Calculus I: MAC2311
Fall 2022
Final Exam A
12/10/2022
Time Limit: 120 Minutes

Name: ______________________

Section: ______________________

UF-ID: ______________________

Scantron Instruction: This exam uses a scantron. Follow the instructions listed on this page to fill out the scantron.

A. Sign your scantron **on the back** at the bottom in the white area.

B. Write **and code** in the spaces indicated:

1) Name (last name, first initial, middle initial)
2) UFID Number
3) 4-digit Section Number

C. Under *special codes*, code in the test numbers 4, 1:

1 2 3 • 5 6 7 8 9 0
• 2 3 4 5 6 7 8 9 0

D. At the top right of your scantron, fill in the *Test Form Code* as A.

• B C D E

E. This exam consists of 22 multiple choice questions. Make sure you check for errors in the number of questions your exam contains.

F. The time allowed is 120 minutes.

G. WHEN YOU ARE FINISHED:

1) Before turning in your test check for **transcribing errors**. Any mistakes you leave in are there to stay!

2) You must turn in your scantron to your proctor. **Be prepared to show your GatorID with a legible signature.**

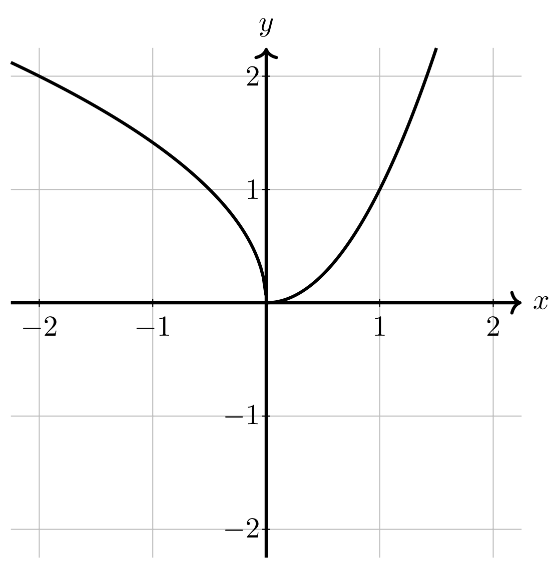
It is your responsibility to ensure that your test has **22 questions**. If it does not, show it to your proctor immediately. You will not be permitted to make up any problems omitted from your test after the testing period ends. There are a total of 110 points available on this exam.

Instructions: 22 multiple choice questions. Complete the scantron sheet provided with your information and fill in the appropriate spaces to answer your questions. Only the answer on the scantron sheet will be graded. Each problem is worth five (5) points for a total of 110 points on the exam.

1. A water storage tank begins leaking at a rate of $r(t) = 10e^{-t}$ gallons per minute. How much water leaks out during the first 2 minutes?

(A) $10(1 - e^{-1})$ (B) $10(1 - e^{-2})$ (C) $10(1 - e)$ (D) 10 (E) $10(1 - e^{-3})$

2. The graph of the function $f(x)$ is shown below.



If $A = \int_0^1 f(x)\,dx$, $B = \int_{-1}^0 f(x)\,dx$, and $C = \int_{-1}^{-2} f(x)\,dx$, then which of the following is true?

(A) $A < C < B$ (B) $A < B < C$ (C) $B < A < C$ (D) $B < C < A$ (E) $C < A < B$

3. Which of the following is the right-endpoint Riemann sum approximation of $f(x) = x^2 + 1$ on the interval $[-1, 7]$ using $n = 4$ rectangles?

(A) $\sum_{i=1}^{4} \left((-1+2i)^2+1\right) 2$

(B) $\sum_{i=0}^{3} \left((-1+2i)^2+1\right) 2$

(C) $\sum_{i=1}^{4} \left((2i)^2+1\right) 2$

(D) $\sum_{i=0}^{3} \left((2i)^2+1\right) 2$

4. Let $f(x)$ be a function such that $f'(x) = 8x^3 + 3x^2 - 10x - 2 + \frac{7}{x}$. If $f(1) = 5$, then what is $f(\sqrt{2})$?

