NAME:_____ MA 23100
Sample Final Exam

PUID:_____

INSTRUCTIONS

- There are 25 problems on 14 pages.
- Record all your answers on the answer sheet provided. The answer sheet is the only thing that will be graded.
- No books or notes are allowed.
- You may use a one-line scientific calculator. No other electronic device is allowed. Be sure to turn off your cellphone.
- Show all your work on the exam. If you need more space, use the backs of the pages.

1. Find the slope of the line passing through the points $(-3, 7)$ and $(4, -3)$

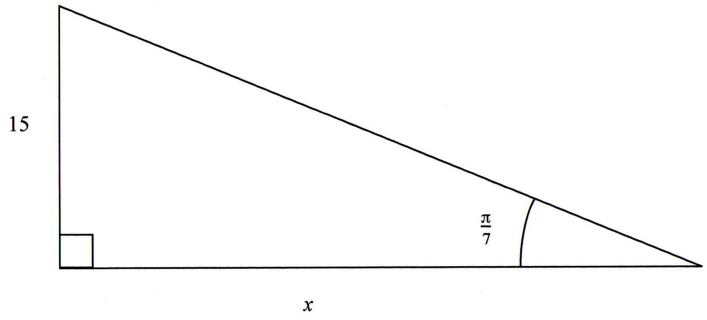
   A. $-\frac{10}{7}$
   B. $-\frac{7}{10}$
   C. $\frac{7}{10}$
   D. $\frac{10}{7}$
   E. $\frac{7}{4}$

2. Which of the following best describes the **domain** of the function

$$f(x) = \frac{x+4}{x^2 - 3x - 10}?$$

   A. All real numbers except $x = -4$.
   B. All real numbers except $x = 2$ and $x = -5$.
   C. All real numbers except $x = -2$ and $x = 5$.
   D. All real numbers except $x = 2$, $x = -5$ and $x = -4$.
   E. All real numbers except $x = -2$, $x = 5$ and $x = -4$.

3. Solve for x. Give your answer as a decimal number rounded to at least 3 decimal places. (Note that the angle is given in radians.)



A. 7.224
B. 16.649
C. 31.148
D. 33.423
E. 34.571

4. What is the **period** of the function

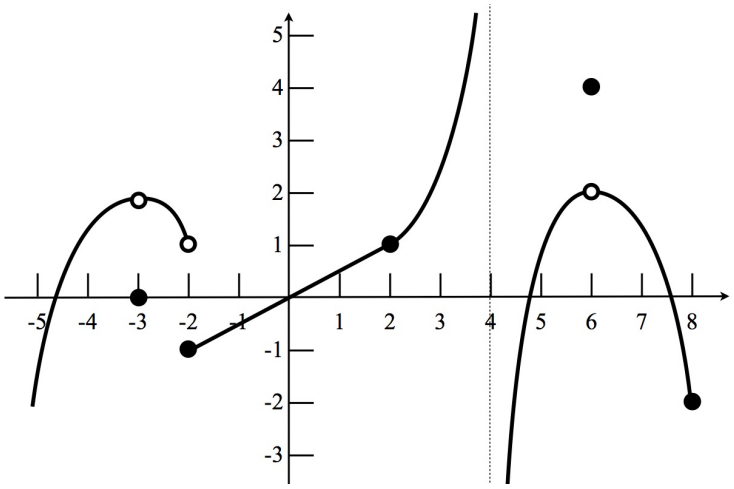
$$p(x) = 14\cos(6t) - 9?$$

A. $\frac{\pi}{7}$
B. $\frac{3}{\pi}$
C. $\frac{\pi}{3}$
D. $\frac{7}{\pi}$
E. 6

5. The graph of a function $f(x)$ is given below. Compute

$$\lim_{x \to -3} f(x),$$

if it exists.



A. 0

B. 1

C. 2

D. This limit does not exist because the one-sided limits are not equal.

E. This limit does not exist because the function is not continuous at the point $x = -3$.

6. Compute

$$\lim_{x \to 5} \frac{2x - 10}{x^2 - 2x - 15},$$

if it exists.

