

Name: _____

Use of books, notes or calculators is **NOT** permitted.

Please show all your work! Answers without appropriate supporting work may not receive full credit.

Clearly indicate your answers to each problem by underlining them or placing a box around your answers!

Trigonometric functions at the values $0, \pi/6, \pi/4, \pi/3, \pi/2$, etc must be evaluated!

T/F Questions are graded with NO PARTIAL CREDIT.

There is a total of 4 **DOUBLE-SIDED** pages to this exam including the cover page.

Exam Score

Problem	Score	Out of:
1		10
2		10
3		20
4		20
5		25
6		10
7		10
Total		105

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1. [10] For the True/False questions below, clearly circle your answer.

T or F If f is differentiable at a , then f is continuous at a .

T or F $\frac{d}{dx}e^2 = 2e$.

T or F If $f(x) = x^3$, then $\lim_{x \rightarrow 1} \frac{f(x) - f(1)}{x - 1} = 3$.

T or F If f is differentiable, and $f' < 0$ on (a, b) , then f is increasing on (a, b) .

T or F If f and g are differentiable, then $[f(g(x))]' = f'(g(x)) \cdot g'(x)$.

2. [10] Use the limit definition of derivative to find the derivative of $f(x) = x^2 - x$.

3. [20] Find the indicated derivatives.

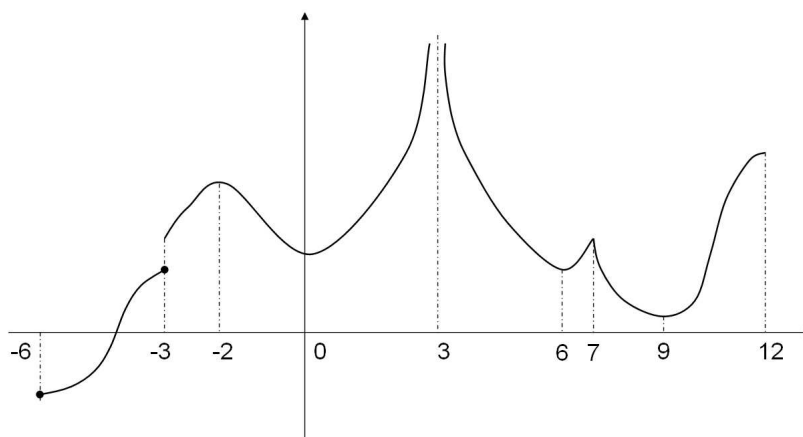
(a) [5 pts] $f(x) = x^2 e^{x^2-1}$. Find $f'(1)$

(b) [5 pts] $g(y) = \frac{1}{\sqrt[3]{y}} - \sin \pi y + \ln \sqrt{y}$, find $\frac{dg}{dy}$

(c) [5 pts] $h(t) = \frac{t^2-1}{t+2}$. Find $h'(t)$

(d) [5 pts] $r(s) = (1 + s^2) \arctan s$. Find $\frac{dr}{ds}$

4. [20] The graph of the function $f : [-6, 12) \rightarrow \mathbf{R}$ is shown below.



- (a) [5 pts] State with reasons the points at which f is not differentiable.

- (b) [5 pts] State with reasons the intervals where $f' > 0$.

- (c) [5 pts] State with reasons the intervals where $f' < 0$.

- (d) [5 pts] State with reasons the points where $f' = 0$.

5. [25] Let us consider the function $f(x) = x^3 + 3x^2 - 24x - 6$.

(a) [10 pts] On what interval is f decreasing?

(b) [10 pts] On what interval is f concave downward?

(c) [5 **Extra Bonus** pts] Show that f has a solution in the interval $(-1, 0)$.

6. [10] Use implicit differentiation to find an equation of the tangent line to the hyperbola $x^2 + 2xy - y^2 + x = 2$ at the point $(1, 2)$.

7. [10] Use logarithmic differentiation to find the derivative of the function $y = (\cos x)^x$.