(A) 6

(B) $\frac{19}{\sqrt{2}} - 5$

(C) $\frac{19}{\sqrt{2}} + 4$

(D) $\frac{7}{2}\ln(2) - 2$

(E) $\frac{7}{2}\ln(2) + 7$

5. Use a right-endpoint approximation to approximate the area below $f(x) = x^2 + x$ on the interval $[0, 3]$ with $n = 3$ rectangles.

(A) 2 (B) 6 (C) 8 (D) 18 (E) 20

6. Let $f(x)$ and $g(x)$ be continuous functions such that $\int_{-1}^{1} f(x)\,dx = 7$, $\int_{-1}^{4} 2g(x)\,dx = 4$, $\int_{-1}^{4} [f(x) + g(x)]\,dx = 9$. What is the value of $\int_{1}^{4} f(x)\,dx$?

(A) 1 (B) 0 (C) 2 (D) 5 (E) Not enough information

7. Calculate $\lim_{x \to 0} \frac{(\sin^{-1}(x))(\sin(x))}{x^2}$.

(A) 1 (B) -1 (C) 0 (D) $\frac{1}{2}$ (E) $-\frac{1}{2}$

8. Let $f(x)$ be a continuous function such that $f(1) = 8$ and $f(9) = 0$. The fact that the equation $f(c) = 1$ has a solution for some c in the interval $(1, 9)$ is the consequence of which theorem?

(A) Intermediate Value Theorem

(B) Mean Value Theorem

(C) Squeeze Theorem

(D) Extreme Value Theorem

(E) Fundamental Theorem of Calculus

9. Evaluate $\displaystyle\int \frac{x}{\sqrt[3]{3x^2+1}}\,dx$.

(A) $\dfrac{1}{9(3x^2+1)^{4/3}}+C$

(B) $9(3x^2+1)^{2/3}+C$

(C) $\dfrac{(3x^2+1)^{2/3}}{4}+C$

(D) $4\ln(3x^2+1)+C$

(E) $\dfrac{\ln(3x^2+1)}{6}+C$

10. The function $f(x)=\dfrac{3-2e^{2x}}{4e^{2x}+2}$ has two horizontal asymptotes at $y=A$ and $y=B$. Find $A+B$.

(A) 0

(B) 1

(C) 2

(D) 3

(E) 4

11. If $x\cos(y) = ye^x$, the value of y' at $(0, 0)$ is equal to:

(A) 0 (B) 1 (C) -1 (D) $\frac{1}{2}$ (E) none of the above

12. Suppose an object moves with velocity $v(t) = 4(t-1)^2(t-3)^3$. If $\int_0^1 v(t)\ dt = A$ and $\int_1^3 v(t)\ dt = B$, then which of the following represents the total distance traveled by the object from $t = 0$ to $t = 3$?

(A) $A + B$ (B) $A - B$ (C) $-A + B$ (D) $-A - B$ (E) 0

13. If $y = f\left([g(x)]^2\right)$, $f(1) = -2$, $f'(1) = 2$, $g(3) = -1$, and $g'(3) = 3$, what is the value of y' when $x = 3$?

(A) 6 (B) -6 (C) -18 (D) -24 (E) -12

14. Evaluate $\displaystyle\int_0^1 xe^{(x^2-2)}\,dx$

(A) $\dfrac{e-1}{2e^2}$ (B) $\dfrac{e+1}{2e^2}$ (C) $\dfrac{e-1}{e^2}$ (D) $\dfrac{e+1}{e^2}$ (E) $\dfrac{e^2-1}{2e}$