A. 0

B. $\frac{1}{4}$

C. 5

D. $\frac{1}{8}$

E. This limit does not exist.

7. Find the equation of the line tangent to the curve

$$y = x^2 + \sqrt{x}$$

at the point $x = 4$.

A. $y = \frac{9}{2}x$
B. $y = \frac{17}{4}x + 1$
C. $y = \frac{33}{4}x - 15$
D. $y = \frac{17}{2}x - 16$
E. $y = 10x - 22$

8. An object moving through space has position, in feet, after t seconds, is given by

$$s(t) = e^{-2t} + \ln(2t + 3).$$

Find the acceleration of this object when $t = 2$.

A. -0.1549 ft/sec^2
B. -0.0084 ft/sec^2
C. 0.0324 ft/sec^2
D. 0.1549 ft/sec^2
E. 0.2491 ft/sec^2

9.

$$f(x) = \frac{4x^2 + 5x - 7}{3x - 1}$$

Find $f'(x)$.

A. $\frac{36x^2+22x-26}{(3x-1)^2}$

B. $\frac{8x-12x^2-16}{(3x-1)^2}$

C. $\frac{36x^2+38x-26}{(3x-1)^2}$

D. $\frac{12x^2+22x-26}{(3x-1)^2}$

E. $\frac{12x^2-8x+16}{(3x-1)^2}$

10.

$$f(x) = \tan\left(\frac{2x+3}{x}\right)$$

Find $f'(x)$.

A. $\frac{3}{x^2}\sec\left(\frac{2x+3}{x}\right)\tan\left(\frac{2x+3}{x}\right)$

B. $\frac{3}{x^2}\sec^2\left(\frac{2x+3}{x}\right)$

C. $-\frac{3}{x^2}\sec\left(\frac{2x+3}{x}\right)\tan\left(\frac{2x+3}{x}\right)$

D. $-\frac{3}{x^2}\sec^2\left(\frac{2x+3}{x}\right)$

E. $\frac{3}{x^2}\sec(x)\tan(x)$

11.

$$f(x) = x \sin x$$

Compute $f''(x)$.

A. $2\cos x - x\sin x$

B. $x\cos x + \sin x$

C. $x\cos x - \sin x$

D. $x\sin x + \cos x$

E. $x\cos x - 2\sin x$

12. The function

$$f(x) = 9x + \frac{1}{x} - 3$$

has critical points at $x = \frac{1}{3}$ and $x = -\frac{1}{3}$. Classify these critical points as relative minima, relative maxima, or neither.

A. Two relative minima at $x = \frac{1}{3}$ and $x = -\frac{1}{3}$.

B. A relative minimum at $x = \frac{1}{3}$ and a relative maximum at $x = -\frac{1}{3}$.

C. A relative maximum at $x = \frac{1}{3}$ and a relative minimum at $x = -\frac{1}{3}$.

D. Two relative maxima at $x = \frac{1}{3}$ and $x = -\frac{1}{3}$.

E. This function has no extrema.

13. Find the point(s) of inflection for the curve

$$y = \frac{1}{x^2 + 12}.$$

A. $x = \sqrt{3}$ and $x = -\sqrt{3}$
B. $x = 2$ and $x = -2$
C. $x = 4$ and $x = -4$
D. $x = 0$
E. $x = \sqrt{12}$ and $x = -\sqrt{12}$

14. Compute

$$\lim_{x \to \infty} \frac{1 + x^3 - 5x^6 + 8x^9}{3 + 32x^2 - 8x^8 - 5x^9}.$$

A. 0
B. $\frac{1}{3}$
C. $-\frac{8}{5}$
D. ∞
E. $-\infty$

15. Find the absolute maximum value of

$$f(x) = x^3 - 12x + 7$$

over the interval $[1, 3]$.

A. -9

B. -4

C. -2

D. 20

E. 23

16. A certain type of apple tree produces 400 lbs of apples per tree yearly when there are 50 trees planted in a single acre plot. However, for every additional tree planted in the same plot, the production of *each* tree decreases by $\frac{1}{2}$ lb. How many trees should be planted in the acre plot in order to produce the maximum total amount of apples?

A. 350

B. 375

C. 400

D. 425

E. 450

17. Suppose

$$x^3 + 4xy - 5y^3 = 9.$$

Compute y'.

