Name: ________________________________                    Math 135 Final Exam  FORMAT
Signature: ________________________________        RUID: __________________
Instructor: ________________________________      Section: __________________

General Instructions:
• Do not detach any pages from this exam.
• Fill out the top of this page and put your Rutgers photo ID card on your desk next to you for checking, but do not open the exam until you are instructed to start the exam.
• No calculators, cell phones or any other electronic devices, or any books, notes or scratch paper may be used during the exam.

Partial-Credit vs. No-Partial-Credit:
• Problems #1 - #20 are multiple-choice. No work is required for these problems, but you may use the provided space for scratch work, and any scratch work you do write will not be graded. You must enter your answers for the multiple-choice problems on the provided answer sheet. Only your answers on the answer sheet will be graded. Any answers or work written on the pages where the multiple-choice problems appear will not be graded.
• Problem #21 requires you to fill in your answers in a table and, for each table entry, you will not be awarded any partial credit. No work is required for this problem, but you may use the provided space for scratch work, and any scratch work you do write will not be graded.
• Problems #22 - #28 require you to show all work and you will be awarded partial credit based on your work. You must write clearly, using proper notation and techniques covered in this course. If you need extra space, use the back of a page but clearly indicate the work that you want graded. Insufficiently supported answers will receive no credit.

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Multiple Choice (#1 - #20) \[ \text{\# of correct answers (max 20)} \times 6 \text{ points} = \text{total points (max 120)} \]

Grand Total
# DO NOT DETACH THIS SHEET!

**ANSWER SHEET FOR MULTIPLE-CHOICE PROBLEMS**

For each problem, USE PENCIL to fill in your choice COMPLETELY. Do not just mark an “X”. If you want to change your answer, ERASE COMPLETELY. You will receive no credit for a problem if more than one answer is filled in. There is no penalty for a wrong guess.

ONLY THIS ANSWER SHEET WILL BE GRADED. Your work and/or answers on the pages where the multiple-choice problems appear will not be graded.

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Problems #1 - #20 are multiple-choice problems, each worth 6 points.

Choose the best answer and then fill in your choice on the provided ANSWER SHEET. ONLY THE ANSWER SHEET WILL BE GRADED. Your work and/or answers on the pages where the multiple-choice problems appear will not be graded. You are not required to show work, but you should use the provided space for scratch work in order to solve the problems accurately.

1. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

   (1A) text for choice A   (1B) text for choice B   (1C) text for choice C
   (1D) text for choice D   (1E) text for choice E   (1F) none of the above

2. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

   (2A) text for choice A   (2B) text for choice B   (2C) text for choice C
   (2D) text for choice D   (2E) text for choice E   (2F) none of the above
3. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(3A) text for choice A  (3B) text for choice B  (3C) text for choice C
(3D) text for choice D  (3E) text for choice E  (3F) none of the above

4. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(4A) text for choice A  (4B) text for choice B  (4C) text for choice C
(4D) text for choice D  (4E) text for choice E  (4F) none of the above
5. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(5A) text for choice A          (5B) text for choice B          (5C) text for choice C
(5D) text for choice D          (5E) text for choice E          (5F) none of the above

6. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(6A) text for choice A          (6B) text for choice B          (6C) text for choice C
(6D) text for choice D          (6E) text for choice E          (6F) none of the above
7. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(7A) text for choice A  (7B) text for choice B  (7C) text for choice C
(7D) text for choice D  (7E) text for choice E  (7F) none of the above

8. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(8A) text for choice A  (8B) text for choice B  (8C) text for choice C
(8D) text for choice D  (8E) text for choice E  (8F) none of the above
9. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(9A) text for choice A (9B) text for choice B (9C) text for choice C
(9D) text for choice D (9E) text for choice E (9F) none of the above

10. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(10A) text for choice A (10B) text for choice B (10C) text for choice C
(10D) text for choice D (10E) text for choice E (10F) none of the above
11. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(11A) text for choice A  
(11D) text for choice D  
(11B) text for choice B  
(11E) text for choice E  
(11C) text for choice C  
(11F) none of the above

12. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(12A) text for choice A  
(12D) text for choice D  
(12B) text for choice B  
(12E) text for choice E  
(12C) text for choice C  
(12F) none of the above
13. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(13A) text for choice A  (13B) text for choice B  (13C) text for choice C
(13D) text for choice D  (13E) text for choice E  (13F) none of the above

14. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(14A) text for choice A  (14B) text for choice B  (14C) text for choice C
(14D) text for choice D  (14E) text for choice E  (14F) none of the above
15. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(15A) text for choice A
(15B) text for choice B
(15C) text for choice C
(15D) text for choice D
(15E) text for choice E
(15F) none of the above

16. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(16A) text for choice A
(16B) text for choice B
(16C) text for choice C
(16D) text for choice D
(16E) text for choice E
(16F) none of the above
17. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(17A) text for choice A  
(17B) text for choice B  
(17C) text for choice C

(17D) text for choice D  
(17E) text for choice E  
(17F) none of the above

18. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(18A) text for choice A  
(18B) text for choice B  
(18C) text for choice C

(18D) text for choice D  
(18E) text for choice E  
(18F) none of the above
19. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(19A) text for choice A  (19B) text for choice B  (19C) text for choice C
(19D) text for choice D  (19E) text for choice E  (19F) none of the above

20. This is a multiple-choice question. Choose the best answer and fill in the corresponding bubble on the answer sheet completely, using pencil. You don’t have to show work, and your scratch work will not be graded, but you should still use the blank space for scratch work in order to solve the problems accurately.

(20A) text for choice A  (20B) text for choice B  (20C) text for choice C
(20D) text for choice D  (20E) text for choice E  (20F) none of the above
Each part of Problem #21 is worth 2 points and will be graded with no partial credit. Accordingly, you are not required to show work but you may use the provided space or the back of a page for scratch work.
Only what you write in each answer box will be graded.

21. (18 points) Consider the function \( f \) and its derivatives below.
\[
f(x) = \cdots, \quad f'(x) = \cdots, \quad f''(x) = \cdots
\]
(The exam will have explicit functions in the line above.)
Find where \( f \) is increasing, decreasing, concave up, and concave down. Use interval notation in your answers. Also, find all horizontal and vertical asymptotes, relative extrema, and inflection points. Write “NONE” as your answer, if appropriate.

<table>
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<tr>
<td>Decreasing</td>
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<td>Equations of horizontal asymptotes</td>
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<td>Equations of vertical asymptotes</td>
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<td>( x )-values of inflection points</td>
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</tbody>
</table>
The remaining problems will be graded with partial credit. You must show all work for full credit. Insufficiently supported answers will receive no credit.

22. (16 points) This problem requires you to show work, and you will be given partial credit based on your work. Insufficiently supported answers may receive no credit. There may also be multiple parts to this problem, which may or may not be related. **There may be extra instructions here on how to format your final answer.**
23. (16 points) This problem requires you to show work, and you will be given partial credit based on your work. Insufficiently supported answers may receive no credit. There may also be multiple parts to this problem, which may or may not be related. 

**There may be extra instructions here on how to format your final answer.**

Final answer =
24. (16 points) This problem requires you to show work, and you will be given partial credit based on your work. Insufficiently supported answers may receive no credit. There may also be multiple parts to this problem, which may or may not be related. **There may be extra instructions here on how to format your final answer.**

Final answer =
25. (16 points) This problem requires you to show work, and you will be given partial credit based on your work. Insufficiently supported answers may receive no credit. There may also be multiple parts to this problem, which may or may not be related. 

There may be extra instructions here on how to format your final answer.

Final answer =
26. (16 points) This problem requires you to show work, and you will be given partial credit based on your work. Insufficiently supported answers may receive no credit. There may also be multiple parts to this problem, which may or may not be related. 

There may be extra instructions here on how to format your final answer.

Final answer =
27. (16 points) This problem requires you to show work, and you will be given partial credit based on your work. Insufficiently supported answers may receive no credit. There may also be multiple parts to this problem, which may or may not be related. 

There may be extra instructions here on how to format your final answer.

Final answer =
28. (16 points) This problem requires you to show work, and you will be given partial credit based on your work. Insufficiently supported answers may receive no credit. There may also be multiple parts to this problem, which may or may not be related.

There may be extra instructions here on how to format your final answer.

Final answer =