**MATHEMATICS 100 (Sections A01-A03),**
**Midterm # 3, November 24, 2018.**

Last name: _____ StudentID: $V00$_____

First name: _____

| Question # | $1-11$ | 12 | TOTAL |
|---|---|---|---|
| Points (max) | 16 points | 9 points | 25 points |
| Points assigned | | | |

- The only calculators allowed on this examination start with Sharp EL-510.
- This test consists of 12 questions and has 11 pages (including this cover and the **Blank page** on the last page).
  - Questions 1 through 11 are "all-or-nothing". Write your detailed solutions in this booklet in the provided space. **Clearly circle your multiple-choice answer.**
  - Question 12 is a long-answer. Write your detailed solutions in space provided in this booklet.
  - You need to show your supporting work for all answers, as we may disallow any answer which is not properly justified.
- For the multiple-choice questions, select the numerical answer closest to yours (unless instructed to "select the exact answer"), by circling it on this paper. If the answer is equidistant from two nearest choices, select the largest of the two choices. Ensure that all your multiple choice answers are correctly filled in on the multiple-choice sheet.
- Before starting your test enter your Name (Last, First), student ID on the top of this page.
- Find your multiple-choice sheet. Write your Name, Course and Date at the right side of your multiple-choice sheet now. In "Form" field bubble "**A**", leave "Special" empty.
- Code your student number with bubbles on the multiple-choice sheet now.
- Pens, pencils and erasers are permitted at your desk. If you have a pencil case it must be stored with your belongings in the front of the room.
- If you have finished working on your paper with less than 10 minutes before the end of the examination, please close your paper and **remain seated** until the test time is completed. It is important to minimize the desruptions in the room.
- At the end of 80-minute test, turn-in this booklet and your completed bubble sheet.

1. (1 point) Calculate $\lim_{x\to 0} \dfrac{x-\sin(x)}{x^3}$. Select the exact answer.

(A) $-2$ (B) $-1$ (C) $-\dfrac{1}{3}$ (D) $-\dfrac{1}{6}$ (E) Does not exist

(F) $0$ (G) $\dfrac{1}{6}$ (H) $\dfrac{1}{3}$ (I) $1$ (J) None of those

2. (1 point) Calculate $\lim_{x\to\infty} \dfrac{2x+\sin(x)}{3x+\cos(4x)}$. Select the exact answer.

(A) $0$ (B) $\dfrac{2}{7}$ (C) $\dfrac{3}{7}$ (D) $\dfrac{2}{3}$ (E) Does not exist

(F) $1$ (G) $\dfrac{3}{2}$ (H) $\dfrac{7}{3}$ (I) $2$ (J) None of those

3. (1 point) Calculate $\lim_{t\to 0^+} (\cos(2t))^{3/t^2}$.

(A) $-6$ (B) $-3$ (C) $-2$ (D) $0.0015$ (E) $0.0025$

(F) $0.05$ (G) $0.5$ (H) $1$ (I) $6$ (J) $400$

4. (1 point) Use the linearization for $\sqrt{x}$ about $x = 25$ to find an approximate value for $\sqrt{29}$.

(A) 5.384 (B) 5.386 (C) 5.388 (D) 5.390 (E) 5.392
(F) 5.394 (G) 5.396 (H) 5.398 (I) 5.400 (J) 5.402

5. (1 point) You are sitting on the bank of a tidal river watching the incoming tide carry a bottle upstream. You record the velocity of the floow every 5 minutes for 30 minutes, with the results shown in the accompamying table. About how far upstream (in meters) did the bottle travel during that 30 minutes? Find an estimate using 6 subintervals of length 5 with left-endpoint values.

Select the exact answer.

| TIME (min) | 0 | 5 | 10 | 15 | 20 | 25 | 30 |
|---|---|---|---|---|---|---|---|
| VELOCITY (m/min) | 1.2 | 1.7 | 2.0 | 1.8 | 1.6 | 1.4 | 1.0 |

(A) 9.5 (B) 9.7 (C) 10.5 (D) 10.7 (E) 11.0

(F) 47.5 (G) 48.5 (H) 52.5 (I) 53.5 (J) None of those

6. (1 point) Let $f$ be continuous on $[0, 1]$ and differentiable on $(0, 1)$. Assume that $f(0) = 4$ and $f(1) = 2$. Choose the value of $k$ which ensures the following statement is true. There exists a point $c$ in $(0, 1)$ with $f'(c) = k$.

(A) $-4$ (B) $-2$ (C) $-1$ (D) $0.5$ (E) $0$

(F) $0.5$ (G) $1$ (H) $2$ (I) $4$ (J) $5$

7. (2 points) Find minimum value of the function $f(x) = \sin(x) - \dfrac{x}{2}$ on the interval $[0, \pi]$.

(A) $-2.5$ (B) $-2.0$ (C) $-1.5$ (D) $-1.0$ (E) $-0.5$

(F) $0.5$ (G) $1.0$ (H) $1.5$ (I) $2.0$ (J) $2.5$

8. (2 points) A point moves on the curve $y = x^2$. How fast is $y$ changing when $x = -2$ and x is decreasing at a rate of 3?

