There are three versions of the exam; answers to all three versions are included here.

Math 121 EXAM I

October 5, 2011

NAME

SECTION

INSTRUCTOR

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This is a closed book, closed notes exam. NO ELECTRONIC DEVICES ARE ALLOWED.
Part I (4 points each) Directions: Write the letter of the best answer in the space provided. Make sure your letter is clear. Any answer that looks like two letters will be marked incorrect.

If \( f(x) = 2x^2 - 1 \), then \( f(-3) \)

A) -37
B) -19
C) 17
D) 23
E) 35

Let \( x = \ln 2 \) and \( y = \ln 3 \). Express \( \ln \left(\frac{8}{9}\right) \) in terms of \( x \) and \( y \).

A) \( 2x - 3y \)
B) \( 3x - 2y \)
C) \( \frac{x}{y} \)
D) \( \frac{3x}{2y} \)
E) \( \frac{2y}{3x} \)

What is the natural domain of the function \( f(x) = \sqrt{x^2 - 3} \)?

A) \( (-\infty, 3] \)
B) \( [0, +\infty) \)
C) \( (-\infty, +\infty) \)
D) \( (-\infty, \sqrt{3}) \cup (\sqrt{3}, +\infty) \)
E) \( (-\infty, -\sqrt{3}) \cup [\sqrt{3}, +\infty) \)
Given that the domain is all real numbers, what is the range of the function
\[ y = -2 \cos \frac{x}{4} \]?

A) \(-2 \leq y \leq 0\)

B) \(-2 \leq y \leq 2\)

C) \(-\infty < y < -\infty\)

D) \(y \leq -2\)

E) \(y \leq 8\pi\)

If \(f(x) = 3x^3 - 5\), then \(f^{-1}(x) =\)

A) \(\left(\frac{x + 5}{3}\right)^{\frac{1}{3}}\)

B) \(\left(\frac{x + 3}{5}\right)^{\frac{1}{3}}\)

C) \(\left(\frac{x}{3} + 5\right)^{\frac{1}{3}}\)

D) \(\left(\frac{x}{5} + 3\right)^{\frac{1}{5}}\)

E) \(\frac{3x^3 - 5}{3} + 5\)
A function \( f \) is said to be an even function if \( f(-x) = f(x) \), where \( x \) is a real number. Which of the following graphs represent an even function?

A)

B)

C)
For which of the following pairs of functions is \( f(g(x)) = x, \ x > 0 \)?

A) \( f(x) = \frac{2}{3}x + 7 \) and \( g(x) = \frac{3}{2x} - 7 \)

B) \( f(x) = x + 1, \ g(x) = \frac{x}{x+1} \)

C) \( f(x) = 2x - 1, \ g(x) = \frac{x + 1}{2} \)

D) \( f(x) = x^2, \ g(x) = \frac{1}{x^2} \)

E) \( f(x) = 2x^2, \ g(x) = \sqrt{x} \)
Which of the following is a value of \( x \) such that \( \cos^{-1}(\cos x) = x \)?

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

If \( \sin \theta = -\frac{\sqrt{13}}{7} \) and the terminal side of \( \theta \) lies in quadrant III, what is the value of \( \tan \theta \)?

A) \(\frac{7}{6}\)
B) \(\frac{6}{7}\)
C) \(\frac{7}{\sqrt{13}}\)
D) \(\frac{6}{\sqrt{13}}\)
E) \(\frac{\sqrt{13}}{6}\)
What is the value of \( \cot(225^\circ) \)?

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

If \( \cos \theta = 0.3 \) and the triangle shown above is given, what is the value of \( x \) ?

A) 0.6
B) 0.9
C) 1.8
D) 5.7
E) 6.3
The graph of \( g \) is given above. What is \( \lim_{x \to 2} g(x) \)?

A) -1  
B) 2  
C) 3  
D) 4  
E) The limit does not exist.
Part II Directions: Show all work and mark your answers clearly to receive full credit. You may only use techniques that were covered on the syllabus.

Solve the equation \( \tan \theta = -\sqrt{3} \) for \( \theta \) on \((-\infty, +\infty)\).

(8 points)

\[
\text{Ref \angle} = \frac{\pi}{3} \quad \sqrt{3}
\]

\[
\theta = -\frac{\pi}{3} = \frac{2\pi}{3} + 2\pi K \quad \text{where} \quad K = 0, 1, 2, 3, 4, \ldots
\]

\[
\theta = 2\pi - \frac{\pi}{3} = \frac{5\pi}{3} + 2\pi K
\]

---

Solve the equation \( \cos^2 \theta + \cos \theta = 0 \) for \( \theta \), where \( \theta \) is in \([0, 2\pi]\).

