pts) Using calculus, find the absolute maximum and absolute minimum values of $f(x) = 3x^4 - 4x^3 - 36x^2 + 90$ on the interval $[-4, 2]$.
- (45 pts) Consider the function f given below. (Its derivatives f' and f'' are denoted by fp and fpp , resp.) Find and identify each of the following (if they exist) – *show your work on your answer sheets, but record your solutions to parts a. through m. on the back of this page.*
 - domain of f
 - intercepts of f
 - vertical asymptotes to the graph of f
 - horizontal asymptotes to the graph of f
 - critical numbers of f
 - intervals on which the graph of f is increasing
 - intervals on which the graph of f is decreasing
 - local maximum points of the graph of f
 - local minimum points of the graph of f
 - 2nd order critical numbers of f
 - intervals on which the graph of f is concave up
 - intervals on which the graph of f is concave down
 - inflection points of the graph of f

$$f := \frac{(2x - 9)^2}{(x + 3)^2} - 1$$

$$fp := \frac{30(2x - 9)}{(x + 3)^3}$$

$$fpp := -\frac{30(4x - 33)}{(x + 3)^4}$$

Then, incorporate all of the above information into a sketch the graph of f .

- (30 pts) Using algebraic/calculus techniques, find the following limits (if they exist):

$$a. \quad \lim_{x \rightarrow \infty} \frac{3x^2 - 2x^{3/2} + 10}{4x^2 + 4x - 1}$$

$$b. \quad \lim_{x \rightarrow 0} \frac{\sin^2 x}{\cos x - 1}$$

$$c. \quad \lim_{x \rightarrow 0^+} \frac{x + x^2}{\cos x - x}$$

$$d. \quad \lim_{x \rightarrow \infty} x^2 e^{-x}$$

$$e. \quad \lim_{x \rightarrow \infty} \sqrt{x}^{1/x}$$

Extra Credit: Using the rules developed in class for differentiation, correctly derive the formulas given in Problem 3 for f' and f'' (2 pts and 3 pts, resp.).

Solution Space for Problem 3

	Problem Statement	Problem Solution
a	domain of f	
b	intercepts of f	
c	vertical asymptotes to the graph of f	
d	horizontal asymptotes to the graph of f	
e	critical numbers of f	
f	intervals on which the graph of f is increasing	
g	intervals on which the graph of f is decreasing	
h	local maximum points of the graph of f	
i	local minimum points of the graph of f	
j	2^{nd} order critical numbers of f	
k	intervals on which the graph of f is concave up	
l	intervals on which the graph of f is concave down	
m	inflection points of the graph of f	