15. Evaluate $\int \frac{\cos(\theta)}{1+\sin^2(\theta)}\, d\theta$.

(A) $\arctan(\sin(\theta)) + C$

(B) $-\arctan(\sin(\theta)) + C$

(C) $\arctan(\cos(\theta)) + C$

(D) $-\arctan(\cos(\theta)) + C$

(E) $\arctan(\sin(\theta)) + \cos(\theta) + C$

16. If $y = (x+1)^{2x+3}$, the value of y' at $x = 0$ is equal to:

(A) 0 (B) 3 (C) 1 (D) 4 (E) 2

17. Which of the following is the derivative of $F(x) = \int_x^{2x} e^t (t+1)^2 \, dt$.

(A) $2e^{2x}(2x+1)^2$

(B) $2e^{2x}(2x+1)^2 + e^x(x+1)^2$

(C) $2e^{2x}(2x+1)^2 - e^x(x+1)^2$

(D) $e^{2x}(2x+1)^2 - e^x(x+1)^2$

(E) $e^{2x}(2x+1)^2 + e^x(x+1)^2$

18. Find the linearization of $f(x) = 5xe^{2x-1}$ at $a = \frac{1}{2}$.

(A) $L(x) = 10 + 10\left(x - \frac{1}{2}\right)$

(B) $L(x) = 5 + 5\left(x - \frac{1}{2}\right)$

(C) $L(x) = \frac{5}{2} + 5\left(x - \frac{1}{2}\right)$

(D) $L(x) = 5 + 10\left(x - \frac{1}{2}\right)$

(E) $L(x) = \frac{5}{2} + 10\left(x - \frac{1}{2}\right)$

19. Evaluate $\int (2x - \sqrt{x})^2 \, dx$.

(A) $\dfrac{(2x-\sqrt{x})^3}{3} + C$

(B) $\dfrac{4x^3}{3} - x^2 + C$

(C) $\dfrac{4x^3}{3} - \dfrac{8x^{5/2}}{5} + \dfrac{x^2}{2} + C$

(D) $\left(x^2 - \dfrac{2x^{3/2}}{3}\right)^2 + C$

20. What is the **sum** of the absolute maximum and minimum values of $f(x) = x^4 - 4x^2$ on the interval $[-1, 3]$?

(A) 48 (B) 42 (C) 41 (D) 45 (E) 38

21. Let $f(x)$ be a function such that

$$\lim_{h \to 0} \frac{f(x+h) - f(x)}{h} = e^{x^2}.$$

Which of the following statements is **false**?

(A) $f'(0) = 1$

(B) $f(x)$ is continuous on $(-\infty, \infty)$

(C) $f(x)$ is increasing on $(-\infty, \infty)$

(D) There is a value of x for which $f(x)$ has a horizontal tangent line.

22. $F(x) = x^2 \ln(x)$ is an antiderivative of which of the following functions?

(A) $\dfrac{x \ln(x)}{2}$ (B) $\dfrac{x^3 \ln(x)}{3}$ (C) $\dfrac{x^3 (\ln(x))^2}{6}$ (D) $x + 2x \ln(x)$ (E) $\dfrac{1}{3} x^3 \ln(x) - \dfrac{x^3}{9}$

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1. Find the linearization of $f(x) = 6xe^{3x-1}$ at $a = \dfrac{1}{3}$.

(A) $L(x) = 2 + 6\left(x - \dfrac{1}{3}\right)$ (B) $L(x) = 12 + 12\left(x - \dfrac{1}{3}\right)$ (C) $L(x) = 1 + 2\left(x - \dfrac{1}{3}\right)$

(D) $L(x) = 12 + 2\left(x - \dfrac{1}{3}\right)$ (E) $L(x) = 2 + 12\left(x - \dfrac{1}{3}\right)$

2. Evaluate $\displaystyle\int_0^1 xe^{(3x^2-1)}\,dx$

(A) $\dfrac{e^3-1}{6e}$ (B) $\dfrac{e^3+1}{2e^2}$ (C) $\dfrac{e^3-1}{3e}$ (D) $\dfrac{e^3+1}{6e^2}$ (E) $\dfrac{e^2-1}{3e}$

3. Let $f(x)$ and $g(x)$ be continuous functions such that $\int_{-1}^{2} f(x)\,dx = -3$, $\int_{-1}^{4} 3g(x)\,dx = 9$, $\int_{-1}^{4} [f(x) + g(x)]\,dx = 12$. What is the value of $\int_{2}^{4} f(x)\,dx$?

