Calculus

1. Let $y = x^3 + 3x^2 - 9x + 2$. Determine the intervals where the function is monotonically increasing and decreasing.

2. Find $\frac{dy}{dx}$ when $xy - y^3 = 1$.

3. Let $f(x) = \sqrt{3x^4 + 5}$. Find $f'(x)$.

4. A population of harmful insects is growing according to the formula $i(t) = 2t^2 + t + 5$, where t is measured in days and $i(t)$ is measured in thousands of insects.
   a) Find the average rate of growth between $t = 1$ and $t = 3$

   b)Find the instantaneous rate of growth at $t = 2$

5. Let $f(x) = \frac{x^3 + 2x}{5x + 7}$ find $f'(x)$

6. Find an equation of the tangent line to the curve $f(x) = 3x^2 + 4x$ at $x = 1$

7. $\int \frac{1}{t^6}$