

**Problem 1.**

(a) Find  $\lim_{x \rightarrow +\infty} \frac{(\ln(x))^2}{x}$ .

(b) Find  $\lim_{x \rightarrow 3} \frac{2x^3 - 9x^2 + 10x - 3}{x^4 - 8x^3 + 16x^2 - 5x + 6}$ .

(c) Find  $\lim_{x \rightarrow 0} \frac{2 \sin(x) - \sin(2x)}{x - \sin(x)}$ .

**Problem 2.**

(a) Compute  $f'(x)$  where  $f(x) = e^{\arctan(x^2)}$ .

(b) Compute  $g'(4)$  where  $g(x) = \ln(x^3 + 3x + \sqrt{x})$ .

(c) Find the tangent line to  $h(x) = \arcsin(e^x)$  at  $\ln(1/2)$ .

**Problem 3.**

(a) Find the derivative of  $f(x) = \cos(x)^x$ .

(b) Let  $j(x) = \sqrt[3]{x^5 + x^4 + x^3 + x^2 + 2x}$ . Find  $(j^{-1})'(4)$ .

(c) Compute the following. In all cases your answers should be exact, with no decimals, and no logs or exponentials or trig functions..

$$\ln(e^3) + \ln(3) + \ln(e/3) =$$

$$\arcsin(-\sqrt{2}/2) =$$

$$\cos(\arcsin(3/7)) =$$

**Problem 4.**

(a) Show that the polynomial  $x^4 - 6x - 2$  has two real roots, that is, there are two (different!) real numbers  $a$  and  $b$  such that  $a^4 - 6a - 2 = b^4 - 6b - 2 = 0$ .

(b) Find the general form of an antiderivative for  $3x^2 + \cos(x)$ .

(c) Find  $y'$  if  $e^y + \ln(y) = x^2 + 1$ .

**Problem 5.**

(a) Use two iterations of Newton's Method starting at 2 to estimate  $\sqrt[3]{7}$ .

(b) Find the formula for the quadratic approximation of  $g(x) = x^x$  near 1.