1. [10 pts.] Evaluate the limit: $\displaystyle\lim_{x \to 0} \frac{\tan 9x}{\sin x}$

2. [10 pts.] Find the derivative of
$$f(x) = \frac{\cos x}{2 - \tan x}$$

3. [10 pts.] Find an equation of the tangent line to the curve $y = 8\cos(x)\sin(x)$ at $x = \pi/3$.
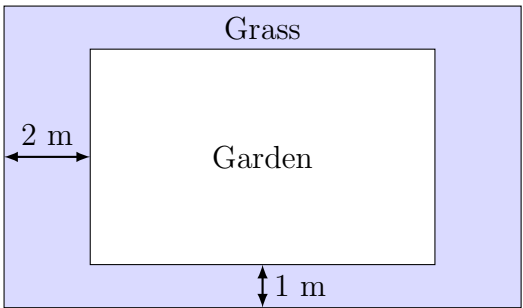
4. [10 pts. each] Find the derivative.

   (a) $f(x) = (5x^3 - x)^{13}$

   (b) $g(t) = -\cos(4\cot t)$

   (c) $h(x) = \sqrt{x + \sqrt{x}}$

5. [10 pts.] Use implicit differentiation to find y', given that $\cos(y^2) + 2x = y^3$.

6. [10 pts.] Find an equation of the tangent line to the curve $x^4 = 2x^2 + 2y^2$ at the point $(2, 2)$.

7. [10 pts.] A rectangle initially has dimensions 2 cm by 4 cm. All sides begin increasing in length at a rate of 1 cm/s. At what rate is the area of the rectangle increasing after 20 seconds?

8. [10 pts.] A 2-meter tall man walks at 1 m/s toward a street light that is 7 meters above the ground. What is the rate of change of the length of his shadow when he is 5 meters from the street light? At what rate is the tip of his shadow moving?

9. [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.

10. Let $f(x) = x^{1/3}(x + 3)^{2/3}$.

    (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.

11. [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?

12. [15 pts.] The intensity of a light source at a given location is directly proportional to the strength of the source and inversely proportional to the square of the distance from the source. Two light sources, one twice as strong as the other, are 12 meters apart. At what point on the line segment joining the sources is the intensity the weakest?