



University of California, San Diego
Department of Mathematics

Instructions

1. Write your *Name*, *PID*, *Section*, and *Exam Version* on the front of your Blue Book.
2. No calculators or other electronic devices are allowed during this exam.
3. You may use one page of notes, but no books or other assistance during this exam.
4. Read each question carefully, and answer each question completely.
5. Write your solutions clearly in your Blue Book.
 - (a) Carefully indicate the number and letter of each question and question part.
 - (b) Present your answers in the same order they appear in the exam.
 - (c) Start each problem on a new page.
6. Show all of your work. No credit will be given for unsupported answers, even if correct.
7. Turn in your exam paper with your Blue Book.

0. (1 point) Carefully read and complete the instructions at the top of this exam sheet and any additional instructions written on the chalkboard during the exam.

1. Compute $\frac{dy}{dx}$ for each of the following.

- (a) (4 points) $y = \tan(\sqrt{x})$.
- (b) (4 points) $y = \ln(\arctan(x))$.
- (c) (4 points) $y = \log_2(x^3 + 1)$.

2. (10 points) Use implicit differentiation to find the equation of the tangent line at the point $(1, 0)$ to the curve given by the equation

$$x^2e^y + \sin(y^2) = 1 + 4y.$$

3. (8 points) Let $g(x) = 3x^4 - x^6$. Find the absolute maximum and absolute minimum values of g on the closed interval $[-1, \sqrt{3}]$ and identify the x values corresponding to the extremal values.

4. The *kinetic energy* E of a rocket of mass m , traveling at velocity v is given by the formula

$$E = \frac{1}{2}mv^2.$$

- (a) (2 points) Find the rate of change of E with respect to m . (Assume the velocity is constant.)
- (b) (2 points) A rocket engine works by ejecting mass out the back of the rocket to generate forward momentum. Suppose the resulting mass of the rocket at time t is

$$m(t) = 3t^2 + t.$$

Assuming the rocket maintains a constant velocity, find the rate of change of E with respect to t .

(This exam is worth 35 points.)