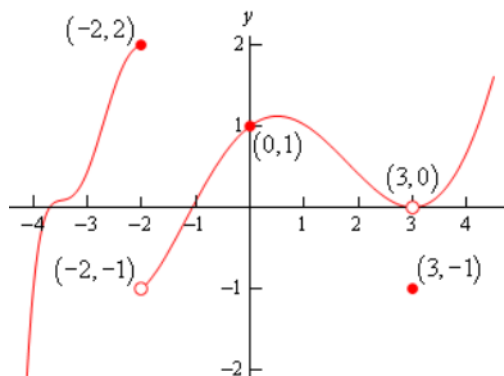


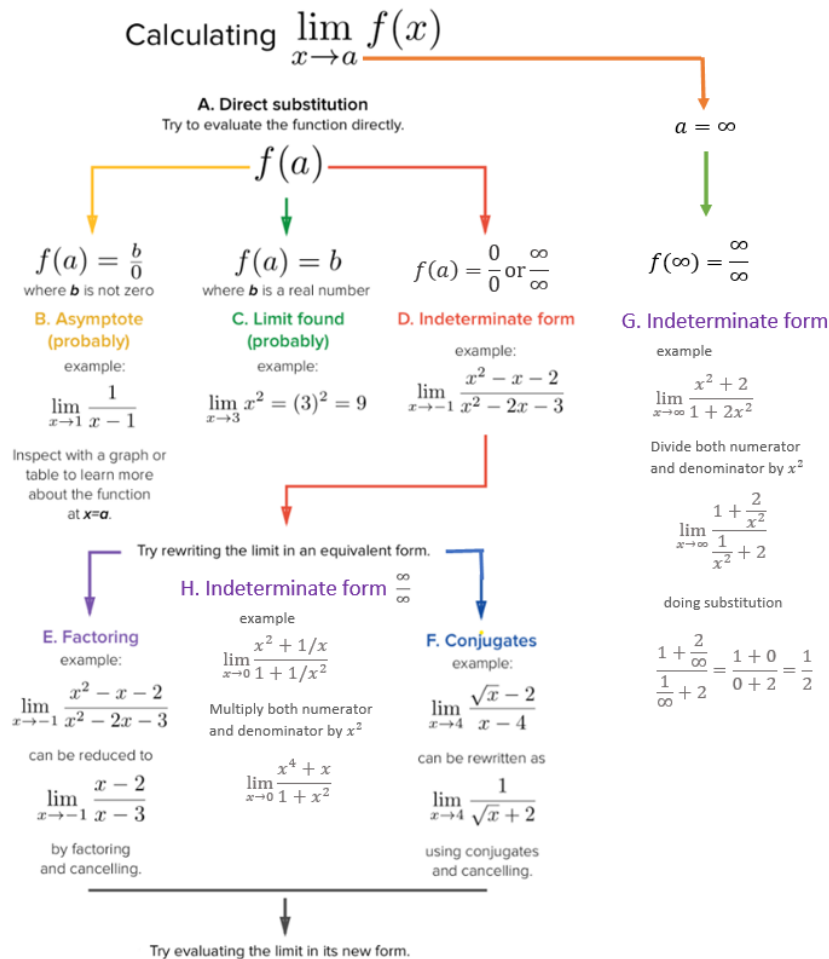
Midterm Exam 1 Review Sheet

MAT143 Brief Calculus

- Graphical Search for Limits (including left and right limits)
 - Example** (a). finding the left limit, right limit, and the existence of the limit of a function with the following given curve at $x = -2, 0, 3$, (b). Is the function continuous at $x = -2, 0, 3$?



- Calculating limits (only focusing on the cases where limit exists at a point): **substitution method**. Please practice the examples shown in the flowchart.



- If the result is $b/0$, the limit is ∞ .
 - If the result is b and $|b| < \infty$, then you have the limit.
 - If the result is $0/0$ or ∞/∞ , you have an **indeterminate form**. You need to do some algebra to simplify the given function and then redo the substitution on the **simplified form** to get either $b/0$ or $|b| < \infty$.
- Average Rate of Change of A Function Over An Interval
 - Definition: $\frac{f(b)-f(a)}{b-a}$.
 - Difference Quotient: $\frac{f(x+h)-f(x)}{h}$.
 - * Need to know how to find the **difference Quotient** for a given function. For example: find the difference quotient of $f(x) = x^2 + 1$.
- Derivative and Power Rule
 - Instantaneous Rate of Change (rate at a given $x = x_0$): $\lim_{x \rightarrow x_0} \frac{f(x+h)-f(x)}{h}$.

- Definition notation of the derivative of $f(x)$: $f'(x) = \lim_{x \rightarrow x_0} \frac{f(x+h)-f(x)}{h}$. $f'(x)$ is also denoted by $\frac{df(x)}{dx}$ or $\frac{d}{dx}f(x)$.
- Power function and the power rule of the derivative $[x^a]' = ax^{a-1}$.
- Basic Properties and Rules of Derivative
 - Constant function: $f(x) = C$, then $f'(x) = (C)' = 0$.
 - Identity function: $f(x) = x$, then $f'(x) = (x)' = 1$.
 - **Power Rule**: $f(x) = x^a$, then $f'(x) = (x^a)' = ax^{a-1}$.
- Basic Properties
 - Scalar multiplication: If $[bf(x)]' = b[f(x)]'$.
 - **Additive rule**: $[f(x) + g(x)]' = f'(x) + g'(x)$
Example: $[3\sqrt{x} + 5x^3]' = [3\sqrt{x}]' + [5x^3]' = 3[x^{1/2}]' + 5[x^3]' = (3/2)x^{-1/2} + 15x^2$.
- Multiplicative, