1. (10 points) Find an equation of the tangent line to the curve \( x^3 + y^3 = 3xy \) at the point \( \left( \frac{3}{2}, \frac{3}{2} \right) \).
2. (4 points each) Find $dy/dx$. Note: You do not need to simplify your answers.

a) $y = \ln(1 - xe^{-x})$

b) $y = e^{-5x^2}$

c) $y = \sin^{-1}(3x)$

d) $y = \ln \left( \frac{\cos x}{\sqrt{4 - 3x^2}} \right)$
e) \[ y = e^{(x-e^x)} \]

f) \[ y = x^2 \tan^{-1} x \]

g) \[ y = \frac{e^x}{\ln x} \]

h) \[ y = x^{\sin x} \]
3. (5 points each) Find the limit.

a) \( \lim_{x \to +\infty} (1 - \frac{3}{x})^x \)

b) \( \lim_{x \to 0} \left( \frac{1}{\sin x} - \frac{1}{x} \right) \)
4. (10 points) Find: (a) the intervals on which $f$ is increasing, (b) the intervals on which $f$ is decreasing, (c) the open intervals on which $f$ is concave up, (d) the open intervals on which $f$ is concave down.

$$f(x) = 2x^3 - 3x^2 - 36x + 27$$
5. (10 points) Sketch the graph of \( f(x) \). Your graph should reflect the regions where \( f(x) \) is increasing and decreasing, and where \( f(x) \) is concave up and concave down. Your graph should show all horizontal and vertical asymptotes, if any. Please show your work on this page and use the coordinate axis on the next page to sketch your graph.

\[
f(x) = \frac{x^2}{x^2 - 4}, \quad f'(x) = \frac{-8x}{(x^2 - 4)^2}, \quad f''(x) = \frac{8(3x^2 + 4)}{(x^2 - 4)^3}
\]
6. (10 points) Find the relative extrema using both the first and second derivative test.

\[ f(x) = x^4 - 4x^3 + 4x^2 \]
7. (10 points) Find the absolute maximum and minimum values of $f$ on the given closed interval and state where those values occur.

$$f(x) = \sin x - \cos x \quad [0, \pi]$$
8. (10 points) If 1200 cm$^2$ of material is available to make a box with a square base and an open top, find the largest possible volume of the box.