IB Math HL 1 L'Hôpital's Rule $\frac{0}{0}$ and $\frac{\infty}{\infty}$ fall into a category called **Indeterminate Forms**.

1. Confirm that all of the following take the form $\frac{0}{0}$. Then evaluate each limit.

a. $\lim_{x \to 5} \frac{x-5}{x^2-25}$

b. $\lim_{x \to 5} \frac{\sqrt{x}-\sqrt{5}}{x-5}$

c. $\lim_{x \to 5} \frac{x-5}{\ln(6-x)}$

[Hint: Use your GFC.]

L'Hôpital's Rule

IF	AND	AND	THEN
f and g are differentiable on (a, b) containing c (except possibly at c itself)	$g'(x) \neq 0$ for $x \in (a, b)$ (except possibly at c itself)	$\lim_{x \to c} \frac{f(x)}{g(x)}$ produces the indeterminate form or	$\lim_{x \to c} \frac{f(x)}{g(x)} = \lim_{x \to c}$ _____ provided this limit exists (or is infinite).

2. Confirm that the limit satisfies the conditions of L'Hôpital's Rule. Then evaluate the limit.

a. $\lim_{x \to 5} \frac{x-5}{x^2-25}$

b. $\lim_{x \to 5} \frac{x-5}{\ln(6-x)}$

c. $\lim_{x \to \infty} \frac{\ln x}{x}$

d. $\lim_{x \to -\infty} \frac{x^2}{e^{-x}}$ [Hint: Repeat the process]

From Larson 8.7

Evaluate the limit.

5. $\lim_{x \to 4} \frac{3(x-4)}{x^2-16}$

7. $\lim_{x \to 6} \frac{\sqrt{x+10}-4}{x-6}$

9. $\lim_{x \to \infty} \frac{5x^2-3x+1}{3x^2-5}$

11. $\lim_{x \to 3} \frac{x^2-2x-3}{x-3}$

13. $\lim_{x \to 0} \frac{\sqrt{25-x^2}-5}{x}$

15. $\lim_{x \to 0} \frac{e^x-(1-x)}{x}$

17. $\lim_{x \to 0^+} \frac{e^x-(1+x)}{x^3}$

19. $\lim_{x \to 1} \frac{x^{11}-1}{x^4-1}$

20. $\lim_{x \to 1} \frac{x^a-1}{x^b-1}$, where $a, b \neq 0$

21. $\lim_{x \to 0} \frac{\sin 3x}{\sin 5x}$

23. $\lim_{x \to 0} \frac{\arcsin x}{x}$

25. $\lim_{x \to \infty} \frac{5x^2+3x-1}{4x^2+5}$

27. $\lim_{x \to \infty} \frac{x^2+4x+7}{x-6}$

29. $\lim_{x \to \infty} \frac{x^3}{e^{\frac{x}{2}}}$

33. $\lim_{x \to \infty} \frac{\cos x}{x}$

35. $\lim_{x \to \infty} \frac{\ln x}{x^2}$

37. $\lim_{x \to \infty} \frac{e^x}{x^4}$

39. $\lim_{x \to 0} \frac{\sin 5x}{\tan 9x}$

41. $\lim_{x \to 0} \frac{\arctan x}{\sin x}$

43. $\lim_{x \to \infty} \frac{\int_1^x \ln\left(e^{4t-1}\right) dt}{x}$

44. $\lim_{x \to 1^+} \frac{\int_1^x \cos\theta \, d\theta}{x-1}$