1. [10 pts. each] Find the critical numbers of the function.

(a) $s(t) = 3t^4 + 4t^3 - 6t^2$

(b) $f(x) = x^{4/5}(x-4)^2$

2. [10 pts. each] Find the absolute maximum and absolute minimum values of f on the given interval.

(a) $f(x) = x^4 - 2x^2 + 3, \quad [-2, 3]$

(b) $f(x) = \sin x + \cos x, \quad [0, \pi/3]$

3. [10 pts.] Verify that the function $f(x) = \dfrac{x}{x+2}$ satisfies the hypotheses of the Mean Value Theorem on the interval $[1, 4]$. Then find all numbers c that satisfy the conclusion of the Mean Value Theorem.

4. [10 pts. each] Let $h(x) = 3x^5 - 5x^3 + 3$.

(a) Find the intervals of increase and decrease.

(b) Find the local maximum and minimum values.

(c) Find the intervals of concavity and the inflection points.

5. [10 pts. each] Find the limit.

(a) $\lim\limits_{y \to \infty} \dfrac{2 - 3y^2}{5y^2 + 4y}$

(b) $\lim\limits_{x \to -\infty} \dfrac{\sqrt{9x^6 - x}}{x^3 + 1}$

(c) $\lim\limits_{x \to \infty} \left(\sqrt{x^4 + 6x^2} - x^2 \right)$

6. [15 pts.] Find the point on the line $y = 2x - 9$ that is closest to the point $(5, -2)$.

7. [15 pts.] A cylindrical can without a top is made to contain V cm^3 of liquid. Find the dimensions that will that minimize the cost of the metal to make the can.

8. [10 pts.] Find the most general antiderivative of the function $f(x) = 6\sqrt{x} - \sqrt[6]{x}$.

9. [10 pts.] Find f, given $f''(x) = 20x^3 + 12x^2 + 4$, $f(0) = 8, \quad f(1) = 5$.

10. [15 pts.] Show that the equation $1 + 2x + x^3 + 4x^5 = 0$ has exactly one real root.