Name: ______________________

Instructor: ______________________

Math 10550, Practice Final Exam, December

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- No calculators.
- The exam lasts for 2 hours.
- Be sure that your name is on this page.
- Be sure that you have all 25 problems.
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1.(6 pts.) Compute $\lim_{x \to 2^-} \frac{x^2 - 4}{x^2 - 5x + 6}$.

(a) -4 (b) ∞ (c) 0 (d) 1 (e) $-\infty$

2.(6 pts.) Compute $\lim_{x \to 0^+} \frac{x^2 - 9}{\sin x}$.

(a) Does not exist and is not ∞ or $-\infty$. (b) ∞

(c) 0 (d) -9

(e) $-\infty$

3.(6 pts.) Evaluate $\lim_{x\to\infty} (\sqrt{x^2 - x} - \sqrt{x^2 + 5x}\,)$.

(a) 0 (b) 3 (c) -6

(d) Does not exist (e) -3

4.(6 pts.) For what constant a is the function f given by

$$f(x) = \begin{cases} ax + 1 & x < 0 \\ x^2 + 1 & x \geq 0 \end{cases}$$

differentiable everywhere?

(a) $a = 2$ (b) $a = 0$

(c) $a = 1$ (d) Any value of a

(e) No value of a

5.(6 pts.) Compute $\lim\limits_{x \to 0} \dfrac{\tan 2x}{\sin 3x}$.

(a) 1/3 (b) 2 (c) 0 (d) 2/3 (e) 1

6.(6 pts.) Compute $\lim\limits_{x \to -\infty} \dfrac{\sqrt{4x^2 + x + 1}}{3x - 1}$.

(a) 0 (b) $-2/3$ (c) 2/3 (d) 1/3 (e) $-1/3$

7.(6 pts.) Compute the tangent line to the ellipse given by the equation $x^2 + 4y^2 = 5$ at the point $(1, -1)$

(a) $y = \frac{1}{2}x - \frac{3}{2}$

(b) The tangent line does not exist.

(c) $y = \frac{1}{4}x - \frac{5}{4}$

(d) $y = \frac{1}{4}x - \frac{3}{4}$

(e) $y = -\frac{1}{4}x - \frac{3}{4}$

8.(6 pts.) Let $F(x) = f(g(x))$. Compute $F'(2)$ using the following information:
$f(-1) = -3$, $f(2) = 12$, $g(-1) = -7$, $g(2) = -1$,
$f'(-1) = 2$, $f'(2) = 8$, $g'(-1) = -1$, $g'(2) = 5$.

(a) 10

(b) -15

(c) 40

(d) 2

(e) 52

9.(6 pts.) For $y = (\sin 4x)^8$, compute y'.

(a) $32(\cos 4x)^7$

(b) $8(\cos 4x)^7$

(c) $8(\sin 4x)^7$

(d) $32(\sin 4x)^7$

(e) $32(\sin 4x)^7 \cos 4x$

10.(6 pts.) How many inflection points does the curve $y = \dfrac{x^5}{5} + \dfrac{x^4}{4}$ have?

(a) 1 (b) 0 (c) 3 (d) 2 (e) 4

11.(6 pts.) Compute the derivative y' for the curve $\sqrt{x^2+y^2} = 2 + y$ at the point $x = 4$, $y = 3$.

(a) $2/11$ (b) -2 (c) 2 (d) 0 (e) $-2/11$

12.(6 pts.) A kite 100 ft above the ground is flying horizontally (away from its holder) with a speed of 16ft/sec. At what rate is the angle between the string and the horizontal direction changing, when 200 ft of the string have been let out?

(a) $\frac{\pi}{50}$ radian/second

(b) $\frac{1}{25}$ radian/second

(c) $\frac{1}{50}$ radian/second

(d) $-\frac{1}{25}$ radian/second

(e) $-\frac{1}{50}$ radian/second

13.(6 pts.) Find the linearization of $f(x) = \sqrt{10 - x^2}$ at $a = -1$.

(a) $L(x) = \frac{2}{3}(x+1) + 3$

(b) $L(x) = -\frac{2}{3}(x+1) + 3$

(c) $L(x) = x + 4$

(d) $L(x) = -\frac{1}{3}(x+1) + 3$

(e) $L(x) = \frac{1}{3}(x+1) + 3$

14.(6 pts.) Find all local maxima and minima of the function $f(x) = 2|x| - x^2 - 1$.

(a) Local maxima: $(x, y) = (-1, 0)$ and $(x, y) = (1, 0)$, local minimum $(x, y) = (0, -1)$.

(b) Only local minimum at $(x, y) = (0, -1)$, no local maxima.

(c) Local maximum: $(x, y) = (-1, 0)$, local minimum $(x, y) = (0, -1)$.

(d) No local maxima or minima, because the function $|x|$ has no derivative at $x = 0$.

(e) Local maxima: $(x, y) = (-1, 0)$ and $(x, y) = (1, 0)$, no local minimum.