(8 points)

\[
\cos^2 \theta + \cos \theta = 0
\]

\[
\cos \theta (\cos \theta + 1) = 0
\]

\[
\cos \theta = 0 \quad \cos \theta + 1 = 0
\]

\[
\theta = \frac{\pi}{2}, \frac{3\pi}{2} \quad \cos \theta = -1
\]

\[
\theta = \pi
\]

\[
\left\{ \frac{\pi}{2}, \frac{3\pi}{2}, \pi \right\}
\]
Solve the logarithmic equation: \[ \log_2 x + \log_2(x-2) = 3 \]

(8 points)

\[ \log_2 x(x-2) = 3 \]

\[ 2^3 = x(x-2) \]

\[ x^2 - 2x = 8 \]

\[ x^2 - 2x - 8 = 0 \]

\[ (x-4)(x+2) = 0 \]

\[ x = 4 \quad x = -2 \]

Neg. will not work since cannot take the log of a neg. number

Solve for \( x \): \( 2^{x+3} = 7 \)

(8 points)

\[ \ln 2^{x+3} = \ln 7 \]

\[ (x+3) \ln 2 = \ln 7 \]

\[ x + 3 = \frac{\ln 7}{\ln 2} \]

\[ x = \frac{\ln 7}{\ln 2} - 3 \]

OR \( x = \frac{\ln 7}{\ln 2} - 3 \ln 2 \)
For the function \( f(x) = x^2 + 6 \) and \( g(x) = \sqrt{x} \), find the domain of the composite function \( f(g(x)) \). Justify your answer. (10 points)

\[
\begin{align*}
\text{D} & \quad \mathbb{R} \\
\text{f} & \quad (-\infty, +\infty) \\
\text{g} & \quad [0, +\infty) \\
\text{R} & \quad [0, +\infty)
\end{align*}
\]

The values of the domain of \( g \), \([0, +\infty)\), are assigned values in the range of \( g \), \([0, +\infty)\). The values in the range of \( g \) are contained in the domain of \( f \), \((-\infty, +\infty)\). Thus, the domain of composite \( f(g(x)) \) is the same as the domain of \( g \), \([0, +\infty)\).
On the xy-plane below, graph the function $f(x) = \frac{|x|}{x}$ and discuss $\lim_{x \to 0} f(x)$.

(10 POINTS)

The $\lim_{x \to 0} f(x)$ does not exist since the left limit at 0 ($\lim_{x \to 0^-} f(x) = -1$) and the right limit at 0 ($\lim_{x \to 0^+} f(x) = +1$) are not equal.
Math 121 Exam 1

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Part I (4 points each) Write the letter of the best answer in the space provided. Make sure your letter is clear. Any answer that looks like two letters will be marked incorrect.

If \( f(x) = 2x^2 - 3 \), then \( f(-5) \)

A) 97

B) 47

C) -3

D) -53

E) -100

If \( f(x) = 3x^3 - 5 \), then \( f^{-1}(x) = \)

A) \( \left(\frac{x + 5}{3}\right)^{\frac{1}{3}} \)

B) \( \left(\frac{x + 3}{5}\right)^{\frac{1}{3}} \)

C) \( \left(\frac{x}{3} + 5\right)^{\frac{1}{3}} \)

D) \( \left(\frac{x}{5} + 3\right)^{\frac{1}{3}} \)

E) \( \frac{3x^3 - 5}{3} + 5 \)
If \( \cos \theta = 0.3 \) and the triangle shown above is given, what is the value of \( x \)?

A) 0.6  
B) 0.9  
C) 1.8  
D) 5.7  
E) 6.3

What is the natural domain of the function \( f(x) = \sqrt{x^2 - 3} \)?

A) \((-\infty, 3]\)  
B) \([0, +\infty)\)  
C) \((-\infty, +\infty)\)  
D) \((-\infty, \sqrt{3}) \cup (\sqrt{3}, +\infty)\)  
E) \((-\infty, -\sqrt{3}] \cup [\sqrt{3}, +\infty)\)

Given the domain is all real numbers, what is the range of the function \( y = -2 \cos \frac{x}{4}\)?

A) \(-2 \leq y \leq 0\)  
B) \(-2 \leq y \leq 2\)  
C) \(-\infty < y < -\infty\)  
D) \(y \leq -2\)  
E) \(y \leq 8\pi\)
A function $f$ is said to be an even function if $f(-x) = f(x)$, where $x$ is a real number. Which of the following graphs represents an even function?

A)

B)

C)
If \( \sin \theta = -\frac{\sqrt{13}}{7} \) and the terminal side of \( \theta \) lies in quadrant III, what is the value of \( \tan \theta \)?

A) \( \frac{7}{6} \)

B) \( \frac{6}{7} \)

C) \( \frac{7}{\sqrt{13}} \)

D) \( \frac{6}{\sqrt{13}} \)

E) \( \frac{\sqrt{13}}{6} \)
For which of the following pairs of functions is \( f(g(x)) = x, \ x > 0 \) ?

