

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.

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  $f(x) > 0$  and  $f$  is differentiable, then  $\frac{d}{dx}\sqrt{f(x)} = \frac{f'(x)}{2\sqrt{f(x)}}$ .

**T or F** An equation of the tangent line to the parabola  $y = x^2$  at  $(2, 4)$  is  $y - 4 = 2x(x - 2)$ .

**T or F**  $\frac{d}{dx}(\ln 10) = \frac{1}{10}$ .

**T or F**  $\frac{d}{dx}(10^x) = x10^{x-1}$ .

**T or F** If  $f$  and  $g$  are differentiable, then  $\frac{d}{dx}[f(x) + g(x)] = \frac{d}{dx}f(x) + \frac{d}{dx}g(x)$ .

2. [10] Use the limit definition of derivative to find the derivative of  $f(x) = 3x^2 + x$ .

3. [20] Find the indicated derivatives.

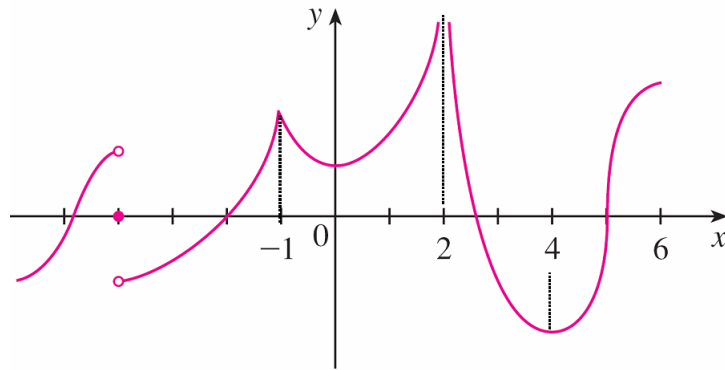
(a) [5 pts]  $f(x) = e^{x^2-1} + \frac{4}{x} + 6x^{\frac{2}{3}} - \pi^2$ . Find  $f'(1)$

(b) [5 pts]  $g(y) = \frac{1}{y^2} + \ln \sqrt{y}$ , find  $\frac{d^2g}{dy^2}$

(c) [5 pts]  $h(t) = t \arctan(t^2)$ . Find  $h'(t)$

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

4. [ 20] The graph of the function  $f$  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  $f(x) = \frac{\ln x}{x}$ .
- (a) [ 5 Extra Bonus pts] What is the domain of  $f$ ?
- (b) [10 pts] On what interval is  $f$  increasing?
- (c) [10 pts] On what interval is  $f$  concave upward?

6. [ 10] Use implicit differentiation to find an equation of the tangent line to the cardioid  $x^2 + y^2 = (2x^2 + 2y^2 - x)^2$  at the point  $(0, 1/2)$ .

7. [ 10] Use logarithmic differentiation to find the derivative of the function  $y = x^{\sqrt{x}}$ .