

Name: _____

4-digit code: _____

- Write your name and the last 4 digits of your SSN in the space provided above.
- The test has five (5) pages, including this one.
- You have fifty (50) minutes to complete the exam.
- Enter your answer in the box(es) provided.
- You must show sufficient work to justify all answers unless otherwise stated in the problem. Correct answers with inconsistent work may not be given credit.
- Credit for each problem is given in parentheses at the right of the problem number.
- No books, notes or calculators may be used on this test.

Page	Max. points	Your points
2	30	
3	20	
4	20	
5	30	
Total	100	

Problem 1 (30 pts). Sketch the graph of the function

$$f(x) = \frac{x}{x^2 - 9}$$

Make sure to indicate clearly:

- Zeros of the function.
- Domain.
- Vertical and horizontal asymptotes.
- Extreme values and inflection points.
- Intervals of increase/decrease.
- Intervals of concavity.

Problem 2 (20 pts). An oil refinery is located on the north bank of a straight river that is 2 km wide. A pipeline is to be constructed from the refinery to storage tanks located on the south bank of the river 6 km east of the refinery. The cost of laying pipe is \$400,000/km over land to a point P on the north bank, and \$800,000/km under the river to the tanks. To minimize the cost of the pipeline, where should P be located?



Problem 3 (20 pts). A rectangular storage container with an open top is to have a volume of 10 m^3 . The length of its base is twice the width. Material for the base costs \$10 per square meter. Material for the sides costs \$6 per square meter. Find the cost of materials for the cheapest such container.



Problem 4 (10 pts). Does there exist a function f such that $f(0) = -1$, $f(2) = 4$, and $f'(x) \leq 2$ for all x ? Use the Mean Value Theorem to either explain the function does not exist, or to build one that satisfies those properties.

Problem 5 (20 pts). A ladder 10 ft long rests against a vertical wall. If the bottom of the ladder slides away from the wall at a rate of 1 ft/s, how fast is the top of the ladder sliding down the wall when the bottom of the ladder is 6 ft from the wall?