A) \( f(x) = \frac{2}{3}x + 7, \ g(x) = \frac{3}{2x} - 7 \)

B) \( f(x) = x + 1, \ g(x) = \frac{x}{x + 1} \)

C) \( f(x) = 2x - 1, \ g(x) = \frac{x + 1}{2} \)

D) \( f(x) = x^2, \ g(x) = \frac{1}{x^2} \)

E) \( f(x) = 2x^2, \ g(x) = \sqrt{x} \)

Let \( x = \ln 2 \) and \( y = \ln 3 \). Express \( \ln \left( \frac{8}{9} \right) \) in terms of \( x \) and \( y \).

A) \( 2x - 3y \)

B) \( 3x - 2y \)

C) \( \frac{x}{y} \)

D) \( \frac{3x}{2y} \)

E) \( \frac{2y}{3x} \)
Which of the following is a value for $x$ such that $\cos^{-1}(\cos x) = x$?

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

What is the value of $\cot(225^\circ)$?

A) $\sqrt{2}$
B) 1
C) $\frac{1}{\sqrt{2}}$
D) -1
E) $-\sqrt{2}$
The graph of \( g \) is given above. What is \( \lim_{x \to 1} g(x) \)?

A) -2

B) 2

C) 3

D) 4

E) The limit does not exist.
Part II: Directions: Show all work and mark your answers clearly to receive full credit. You may only use techniques that were covered on the syllabus. This is a closed book, closed notes exam. NO ELECTRONIC DEVICES ARE ALLOWED.

Solve the equation \( \cos \theta = -\frac{\sqrt{3}}{2} \) for \( \theta \) on \((-\infty, +\infty)\).

(8 points)

\[
\text{Ref. } \angle \text{ is } \frac{\pi}{3} \quad \checkmark
\]

\[
\begin{align*}
\theta &= \frac{2}{3} \pi + 2k\pi \\
\theta &= \frac{4}{3} \pi + 2k\pi
\end{align*}
\]

When \( k = 0, \pm 1, \pm 2, \pm 3, \ldots \), \( \pi \pm \frac{\pi}{3} \).

Solve the equation \( \cos^2 \theta + \cos \theta = 0 \), where \( \theta \) is in \([0, 2\pi]\).

(8 points)
Solve the logarithmic equation: \( \log_2 x + \log_2 (x-2) = 3 \)  
(8 points)

Solve for \( x \): \( 3^{x+2} = 5 \)  
(8 points)

\[
\begin{align*}
\ln 3^{x+2} &= \ln 5 \\
(x+2) \ln 3 &= \ln 5 \\
x+2 &= \frac{\ln 5}{\ln 3} \\
x &= \frac{\ln 5}{\ln 3} - 2
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D) -14
B) -2
C) 0
D) 10
E) 34

What is the natural domain of the function \( f(x) = \sqrt{x^2 - 3} \) ?

E) \( (-\infty, 3] \)
B) \([0, +\infty)\)
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If \( f(x) = 3x^3 - 5 \), then \( f^{-1}(x) = \)

A) \( \left( \frac{x}{3} + \frac{5}{3} \right)^{\frac{1}{3}} \)

B) \( \left( \frac{x}{5} + \frac{3}{5} \right)^{\frac{1}{3}} \)

C) \( \left( \frac{x}{3} + 5 \right)^{\frac{1}{3}} \)

D) \( \left( \frac{x}{5} + 3 \right)^{\frac{1}{3}} \)

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What is the value of \( \cot(225^\circ) \)?

A) \( \sqrt{2} \)

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(8 points)

\[ \text{Ref. } \angle = \frac{\pi}{3} \quad \text{or} \quad \frac{\pi}{3} + \frac{\pi}{3} \]

\[ \theta = \frac{4\pi}{3} + 2k\pi \quad \text{or} \quad \frac{2\pi}{3} - \frac{\pi}{3} \]

\[ \theta = \frac{5\pi}{3} + 2k\pi \]

Solve the equation \( \cos^2 \theta + \cos \theta = 0 \), where \( \theta \) is in \( [0, 2\pi] \).

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Solve the logarithmic equation: \( \log_2 x + \log_2 (x - 2) = 3 \)
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Solve for \( x \):
\[
5^{x+3} = 7
\]
(8 points)

\[
\ln 5^{x+3} = \ln 7
\]

\[
(x+3) \ln 5 = \ln 7
\]

\[
x \ln 5 + 3 \ln 5 = \ln 7
\]

\[
x \ln 5 = \ln 7 - 3 \ln 5
\]

\[
x = \frac{\ln 7 - 3 \ln 5}{\ln 5}
\]