Problem 1: Use the $\varepsilon - \delta$ definition of limit to prove $\lim_{x\to2}(-4x + 1) = -7$

Problem 2: Find the limit: $\lim_{x\to4}(\sqrt{2x + 1})$

Problem 3: Find the limit: $\lim_{w\to0}(\frac{\sin(5w)}{w})$

Problem 4: Find the limit: $\lim_{x\to0}\frac{-x}{\sqrt{1 + x} - 1}$

Problem 5: Find the limit: $\lim_{x\to1^-}\frac{x + 1}{x^4 - 1}$

Problem 6: Find where $f(x) = \frac{2 + x}{x^2 - 4}$ is not continuous. Label the discontinuities as removable or nonremovable.

Problem 7: Find the limit: $\lim_{x\to7}\frac{|x - 7|}{x - 7}$

Problem 8: Find the limit: $\lim_{x\to0^+}\frac{x^3 + 1}{x^2}$

Problem 9: Find the vertical asymptotes (if any) of $f(x) = \frac{4x}{4 - x^2}$. You must prove that the function has a vertical asymptote by using the limit process.

Problem 10: Use the definition of derivative to find $f'(x)$ for $f(x) = x^2 + x$.

Problem 11: Find the derivative of $y = \frac{1}{x^2} + \tan(x)$

Problem 12: Find the equation of the tangent line to $f(x) = \frac{x^2 + 4}{x^2 + 5}$ at the point (1,1).

Problem 13: Find the derivative of $y = \tan(\sqrt{x}) + \sqrt{\tan(x)}$

Problem 14: Find the derivative of $y = \sqrt{2x + \sqrt{x}}$

Problem 15: Find $\frac{dy}{dx}$ by implicit differentiation: $x^4 + 2xy + y^4 = 16$

Problem 16: All the edges of a cube are expanding at the rate of 2cm per second. How fast is the volume changing when each edge is 5 cm?

Problem 17: Find the absolute extrema of the function $f(x) = x^4 - 2x^2$ on [-1,4].

Problem 18: Let $f(x) = x - x^{1/3}$ on the interval [0,1]. State which of the 3 theorems apply: The Extreme Value Theorem, the Mean Value Theorem, or Rolle’s Theorem.

Problem 19: Find the critical numbers of $f(x) = x^{2/3}(x - 5)$, find the open intervals where $f(x)$ is increasing or decreasing, and locate all relative extrema.

Problem 20: Let $f(x) = \frac{1}{3}x^3 - 3x^2 + 8x$. Find all the relative extrema. Use the Second Derivative Test.

Problem 21: Find all inflection points and discuss the concavity of the function $f(x) = \sin(x) + \cos(x)$, $0 \leq x \leq 2\pi$.

Problem 22: Find the horizontal asymptotes of: $\lim_{x\to\infty}\frac{-2x + 1}{4x - 18}$

Problem 23: Analyze the graph of $f(x) = x^5 - 4x^4 + 4x^3$, by using the steps on your graphing handout. With the information you derived, sketch the graph. Make sure
that you clearly label the intercepts, local extrema, and inflection points.

Problem 24: A rectangular area of 1600 ft$^2$ is to be fenced off. Two opposite sides will be using fencing costing $1.00 per foot, and the remaining sides will use fencing costing $2.00 per foot. Find the dimensions of the rectangle of least cost.

Problem 25: Find the differential $dy$ for $y = \sqrt{4x^2 - 12}$

Problem 26: Evaluate: \( \int \frac{x^3 + 2x^2 + 1}{x^2} \, dx \).

Problem 27: Solve the differential equation: \( f''(x) = -2, \; f'(0) = 3, \; f(1) = 1 \)

Problem 28: Evaluate the sum: \( \sum_{i=1}^{n} (i - 1)^2 \)

Problem 29: Using a Riemann Sum, find the area under the curve $y = 2x + 1$ between the values of $x=0$ and $x=4$.

Problem 30: Evaluate \( \int_{\frac{3\pi}{2}}^{\pi} \cos x \, dx \)

Problem 31: Evaluate: \( \int_{\frac{\pi}{2}}^{\infty} \frac{1}{x} \, dx \)

Problem 32: Find $f'(x)$ when $f(x) = \int_{1}^{x} \sqrt{16t^3 + 1} \, dt$

Problem 33: Evaluate: \( \int \sqrt{\cos x} \sin x \, dx \)

Problem 34: Evaluate: \( \int x \sqrt{x + 1} \, dx \)

Problem 35: Evaluate: \( \int \frac{x^4}{(16 - x^5)^2} \, dx \)

Problem 36: Evaluate: \( \int \frac{\pi}{12} \csc 2x \cot 2x \, dx \)

Problem 37: Sketch the graph and find its domain and range: \( f(x) = \log(2x - 4) \)

Problem 38: Write as a single log: \( \ln(x - 2) - \ln(x + 2) + \ln 3 \)

Problem 39: Find the derivative: \( y = 3 \ln(3x^2) \)

Problem 40: Find the derivative: \( y = \log_2(6x) \)

Problem 41: Use implicit differentiation to find the derivative: \( \ln(xy) + 5x = 30 \)

Problem 42: Find the derivative: \( y = \ln(\ln x) \)

Problem 43: Note: We will cover this in math 141. Skip it. Evaluate: \( \int \frac{2x}{(x + 1)^2} \, dx \)

Problem 44: Evaluate: \( \int \frac{\sec x \tan x}{\sec x - 1} \, dx \)

Problem 45: Evaluate: \( \int_{\frac{\pi}{4}}^{\infty} \frac{x - 1}{x + 1} \, dx \)

Problem 46: Find the inverse of \( f(x) = \sqrt{x - 1} \)

Problem 47: Solve for $x$: \( e^{-4x} = 5 \)

Problem 48: Find the derivative of \( f(x) = e^{-x} \ln x \)
Problem 49: Find the derivative: \( y = 3^{2-x} \)

Problem 50: Evaluate without a calculator: \( \sin(\arcsin(.5)) \) \( \cos(\arcsin(.5)) \)
\[ \sin(\arctan(\frac{3}{4})) \]

Problem 51: Find the derivative: \( f(x) = 2 \arcsin(x - 1) \)

Problem 52: Evaluate the integral:
\[ \int \frac{\arcsin(x)}{\sqrt{1-x^2}} \, dx \]

Problem 53: Find the derivative: \( y = \sinh(3x + 5) \)

Problem 54: Find the derivative:
\[ g(x) = x \cosh(x) \]

Problem 55: Evaluate:
\[ \int \frac{\cosh(\sqrt{x})}{\sqrt{x}} \, dx \]