15.(6 pts.) Find all asymptotes of the curve $y = \dfrac{2x^2 + x + 1}{x - 1}$.

(a) vertical asymptote $x = 1$, no other asymptotes.

(b) slant asymptote $y = 2x + 1$, vertical asymptote $x = 1$, no horizontal asymptotes.

(c) horizontal asymptotes $y = 2$, slant asymptote $y = 2x + 3$, no vertical asymptotes.

(d) slant asymptote $y = 2x + 3$, vertical asymptote $x = 1$, no horizontal asymptotes.

(e) horizontal asymptotes $y = 2$, vertical asymptote $x = 1$, no slant asymptotes.

16.(6 pts.) Find **all** the points on the hyperbola $y^2 - x^2 = 4$ that are closest to the point $(2, 0)$.

(a) $(1, \pm 5)$ (b) $(1, \pm\sqrt{5})$ (c) $(-1, \sqrt{5})$

(d) $(1, \sqrt{5})$ (e) $(\sqrt{5}, 1)$

17.(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) $3\sqrt{7} \times \frac{50}{\sqrt{7}}$ (b) 5×30 (c) $11\frac{7}{13} \times 13$

(d) $5\sqrt{3} \times \frac{30}{\sqrt{3}}$ (e) 10×15

18.(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) 1.50 (b) 0.95 (c) 3 (d) 1.35 (e) 1.75

19.(6 pts.) Express the limit below as a definite integral.

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

(a) $\displaystyle\int_0^1 \sec^2\left(\frac{\pi}{4}x\right)dx$

(b) $\displaystyle\frac{\pi}{4}\int_0^{\pi/4} \sec^2(x)dx$

(c) $\displaystyle\int_0^{\pi/4} \sec^2\left(\frac{\pi}{4}\right)dx$

(d) $\displaystyle\int_0^{\pi/2} \sec^2(x)dx$

(e) $\displaystyle\int_0^{\pi/4} \sec^2(x)dx$

20.(6 pts.) If $f(x) = \displaystyle\int_0^{5x} \cos(u^2)du$, find $f'(x)$.

(a) $-\cos(5x^2)$

(b) $5\cos(25x^2)$

(c) $-25\cos(5x^2)$

(d) $5\cos(5x^2)$

(e) $-5\cos(25x^2)$

21.(6 pts.) Evaluate the integral $\int_0^{\sqrt{\pi}} x\sin(x^2)dx$.

(a) $\frac{\pi}{4}$ (b) 2 (c) $\frac{1}{4}$ (d) $1-\frac{1}{\pi}$ (e) 1

22.(6 pts.) Which of the following integrals give the area of the region below the curve $y = 2x$ and above the curve $y = x^2 - 4x$?

(a) $\int_0^4 \Big((x^2 - 4x) - 2x\Big)dx$

(b) $\int_0^6 \Big((x^2 - 4x) - 2x\Big)dx$

(c) $\int_0^6 \Big(2x - (x^2 - 4x)\Big)dx$

(d) $\int_0^4 \Big(2x - (x^2 - 4x)\Big)dx$

(e) $\int_0^4 \Big(2x - (x^2 - 4x)\Big)dx + \int_4^6 \Big((x^2 - 4x) - 2x\Big)dx$

23.(6 pts.) An area in xy plane bounded by the curves $y = 0$ and $y = x - x^2$. If we rotate this area about $x = 7$, which integral below gives the volume?

(a) $\pi \int_0^{1/4} (x - x^2)^2 \, dx$

(b) $2\pi \int_0^1 (7 - x)(x - x^2) \, dx$

(c) $2\pi \int_0^{\pi} (x - x^2 - 7) \, dx$

(d) $\pi \int_0^1 (x - x^2)^2 \, dx$

(e) $2\pi \int_0^1 (x - 7)(x - x^2) dx$

24.(6 pts.) The plane region bounded by the curves $y = 2$ and $y = 2 + 2x - x^2$ is rotated about the x axis. Which integral below gives the volume?

(a) $\pi \int_0^2 \left(4 - (2 + 2x - x^2)^2\right) \, dx$

(b) $\pi \int_0^2 \left((2 + 2x - x^2)^2 - 4\right) dx$

(c) $2\pi \int_0^2 \left((2 + 2x - x^2) - 2\right) dx$

(d) $\pi \int_0^1 \left((2 + 2x - x^2)^2 - 4\right) dx$

(e) $\pi \int_0^1 \left(4 - (2 + 2x - x^2)^2\right) \, dx$

25.(6 pts.) The function $f(x) = \sqrt{16 - 2x}$ is continuous on the interval $[0, 8]$. Which number below is its average value on this interval?

(a) $\frac{8}{3}$

(b) $\frac{64}{3}$

(c) $\frac{8}{3}\sqrt{8}$

(d) $\frac{16}{3}$

(e) $-\frac{8}{3}$

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