Work in groups of 3 or 4. Show your work. Acknowledge any help on these specific problems.

1. (a) Prove that \( \frac{d}{dx} (\cot^{-1}(x)) = -\frac{1}{1 + x^2} \).

(b) State L'Hôpital’s Rule. Identify what are its assumptions (hypotheses) and what are its conclusions.
2. Compute the following limits:

(a) \( \lim_{t \to 0} \frac{e^{2t} - 1}{\sin(t)} = \)

(b) \( \lim_{x \to \infty} x^4 e^{-x^2} = \)

(c) \( \lim_{x \to 0^+} x^{\sqrt{x}} = \)
3. Compute the following derivatives:

/10 (a) \( \frac{d}{dx} \sqrt{\arctan(3x)} = \)

/10 (b) \( \frac{d}{dx} \cos(\cosh(\cos^{-1}(x))) = \)

/10 (c) \( \frac{d}{dx} \frac{\cot^{-1}(1 + x^2)}{\sech(5x)} = \)
4. If an electrostatic field $E$ acts on a liquid polar dielectric, the net dipole moment $P$ per unit volume is

$$P(E) = \frac{\cosh(E)}{\sinh(E)} - \frac{1}{E}.$$ 

Show that $\lim_{E \to 0^+} P(E) = 0.$

5. Show that $\cosh^2(x) - \sinh^2(x) = 1.$