

1.(6 pts.) Determine the following limit

$$\lim_{x \rightarrow -1} \left(\frac{x^2 + 6x + 5}{x^2 + x} + \cos(x^2\pi) \right).$$

- (a) 2 (b) 1 (c) -5 (d) -3 (e) -4

2.(6 pts.) Calculate the following limit

$$\lim_{x \rightarrow 3^-} \frac{x^2 |x - 3|}{x - 3}.$$

- (a) 9 (b) -9 (c) 6 (d) -3 (e) 3

3.(6 pts.) Find all points where the following function is discontinuous

$$f(x) = \begin{cases} \frac{(x-1)(x+2)}{(x^2-1)x} & x \neq 1 \\ \frac{3}{2} & x = 1 \end{cases}.$$

(a) $x = 0, x = -2, x = 1$

(b) $x = 0, x = -1$

(c) $x = 1, x = 0$

(d) $x = -2, x = -1, x = 1$

(e) $x = -1, x = 1, x = 0$

4.(6 pts.) Let

$$f(x) = \sin(x) \cos(2x) + \sin(2x) \cos(x).$$

Find $f'(\pi) = ?$

(a) -3

(b) 2

(c) -1

(d) 0

(e) -2

5.(6 pts.) Find the equation of the tangent line to the following curve at (1, 2):

$$f(x) = x^2 - x + 2.$$

- (a) $y = 2x$ (b) $y = -x - 1$ (c) $y = x + 1$ (d) $y = -x + 3$ (e) $y = x - 1$

6.(6 pts.) Let

$$f(x) = \frac{\sin x}{x}.$$

Find $f''(x) = ?$

(a) $\frac{-x^2 \sin x - 3x \cos x + 3 \sin x}{x^3}$

(b) $\frac{-x^2 \sin x + 4x \cos x + 5 \sin x}{x^3}$

(c) $\frac{x^2 \sin x + 4x \cos x + 2 \sin x}{x^3}$

(d) $\frac{x^2 \sin x - 3x \cos x + 2 \sin x}{x^3}$

(e) $\frac{-x^2 \sin x - 2x \cos x + 2 \sin x}{x^3}$

7.(6 pts.) If $y = (x + 1)^3 + \sin(5x^3 + \sin x + \pi)$ what is $y'(0)$?

- (a) $3/2$ (b) 2 (c) $1/2$ (d) $5/2$ (e) 4

8.(6 pts.) If $\sin(x + y) = y^2 \cos x$, what is y' at the point $(0, 0)$?

- (a) 4 (b) 0 (c) 2 (d) -1 (e) -2

9.(6 pts.) The mechanics at South Bend Automotive are reboring a 6-inch-deep cylinder to fit a new piston. The machine they are using increases the cylinder's radius one-thousandth of an inch every 3 minutes. How rapidly is the cylinder volume increasing when its radius is 3.5 in.?

- (a) $\frac{14\pi}{1000}$ in.³/min (b) $\frac{24.5\pi}{1000}$ in.³/min (c) $\frac{7\pi}{3000}$ in.³/min
(d) $\frac{73.5\pi}{1000}$ in.³/min (e) $\frac{10.5\pi}{3000}$ in.³/min

10.(6 pts.) Use differentials (or, equivalently, a linear approximation) to estimate $f(3.2)$ if $f(3) = 72$ and $f'(3) = 7$.

- (a) 79 (b) 65 (c) 70.6 (d) 72.7 (e) 73.4

11.(6 pts.) Identify the x values of the local maxima and minima of the function $f(x) = (x + 4)^5(x - 3)^4$.

- (a) local minimum at $x = 3$; local maxima at $x = -4$ and $x = -1/9$.
- (b) local minima at $x = 3$ and $x = -4$; local maximum at $x = -1/9$.
- (c) local minimum at $x = -4$; local maximum at $x = 3$
- (d) local minimum at $x = 3$; local maximum at $x = -4$
- (e) local minimum at $x = 3$; local maximum at $x = -1/9$.

12.(6 pts.) Consider the function $f(x) = \frac{x + 1}{x^2 + x + 1}$. Which of the following statements is true? Note that $y = 0$ is a horizontal asymptote and draw a rough sketch of the graph after analyzing f' .

- (a) f has an absolute maximum at $x = 0$ and an absolute minimum at $x = -2$.
- (b) f has no absolute maximum or minimum.
- (c) f has an absolute maximum at $x = 0$ and an absolute minimum at $x = 2$.
- (d) f has an absolute maximum at $x = 0$ and no absolute minimum.
- (e) f has no absolute maximum and an absolute minimum at $x = -2$.

13.(6 pts.) The value $x = c$ given by the Mean Value Theorem applied to the function $f(x) = x^3 + x - 1$ on the interval $[0, 2]$ is

- (a) $x = \frac{2\sqrt{3}}{3}$ (b) $x = \sqrt{\frac{7}{6}}$ (c) $x = \frac{\sqrt{3}}{3}$ (d) $x = 1$ (e) $x = 2$

14.(6 pts.) If $y = 2x^2 - x^4$, which one of the following is true?

- (a) There are two local minima and two inflection points.
(b) There is one inflection point, one local minima and one local maxima.
(c) The line $y = 4x - 4$ is a slant asymptote.
(d) There are two local maxima and two inflection points.
(e) There is just one inflection point.

