

# MATH31B: Week 3 Mock Midterm

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**Question 1.** Show that  $f(x) = \frac{1}{x^2 + 1}$  is one-to-one on  $(-\infty, 0]$  and find a formula for  $f^{-1}$  for this domain of  $f$ .

**Question 2.** Given that  $1 - \tanh^2(x) = \operatorname{sech}^2(x)$ , prove that  $\frac{d}{dx} \tanh^{-1}(x) = \frac{1}{1 - x^2}$ .

**Question 3.** Evaluate  $\lim_{x \rightarrow 2} \frac{e^{x^2} - e^4}{x - 2}$ .

**Question 4.** Differentiate

(a)  $y = (2x + 1)(4x^2)\sqrt{x - 9}$

(b)  $y = \ln(\arcsin(x))$

**Question 5.** Evaluate the following integrals

(a)  $\int \frac{dx}{\sqrt{1 - 16x^2}}$

(b)  $\int 3^x dx$

(c)  $\int e^x \cos(x) dx$