(A) 6 (B) 12 (C) 2 (D) 5 (E) Not enough information

4. The function $f(x) = \dfrac{7 - 2e^{3x}}{6e^{3x} + 3}$ has two horizontal asymptotes at $y = A$ and $y = B$. Find $A + B$.

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

5. If $3x\cos(y) = 2ye^x$, the value of y' at $(0,0)$ is equal to:

(A) 0 (B) $\frac{1}{2}$ (C) 1 (D) $\frac{3}{2}$ (E) none of the above

6. Suppose an object moves with velocity $v(t) = 4(t-1)^3(t-3)^2$. If $\int_0^1 v(t)\ dt = A$ and $\int_1^3 v(t)\ dt = B$, then which of the following represents the total distance traveled by the object from $t = 0$ to $t = 3$?

(A) $A + B$ (B) $A - B$ (C) $-A + B$ (D) $-A - B$ (E) 0

7. Evaluate $\int (x - 2\sqrt{x})^2 \, dx$.

(A) $\dfrac{(x-2\sqrt{x})^3}{3} + C$

(B) $\dfrac{x^3}{3} - \dfrac{x^2}{2} + C$

(C) $\dfrac{x^3}{3} - \dfrac{8x^{5/2}}{5} + 2x^2 + C$

(D) $\left(x^2 - \dfrac{2x^{3/2}}{3}\right)^2 + C$

8. Calculate $\lim_{x\to 0} \dfrac{(\tan^{-1}(x))(\sin(x))}{x^2}$.

(A) 1

(B) -1

(C) 0

(D) $\dfrac{1}{2}$

(E) $-\dfrac{1}{2}$

9. If $y = (x+1)^{3x+2}$, the value of y' at $x = 0$ is equal to:

(A) 0 (B) 3 (C) 1 (D) 4 (E) 2

10. $F(x) = x^2 \ln(x)$ is an antiderivative of which of the following functions?

(A) $\dfrac{x\ln(x)}{2}$ (B) $\dfrac{x^3\ln(x)}{3}$ (C) $\dfrac{x^3(\ln(x))^2}{6}$ (D) $x + 2x\ln(x)$ (E) $\dfrac{1}{3}x^3\ln(x) - \dfrac{x^3}{9}$

11. Which of the following is the left-endpoint Riemann sum approximation of $f(x) = x^2 + 1$ on the interval $[-1, 7]$ using $n = 4$ rectangles?

(A) $\sum_{i=1}^{4} \left((-1+2i)^2+1\right) 2$

(B) $\sum_{i=0}^{3} \left((-1+2i)^2+1\right) 2$

(C) $\sum_{i=1}^{4} \left((2i)^2+1\right) 2$

(D) $\sum_{i=0}^{3} \left((2i)^2+1\right) 2$

12. Evaluate $\int \frac{x}{\sqrt[3]{3x^2+2}}\, dx$.

(A) $\frac{\ln(3x^2+2)}{6} + C$

(B) $4\ln(3x^2+2) + C$

(C) $\frac{(3x^2+2)^{2/3}}{4} + C$

(D) $9(3x^2+2)^{2/3} + C$

(E) $\frac{1}{9(3x^2+2)^{4/3}} + C$

13. A water storage tank begins leaking at a rate of $r(t) = 10e^{-t}$ gallons per minute. How much water leaks out during the first 3 minutes?

(A) $10(1 - e^{-1})$ (B) $10(1 - e^{-2})$ (C) $10(1 - e)$ (D) 10 (E) $10(1 - e^{-3})$

14. Let $f(x)$ be a continuous function such that $f(-1) = 2$ and $f(7) = 10$. The fact that the equation $f(c) = 4$ has a solution for some c in the interval $(1, 9)$ is the consequence of which theorem?

