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No calculators.
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Be sure that you have all 9 pages of the test.

### PLEASE MARK YOUR ANSWERS WITH AN X, not a circle!

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Multiple Choice

1. (7 pts.) If \( f(2) = 5, \ f(3) = 2, \ f(4) = 5, \ g(2) = 6, \ g(3) = 2 \) and \( g(4) = 0 \), find \( (f \cdot g)(2) + f(g(3)) \).

(a) 30  
(b) 35  
(c) 25  
(d) 20  
(e) 15

2. (7 pts.) Evaluate the following limit

\[
\lim_{x \to 0} \frac{2 - \sqrt{4 - x^2}}{x^2}.
\]

(a) \(-\frac{1}{2}\)  
(b) \(\frac{1}{2}\)  
(c) \(\frac{1}{4}\)  
(d) does not exist  
(e) \(-\frac{1}{4}\)
3. (7 pts.) For which value of the constant $c$ is the function $f(x)$ continuous on $(-\infty, \infty)$?

$$f(x) = \begin{cases} c^2x - c & x \leq 1 \\ cx - x & x > 1. \end{cases}$$

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

4. (7 pts.) Compute

$$\lim_{x \to \pi/2^+} \tan x.$$

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

(e) Does not exist and is neither $\infty$ nor $-\infty$. 

3
5. (7 pts.) The function

\[ f(x) = \frac{x^2 - 1}{x^3 - 4x} \]

is continuous everywhere except at

(a) \( x = \pm 2 \)
(b) \( x = 0 \) and \( x = \pm 1 \)
(c) \( f \) is a rational function and so it is continuous everywhere.
(d) \( x = 0, x = \pm 1 \) and \( x = \pm 2 \)
(e) \( x = 0 \) and \( x = \pm 2 \)

6. (7 pts.) If \( f(x) = (x^2 + 3x)(6x^5 - 2x^8) \), compute \( f'(1) \).

(a) 67 \hspace{1cm} (b) 76 \hspace{1cm} (c) 16 \hspace{1cm} (d) 70 \hspace{1cm} (e) -36
7. (7 pts.) For \( f(x) = \sqrt[3]{x^3} + \frac{6}{\sqrt[5]{x^3}} \), find \( f'(x) \).

(a) \( \frac{5\sqrt[3]{x^2}}{3} + \frac{5}{18\sqrt[5]{x^3}} \)

(b) \( \frac{3\sqrt[3]{x^2}}{5} - \frac{5}{18\sqrt[5]{x^3}} \)

(c) \( \frac{5\sqrt[3]{x^2}}{3} - \frac{18}{5\sqrt[5]{x^3}} \)

(d) \( \frac{3\sqrt[3]{x^2}}{5} + \frac{18}{5\sqrt[5]{x^3}} \)

(e) \( \frac{3\sqrt[3]{x^2}}{5} - \frac{18}{5\sqrt[5]{x^3}} \)

8. (7 pts.) Find the equation of the tangent line to
\[
y = \frac{7x - 3}{6x + 2}
\]
at the point \( (1, \frac{1}{2}) \).

(a) \( y = \frac{5}{4}x - \frac{3}{4} \)

(b) \( y = \frac{1}{2}x + \frac{1}{2} \)

(c) \( y = \frac{1}{2}x - \frac{1}{2} \)

(d) \( y = \frac{1}{2}x \)

(e) \( y = \frac{5}{4}x + \frac{3}{4} \)
9. (7 pts.) If \( f(x) = x^2 \cos x \), find \( f''(x) \).

(Hint: \((\sin x)' = \cos x, (\cos x)' = -\sin x\).)

(a) \( f''(x) = 4 \cos x + 4x \sin x - 2x^2 \cos x \)
(b) \( f''(x) = 4 \cos x - 4x \sin x + x^2 \cos x \)
(c) \( f''(x) = 2 \cos x - 4x \sin x - x^2 \cos x \)
(d) \( f''(x) = 2 \cos x + 2x \sin x - x^2 \cos x \)
(e) \( f''(x) = 2 \cos x - 4x \sin x + x^2 \cos x \)

10. (7 pts.) A ball is thrown straight upward from the ground with the initial velocity \( v_0 = 96 \text{ft/s} \). Find the highest point reached by the ball. Hint: The height of the ball at time \( t \) is given by \( y(t) = -16t^2 + 96t \).

(a) 80ft    (b) 120ft    (c) 128ft
(d) 288ft    (e) 144ft
Partial Credit
You must show your work on the partial credit problems to receive credit!

11.(10 pts.) Find the equation of the tangent line to the curve \( y = \frac{x^3}{3} - x^2 + 1 \) which is parallel to the line \( y + x = 4 \).
12. (10 pts.) Show that there are at least \textit{two} roots of the equation

\[ x^4 + 6x - 2 = 0. \]

Justify your answer and identify the theorem you use.
13. (10 pts.) Given

\[ y = \frac{1}{x^2 + 1}, \]

find \( y' \) using the definition of the derivative.
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