1. Find the value

(a) $e^{3\ln 2}$  
(b) $\ln e^{-0.3}$  
(c) $\log_{10} \left( \frac{1}{100} \right)$  
(d) $\log_{100} \left( \frac{1}{10} \right)$

(e) $\sin^{-1} \left( \sin \left( -\frac{\pi}{5} \right) \right)$  
(f) $\cos^{-1} \left( \cos \left( -\frac{\pi}{5} \right) \right)$  
(g) $\sin \left( \sin^{-1}(-.6) \right)$  
(h) $\cos \left( \sin^{-1}(-.6) \right)$

(i) $\sinh(\ln 2)$  
(j) $5^{\ln 5}$

2. Find $\frac{dy}{dx}$

(a) $y = e^{3x^2 - 7}$  
(b) $y = \ln(7x^3 + 2)$  
(c) $y = \tan^{-1}(2x + 5)$  
(d) $y = \pi^x + x^\pi$

(e) $y = \log_2 x$  
(f) $y = \frac{(x^2 + 7)^3 e^{7x}}{x^{4/3}(3x + 1)}$  
(g) $y = (x^2 + 1)^{2x+7}$  
(h) $y = x \sin^{-1}(e^{2x})$

3. Evaluate

(a) $\int x e^{3x^2} \, dx$  
(b) $\int \frac{x^2}{2 - 7x^3} \, dx$  
(c) $\int_5^8 \, \frac{dx}{3 - x}$  
(d) $\int \frac{1}{4 + x^2} \, dx$

(e) $\int_e^1 \frac{1}{x\sqrt{\ln x}} \, dx$  
(f) $\int \frac{\ln x}{x} \, dx$  
(g) $\int 2^x \, dx$  
(h) $\int \frac{x^2 \, dx}{1 + x^6}$

(i) $\int \frac{\ln(\ln x)}{x\ln x} \, dx$  
(j) $\int \tanh x \, dx$  
(k) $\int \frac{e^{3/x}}{x^2} \, dx$

4. Determine whether the function $f(x)$ is one-to-one. If it is, give a formula for $f^{-1}(x)$. If it isn’t, find specific values $x_1 \neq x_2$ for which $f(x_1) = f(x_2)$.

(a) $f(x) = \frac{x + 2}{x - 2}$  
(b) $f(x) = x^4 - 7$  
(c) $f(x) = \frac{e^x + 2}{e^x}$

5. For what values of $x$ is $f(x)$ increasing?

(a) $f(x) = xe^{3x-1}$  
(b) $f(x) = x \ln x$

6. Let $f(x) = e^{6x} + e^x - 1$. Show that $f(x)$ is one-to-one. Let $g(x)$ be the inverse function of $f(x)$. Determine $g'(1)$.

7. Bacteria in a culture grow at a rate proportional to its size. The count in the culture was 400 after 2 hours and 25,600 after 6 hours.

(a) What was the initial population of the culture?

(b) Find an expression for the population after $t$ hours.

(c) How long does it take for the population to double?
8. Find the local extrema of \( f(x) = \sinh x - (x - 1) \cosh x \).

9. A salt in solution decomposes into another substance at a rate proportional to the amount still present. If 10 kg of salt reduces to 5 kg in \( \frac{1}{2} \) hour, how much is left after 6 hours?

10. Find the limits:
    \[
    (a) \quad \lim_{x \to 0} (1 + 2x)^{-1/x} \quad \quad (b) \quad \lim_{x \to -\infty} \tanh x
    \]
