

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 continuous at  $a$ , then  $f$  is differentiable at  $a$ .

**T or F**  $\frac{d}{dx} \ln \pi = \frac{1}{\pi}$ .

**T or F** If  $f(x) = x^4$ , then  $\lim_{x \rightarrow 2} \frac{f(x) - f(2)}{x - 2} = 32$ .

**T or F** If  $f$  is differentiable, and  $f'' > 0$  on  $(a, b)$ , then  $f$  is concave upwards on  $(a, b)$ .

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

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

3. [20] Find the indicated derivatives.

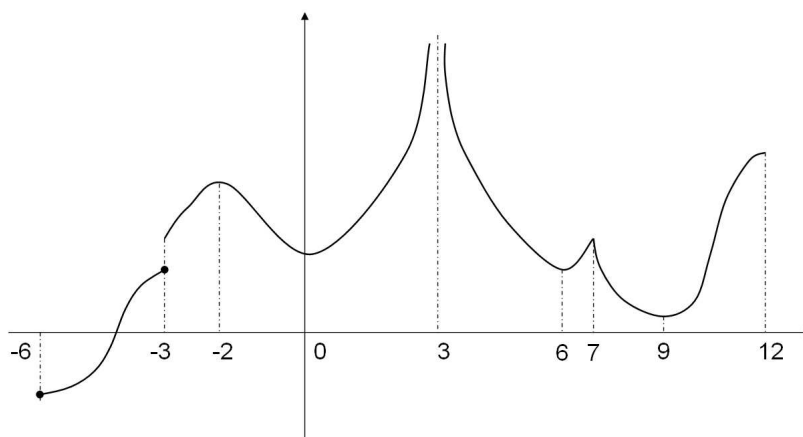
(a) [5 pts]  $f(x) = x^3 e^{x^2}$ . Find  $f'(1)$

(b) [5 pts]  $g(y) = \frac{1}{\sqrt[3]{y^2}} + \cos 2\pi y + \ln y^2$ , find  $\frac{dg}{dy}$

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

(d) [5 pts]  $r(s) = \frac{s^3}{1-s^2}$ . 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  $f(x) = x^3 + 3x^2 - 9x - 6$ .

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

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

(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 ellipse  $x^2 + xy + y^2 = 3$  at the point  $(1, 1)$ .

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