15.(6 pts.) Find

$$\lim_{x \rightarrow -\infty} \frac{\sqrt{4x^4 + 7x + 2}}{\sqrt[3]{27x^6 + 17}}$$

(a) $\frac{\sqrt{2}}{\sqrt[3]{17}}$

(b) $-\frac{2}{3}$

(c) ∞

(d) $\frac{2}{3}$

(e) $-\infty$

16.(6 pts.) A page of a book is to have a total area of 150 square inches, with 1 inch margins at the top and sides, and a 2 inch margin at the bottom. Find the dimensions in inches of the page which will have the largest print area.

(a) 30×5

(b) $\frac{30}{\sqrt{3}} \times 5\sqrt{3}$

(c) $13 \times 11\frac{7}{13}$

(d) 15×10

(e) $3\sqrt{7} \times \frac{50}{\sqrt{7}}$

17.(6 pts.) Newton's method is to be used to find a root of the equation

$$x^3 - x - 1 = 0 .$$

If $x_1 = 1$, find x_2 .

- (a) 0.95 (b) 1.35 (c) 1.50 (d) 3 (e) 1.75

18.(6 pts.) Express the limit below as a definite integral. Calculate that integral.

$$\lim_{n \rightarrow \infty} \sum_{i=1}^n \frac{\pi}{4n} \sec^2\left(\frac{i\pi}{4n}\right)$$

- (a) $-\pi$ (b) 1 (c) 0 (d) -1 (e) π

19.(6 pts.) Find $f'(2)$ if $f(x) = \int_2^x \sqrt{1+t^3} dt$.

(a) 9

(b) 0

(c) 1

(d) 4

(e) 3

20.(6 pts.) A car racing on a straight road crosses the starting line with a velocity of 88 ft/sec. From this point on it accelerates at $\frac{60}{\sqrt{t+1}}$ ft/sec/sec. How fast in ft/sec will the car be going in 3 seconds?

(a) 152

(b) 328

(c) 292

(d) 244

(e) 208

21.(6 pts.) Find

$$\int_3^6 \frac{\pi}{x^2} \cos\left(\frac{\pi}{x}\right) dx$$

- (a) $\frac{\sqrt{3}+1}{2}$ (b) $\frac{1}{\sqrt{2}}$ (c) $\frac{\sqrt{3}-1}{2}$ (d) $\frac{1}{2}$ (e) 0

22.(6 pts.) A solid in space intersects the xy plane in the region between $x = 0$ and $x = \pi$; bounded above by the graph of $y = \sin x$ and below by the graph of $y = -2 \sin x$. Each cross section perpendicular to the x -axis is a rectangle whose short side is the line in the xy plane and whose long side is 2 times the length of the short side. Which integral below gives the volume?

- (a) $6 \int_0^\pi \sin^2 x \, dx$ (b) $6 \int_0^\pi \sin x \, dx$ (c) $18 \int_0^\pi \sin^2 x \, dx$
(d) $-\int_0^\pi \sin^2 x \, dx$ (e) $18 \int_0^\pi \sin x \, dx$

23.(6 pts.) The plane region bounded below by the graph of $y = \sqrt{x}$ and above by the graph of $y = \sqrt[3]{x}$ is rotated about the line $x = 5$. Which integral below gives the volume?

(a) $\pi \int_0^1 (5 - \sqrt{x})^2 - (5 - \sqrt[3]{x})^2 dx$ (b) $2\pi \int_0^1 (5 - x) \cdot (\sqrt{x} - \sqrt[3]{x}) dx$

(c) $\pi \int_0^1 (5 - \sqrt[3]{x})^2 - (5 - \sqrt{x})^2 dx$ (d) $2\pi \int_0^1 (5 - x) \cdot (\sqrt[3]{x} - \sqrt{x}) dx$

(e) $2\pi \int_0^1 (x - 5) \cdot (\sqrt[3]{x} - \sqrt{x}) dx$

24.(6 pts.) Consider the plane region bounded by the graphs of $y = \sqrt{x}$, $y = 0$, $x = 0$ and $x = 4$. Rotate this region about the line $y = -1$ and calculate the volume.

(a) 28π (b) $\frac{56\pi}{3}$ (c) $\frac{61\pi}{3}$ (d) $\frac{28\pi}{3}$ (e) $\frac{112\pi}{3}$

25.(6 pts.) The function $f(x) = \sqrt[3]{x}$ is continuous on the interval $[1, 8]$. Which number below is its average value on this interval?

(a) $\frac{7}{5}$

(b) $\frac{5}{3}$

(c) $\frac{45}{28}$

(d) $\frac{45}{8}$

(e) $\frac{5}{2}$

Name: _____

Instructor: _____

Math 125, Final Exam₂, December 12, 2002

- Be sure that you have all 14 pages of the test.
- No calculators are to be used.
- The exam lasts for two hours.
- **When told to begin, remove this answer sheet and keep it under the rest of your test. When told to stop, hand in just this one page.**
- The Honor Code is in effect for this examination, including keeping your answer sheet under cover.

Please mark your answers with an **X!** Do NOT circle them!

The dotted lines in the answer box indicate page breaks.

1.	(a)	(b)	(c)	(d)	(e)	15.	(a)	(b)	(c)	(d)	(e)
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5.	(a)	(b)	(c)	(d)	(e)	19.	(a)	(b)	(c)	(d)	(e)
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Name: _____

Instructor: ANSWER

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