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(B) Mean Value Theorem

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(E) Fundamental Theorem of Calculus

15. Evaluate $\int \frac{\sin(\theta)}{1+\cos^2(\theta)}\, d\theta$.

(A) $\arctan(\sin(\theta)) + C$

(B) $-\arctan(\sin(\theta)) + C$

(C) $\arctan(\cos(\theta)) + C$

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(E) $\arctan(\sin(\theta)) + \cos(\theta) + C$

16. Which of the following is the derivative of $F(x) = \int_x^{3x} e^t(t-7)^2\, dt$.

(A) $3e^{3x}(3x-7)^2 + e^x(x-7)^2$

(B) $e^{3x}(3x-7)^2 - e^x(x-7)^2$

(C) $3e^{3x}(3x-7)^2 - e^x(x-7)^2$

(D) $e^{3x}(3x-7)^2 + e^x(x-7)^2$

(E) $3e^{3x}(3x-7)^2$

17. Let $f(x)$ be a function such that

$$\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}=\cos(x^2).$$

Which of the following statements is **false**?

(A) $f'(0)=1$

(B) $f(x)$ is continuous on $(-\infty,\infty)$

(C) $f(x)$ is increasing on $(-\infty,\infty)$

(D) There is a value of x for which $f(x)$ has a horizontal tangent line.

18. Let $f(x)$ be a function such that $f'(x)=8x^3+3x^2-10x-2+\dfrac{7}{x}$. If $f(1)=5$, then what is $f(\sqrt{2})$?

(A) 6 (B) $\dfrac{19}{\sqrt{2}}-5$ (C) $\dfrac{19}{\sqrt{2}}+4$ (D) $\dfrac{7}{2}\ln(2)-2$ (E) $\dfrac{7}{2}\ln(2)+7$

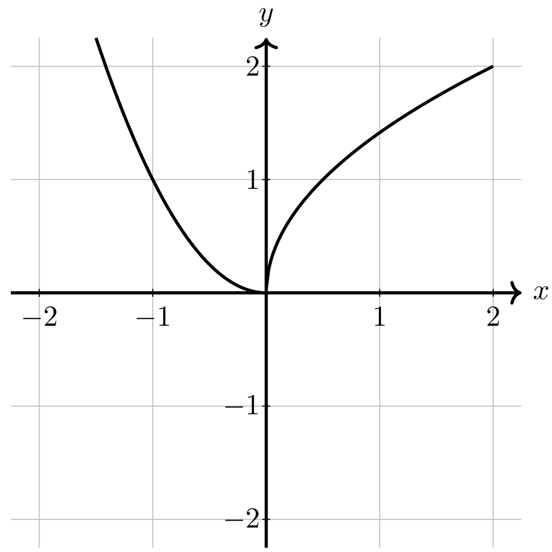
19. What is the **sum** of the absolute maximum and minimum values of $f(x) = x^4 - 3x^2$ on the interval $[0, 2]$?

(A) 2 (B) $\dfrac{13}{4}$ (C) $\dfrac{7}{4}$ (D) $\dfrac{25}{4}$ (E) 4

20. If $y = f\left([g(x)]^3\right)$, $f(-1) = -2$, $f'(-1) = 2$, $g(3) = -1$, and $g'(3) = 3$, what is the value of y' when $x = 3$?

(A) 36 (B) 28 (C) 48 (D) 18 (E) 54

21. The graph of the function $f(x)$ is shown below.



If $A = \int_0^1 f(x)\,dx$, $B = \int_1^2 f(x)\,dx$, and $C = \int_{-1}^0 f(x)\,dx$, then which of the following is true?

(A) $A < C < B$ (B) $A < B < C$ (C) $B < A < C$ (D) $B < C < A$ (E) $C < A < B$

22. Use a left-endpoint approximation to approximate the area below $f(x) = x^2 + x$ on the interval $[0, 3]$ with $n = 3$ rectangles.

(A) 2 (B) 6 (C) 8 (D) 18 (E) 20