1. (16 points) Calculate the following limits. Please show all work.

(a) \[ \lim_{x \to 1} \frac{x^5 - x^4 - 2x^3 + 2x^2 + x - 1}{x^5 - 2x^4 + 2x^2 - x} \]

(b) \[ \lim_{x \to 0} \frac{e^x - \cos x}{\sin x} \]
2. (20 points) Suppose $f(x)$ is a function whose first two derivatives are

\[
f'(x) = \frac{(x - 3)^2 (x + 3)}{(x + 1)^3} \quad \text{and} \quad f''(x) = \frac{6(x - 3)(x + 5)}{(x + 1)^4}.
\]

For what values of $x$ is $f(x)$ increasing, and for what values is it decreasing? For what values of $x$ is $f(x)$ concave up, and for what values is it concave down? What are the local maxima and minima (peaks and valleys) of $f(x)$? What are its inflection points? Explain. For extra credit, find a possible $f(x)$. 
3. (28 points) Consider the parametric curve \( x = 6t^2 - t^3, \ y = 6t - t^2 \).

(i) For what values of \( t \) does \( y = 0 \)?
(ii) For what values of \( t \) does the curve go through the origin?
(iii) Calculate \( \frac{dx}{dt}, \ \frac{dy}{dt}, \ \text{and} \ \frac{dy}{dx} \).
(iv) What slope or slopes does the curve have at the origin?
(v) A non-parametric form of the curve is \( x^2 + y^3 = 6xy \). Calculate \( \frac{dy}{dx} \) from this form.
(vi) Is it possible to use your answer to (v) to find the slope of the curve at the origin? Explain.
4. (20 points) Calculate the following derivatives and antiderivatives:

(a) If \( a(x) = \ln(\sin x) \), find \( a'(x) \).

(b) If \( b(x) = \ln(\cos x) \), find \( b'(x) \).

(c) Evaluate either \( \int \cot x \, dx \) or \( \int \csc x \, dx \) (your choice).

(d) Evaluate either \( \int \tan x \, dx \) or \( \int \sec x \, dx \) (your choice).
5. (22 points) Calculate the indefinite integrals:

(i) \[ \int \left( 12x^5 - 8x + 5 + 6x^{-4} + 3 \sin x - 4 \cos x \right) \, dx \]

(ii) \[ \int \frac{(x + 6)(x + 1)}{x^2} \, dx \]
6. (14 points) Find the area between the two parabolas \( y = 2x^2 - 3x + 1 \) and \( y = x^2 + 5x - 6 \).