

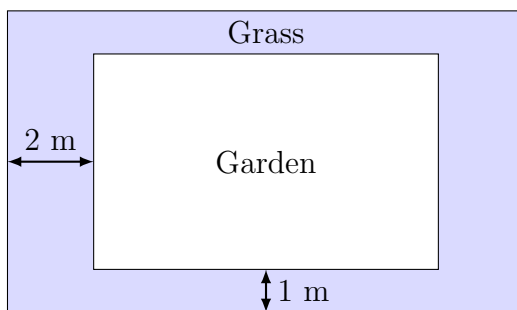
1. 10 pts. Find the critical points of

$$f(x) = x^3 - 2x^2 - 5x + 6$$

on the interval $I = [4, 8]$, then determine the global extrema of f on I .

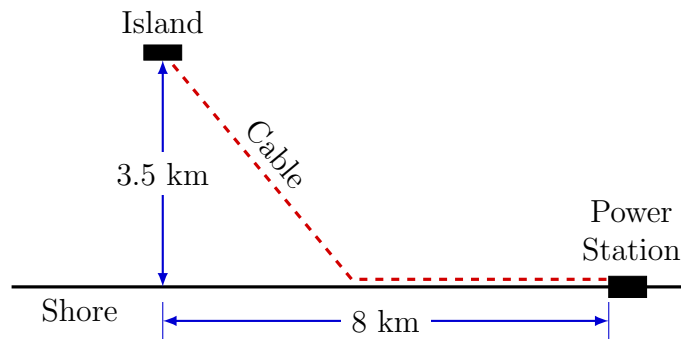
2. Let $f(x) = \frac{3x - 5}{x^2 - 1}$.

- (a) 5 pts. Find the domain of f .
- (b) 5 pts. Find the intercepts of f .
- (c) 5 pts. Find the asymptotes of f .
- (d) 15 pts. Use the Monotonicity Test to find intervals of increase and decrease, then find critical points and use the First Derivative Test to find all local extrema.
- (e) 10 pts. Use the Concavity Test to find intervals where f is concave up or down, and identify inflection points.
- (f) 5 pts. Sketch the graph of f .
3. 10 pts. A rectangular garden with an area of 30 m^2 is surrounded by a grass border 1 m wide on two sides and 2 m wide on the other two sides. What dimensions of the garden minimize the combined area of the garden and borders?



4. Let $f(x) = \sqrt[3]{x}$.
- (a) 10 pts. Write the equation of the line L that represents the linear approximation to f at $x = 8$.
- (b) 5 pts. Use L to estimate $\sqrt[3]{9}$
5. 10 pts. Does there exist a continuous function f such that $f(0) = 2$, $f(2) = 5$, and $f'(x) \leq 1$ for all $x \in (0, 2)$? Provide a proof to back up your answer using appropriate theorems.

6. 15 pts. An island is 3.5 km from the nearest point on a straight shoreline, and that point is 8 km from a power station. A utility company plans to lay electrical cable underwater from the island to the shore and then underground along the shore to the power station. Assume that it costs \$2400 per kilometer to lay underwater cable and \$1200 per kilometer to lay underground cable. At what point should the underwater cable meet the shore in order to minimize the cost of the project?



7. 15 pts. Show that

$$6x^5 + 13x + 1 = 0$$

has exactly one real root using appropriate theorems and a coherent argument.

8. 10 pts. Find the solution of the initial value problem:

$$g'(x) = 7x^6 - 4x^3 + 12; \quad g(1) = 24.$$

9. 10 pts. each Determine the indefinite integral.

(a) $\int (3x^8 - 7x^{13}) dx$

(b) $\int \left(5\sqrt{x} - \frac{3}{\sqrt{x}} \right) dx$

(c) $\int [\sin(4t) - \sin(t/4)] dt$