There are 12 multiple choice questions. For each problem five possible answers are given, only one of which is correct. You should solve the problem and circle the letter of the answer that you wish to give. Circle only one choice. If you circle D and then decide to change your answer to A, please make certain to erase the circle around D completely or cross off the letter. No credit will be given if two (or more) letters are circled.

There are 5 true-false questions. If the statement is true, circle T. If the statement is false, circle F.

There are 3 partial credit questions. In order to obtain full credit for these problems, all work must be shown. Credit will not be given for an answer not supported by work.

The point value for each question is in parentheses to the right of the question number.

THE USE OF CALCULATORS IS NOT PERMITTED IN THIS EXAMINATION.

This is a closed-book, no-notes examination.

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Do not write in the box to the left.
1. (5 points) If $\cos \theta = \frac{-3}{4}$ and $\csc \theta > 0$, then $\tan \theta =$

a) $\frac{5}{3}$

b) $\frac{\sqrt{7}}{3}$

c) $\frac{-\sqrt{7}}{3}$

d) $\frac{-5}{3}$

e) $\frac{3}{5}$

2. (5 points) If $f(x) = \cos^3(4x)$, then $f'(\frac{\pi}{12}) =$

a) $\frac{-3\sqrt{3}}{8}$

b) $-3\sqrt{3}$

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

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

e) $\frac{-3\sqrt{3}}{2}$
3. (5 points) If \( y^4 - x^4 = 11 \), then \( y'' = \\

\begin{align*}
\text{a) } & \frac{44x^2}{y^4} \\
\text{b) } & \frac{11x^3}{y^3} \\
\text{c) } & \frac{-44x^2}{y^7} \\
\text{d) } & \frac{33x^2}{y^7} \\
\text{e) } & \frac{33x^2}{y^6}
\end{align*}

4. (5 points) \( \sec \left[ \sin^{-1} \left( \frac{1}{x} \right) \right] = \\

\begin{align*}
\text{a) } & \frac{x}{\sqrt{x^2 - 1}} \\
\text{b) } & \frac{\sqrt{1-x^2}}{x} \\
\text{c) } & \sqrt{1-x^2} \\
\text{d) } & \frac{x}{x-1} \\
\text{e) } & 1-x
\end{align*}
5. (5 points) If $\sec y = x$ with $0 < y < \frac{\pi}{2}$, then $y' =$

a) $\sqrt{x^2 + 1}$

b) $\frac{1}{x\sqrt{x^2 - 1}}$

c) $\frac{1}{\sqrt{x^2 - 1}}$

d) $\frac{1}{x - 1}$

e) $\frac{-1}{x(x - 1)}$

6. (5 points) $\cos^{-1}\left(\frac{-1}{2}\right) =$

a) $\frac{2\pi}{3}$

b) $\frac{\pi}{3}$

c) $\frac{-\pi}{6}$

d) $\frac{-\pi}{3}$

e) does not exist.
7. (5 points) \[ \lim_{x \to 0} \frac{\cot(7x) \sin^2(2x)}{3x \cos(5x)} = \]

a) 12

b) \( \frac{4}{21} \)

c) \( \frac{14}{15} \)

d) \( \frac{14}{3} \)

e) \( \frac{28}{3} \)

8. (5 points) If \( f \) and \( g \) are both differentiable with \( F(x) = f(g(x)) \) and

\[
\begin{align*}
g(5) &= 2 & f''(4) &= 11 \\
f(2) &= 7 & f''(5) &= 1 \\
g'(5) &= 4 & f'(2) &= 3
\end{align*}
\]

then \( F'(5) = \)

a) 3

b) 4

c) 11

d) 12

e) 21
9. (5 points) If \( \csc \theta = \frac{5}{3} \) with \( \frac{\pi}{2} < \theta < \pi \), then \( \sin(2\theta) = \)

a) \( \frac{24}{25} \)
b) \( \frac{12}{25} \)
c) \( \frac{6}{5} \)
d) \( \frac{-12}{25} \)
e) \( \frac{-24}{25} \)

10. (5 points) If \( f(x) = 4\sqrt{x} - \sqrt{x} \), then \( f'(4) = \)

a) \( \frac{3\sqrt{2}}{4} \)
b) \( \frac{\sqrt{2}}{4} \)
c) \( \frac{\sqrt{2}}{8} \)
d) \( \frac{3\sqrt{2}}{8} \)
e) \( \frac{5\sqrt{2}}{2} \)
11. (5 points) A ball is thrown straight up in the air. Its height \( s \) in feet after \( t \) seconds is given by
\[
s(t) = -16t^2 + 80t.\]
The maximum height that the ball attains is

a) 32 ft  
b) 64 ft  
c) 96 ft  
d) 100 ft  
e) 120 ft

12. (5 points) If \( y = \tan x^2 + \tan^2 x \), then \( y' = \)

a) \( \sec^2 x^2 + \sec^4 x \)  
b) \( 2x \sec^2 x + \sec^4 x \)  
c) \( 2x \tan x^2 + 2 \sec^4 x \)  
d) \( 2x \sec^2 x^2 + 2 \tan x \sec^2 x \)  
e) \( x^2 \sec^2 x + 2x \tan x + 2 \sec^4 x \)
13. (10 points - 2 pts each) If the following statement is true for all values, circle T. If the statement is false, circle F.

a) \( \sin^2 x = \frac{1 + \cos(2x)}{2} \) T F

b) \( \cos(A + B) = \cos A \cos B + \sin A \sin B \) T F

c) \( \tan^2 x = \sec^2 x - 1 \) T F

d) \( \frac{d}{dx} \left[ -\sin x \right] = \cos x \) T F

In part e) \( A \) - Area of a sector of a circle, \( r \) - radius, and \( \theta \) is the central angle measured in radians.

e) \( A = \frac{1}{2} r \theta \) T F
14. (10 points) State the derivatives of the following functions:

\[ f(x) = \sin x \quad f'(x) = \]

\[ f(x) = \cos x \quad f'(x) = \]

\[ f(x) = \tan x \quad f'(x) = \]

\[ f(x) = \cot x \quad f'(x) = \]

\[ f(x) = \sec x \quad f'(x) = \]

\[ f(x) = \csc x \quad f'(x) = \]

(5 pts) Find the derivative of \( \csc x \) by rewriting \( \csc x \) in terms of \( \sin x \) and \( \cos x \) and using the quotient rule. (Your final answer should match what you wrote above...)

16. (10 points) A spotlight on the ground shines on a wall 12 m away. If a man 2 m tall walks from the spotlight toward the building at a speed of \( \frac{8}{5} \) m/s. at what rate is the height of his shadow on the building changing when he is 4 m from the building?

To get full credit, you must show ALL steps. There will be no credit given for an answer not supported by work...
15. (10 points) (To get full credit, you must show all work.)
Find all values of $x$ on the interval $[0, 2\pi)$ where

a) $\sin x = 0$

b) $\sin x = -1$

c) $\sin x = -\frac{1}{2}$

d) $2\sin^3 x + 3 = 3\cos^2 x - \sin x$