(A) $-12$ (B) $-6$ (C) $-4$ (D) $-2$ (E) $2$

(F) $4$ (G) $6$ (H) $9$ (I) $12$ (J) $15$

9. (2 points) Let $f$ be differentiable and $f'(x)$ be given by

$$f'(x) = x(x - \pi/2)\cos(x).$$

Classify each of the critical points of $f$ at $x = 0$ and $x = \pi/2$ as a local maximum, a local minimum, or neither.

| | $0$ | $\pi/2$ |
|---|---|---|
| (A) | local maximum | neither |
| (B) | local maximum | local maximum |
| (C) | local maximum | local minimum |
| (D) | local minimum | neither |
| (E) | local minimum | local maximum |
| (F) | local minimum | local minimum |
| (G) | neither | neither |
| (H) | neither | local maximum |
| (I) | neither | local minimum |

10. (2 points) An automobile manufacturer sells 2,000 cars per month, at an average profit of $\$1,000$ per car. Market research indicates that for each \$50 discount in car price the manufacturer expects to sell 200 more cars each month.

    In order to figure out how many \$50 discounts the manufacturer should offer to maximize its monthly profit, the manufacturer needs a function for calculating monthly profit.

    Set up a function $F(n)$, where $F$ is a function describing monthly profit , and $n$ is a number of \$50-discouts offered (so that the total discount in a car price is equal to $50n$).

    Select an exact answer.

    (A) $F(n) = 2,000,000 + 100,000n - 10,000n^2$ (B) $F(n) = 2,000,000 + 100,000n + 10,000n^2$

    (C) $F(n) = 2,000,000 - 100,000n + 10,000n^2$ (D) $F(n) = 2,000,000 - 100,000n - 10,000n^2$

    (E) $F(n) = -2,000,000 - 100,000n - 10,000n^2$ (F) $F(n) = -2,000,000 + 100,000n + 10,000n^2$

    (G) $F(n) = -2,000,000 + 100,000n - 10,000n^2$ (H) None of those

11. (2 points) If $\dfrac{dv}{dt} = \dfrac{3}{t\sqrt{t^2-1}}$ , $t > 1$ and $v(2) = 0$, find $v(\sqrt{2})$.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (A) | $-6.0$ | (B) | $-3.0$ | (C) | $-1.5$ | (D) | $-1.0$ | (E) | $-0.75$ |
| (F) | $0.0$ | (G) | $0.75$ | (H) | $1.0$ | (I) | $1.5$ | (J) | $3.0$ |

12. Let

$$f(x) = \frac{e^x}{1+e^x}.$$

Notice that

$$f'(x) = \frac{e^x}{(1+e^x)^2}, \text{ and } f''(x) = \frac{e^x(1-e^x)}{(1+e^x)^3}.$$

(a) (2 points) Find the intervals on which $f$ is increasing and the intervals on which $f$ is decreasing. Give justification for your answer.

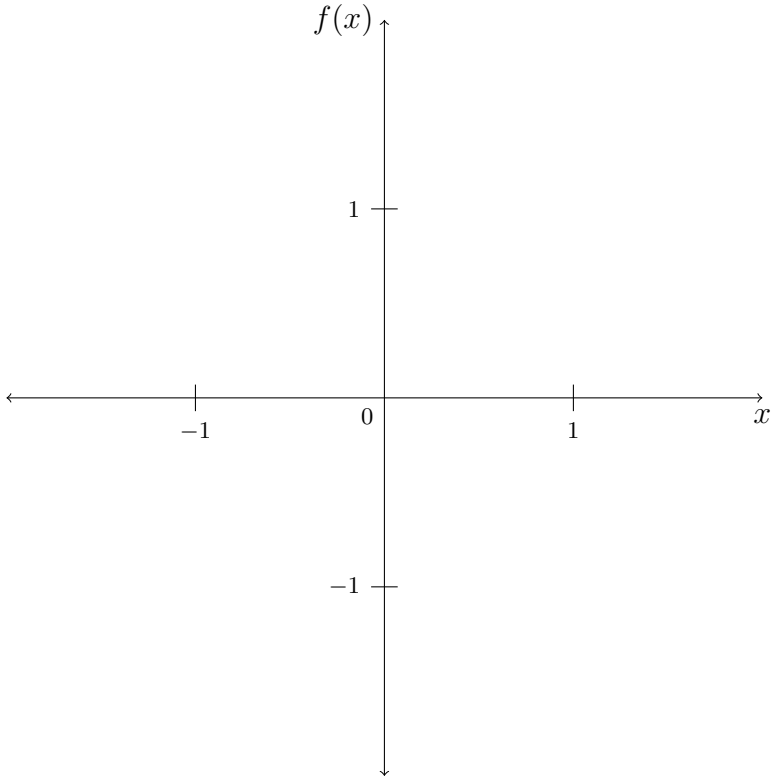
(b) (3 points) Find the intervals on which $f$ is concave up and the intervals on which $f$ is concave down. Identify any inflection points. Give justification for your answer.

Recall

$$f(x) = \frac{e^x}{1+e^x}, f'(x) = \frac{e^x}{(1+e^x)^2}, f''(x) = \frac{e^x(1-e^x)}{(1+e^x)^3}$$

(c) (2 points) Determine if $f$ has any asymptotes. If $f$ has any asymptotes give equations for them. Give justification for your answer.

(d) (2 points) Sketch a graph of $f$.



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