A. $\frac{3x^2+4y}{15y^2-4x}$

B. $\frac{3x^2+4y-9}{15y^2-4x}$

C. $\frac{3x^2+4y-9}{15y^2}$

D. $\frac{3x^2+4y}{15y^2}$

E. $\frac{3x^2}{15y^2-4}$

18.

$$f(x) = (3x^2 - 5x + 7)e^{-4x}.$$

Compute $f'(x)$.

A. $(20 - 24x)e^{-4x}$

B. $(23 - 14x - 12x^2)e^{-4x}$

C. $(12x^2 - 14x + 23)e^{-4x}$

D. $(3x^2 + x - 2)e^{-4x}$

E. $(26x - 33 - 12x^2)e^{-4x}$

19.

$$f(x) = \ln\left(e^{x^2} + 4\right)$$

Compute $f'(x)$.

A. $2x$

B. $2x + \frac{1}{4}$

C. $\frac{2xe^{x^2}}{e^{x^2}+4}$

D. $\frac{1}{e^{x^2}+4}$

E. $\frac{1}{2xe^{x^2}}$

20. A certain radioactive substance decays exponentially with a half-life of 30 days. If a 500 gram sample is left in storage, how many grams will remain after 50 days?

A. 11.6 g

B. 83.3 g

C. 113.9 g

D. 157.5 g

E. 166.7 g

21. Compute

$$\int \left(x^3 + \frac{3}{x^3} \right) dx.$$

A. $\frac{1}{3}x^4 + \frac{1}{x^2} + C$
B. $\frac{1}{3}x^4 - \frac{1}{x^2} + C$
C. $\frac{1}{4}x^4 + \frac{3}{2x^2} + C$
D. $\frac{1}{4}x^4 - \frac{3}{2x^2} + C$
E. $\frac{1}{4}x^4 - \frac{3}{4x^2} + C$

22. Compute

$$\int (3\cos 5x + 7\sin 8x)dx.$$

A. $\frac{7}{8}\cos 8x - \frac{3}{5}\sin 5x + C$
B. $\frac{3}{5}\sin 5x - \frac{7}{8}\cos 8x + C$
C. $56\cos 8x - 15\sin 5x + C$
D. $15\sin 5x - 56\cos 8x + C$
E. $15\sin 5x + 56\cos 8x + C$

23. Which sum is the Riemann Sum that approximates the integral

$$\int_1^3 \frac{1}{x+1} dx$$

with $n = 4$?

A. $\frac{1}{2}\left(\frac{1}{\frac{3}{2}+1} + \frac{1}{2+1} + \frac{1}{\frac{5}{2}+1} + \frac{1}{3+1}\right)$

B. $\frac{1}{2}\left(\frac{1}{\frac{1}{2}+1} + \frac{1}{1+1} + \frac{1}{\frac{3}{2}+1} + \frac{1}{3+1}\right)$

C. $\frac{1}{2}\left(\frac{1}{\frac{1}{2}+1} + \frac{1}{1+1} + \frac{1}{\frac{3}{2}+1} + \frac{1}{2+1}\right)$

D. $\frac{1}{4}\left(\frac{1}{\frac{3}{2}+1} + \frac{1}{2+1} + \frac{1}{\frac{5}{2}+1} + \frac{1}{3+1}\right)$

E. $\frac{1}{4}\left(\frac{1}{\frac{1}{2}+1} + \frac{1}{1+1} + \frac{1}{\frac{3}{2}+1} + \frac{1}{2+1}\right)$

24. Compute the area under the curve

$$y = 2x + \frac{2}{x}$$

over the interval $[2, 5]$.

A. 33.61

B. 28.22

C. 25.61

D. 22.83

E. 21.21

25. Compute

$$\int_0^{\pi} \left(e^{2x} + \sin x\right) dx.$$

A. $\frac{1}{2}e^{2\pi} - \frac{5}{2}$
B. $\frac{1}{2}e^{2\pi} + \frac{3}{2}$
C. $2e^{2\pi} - 4$
D. $2e^{2\pi}$
E. $e^{\pi^2} + 1$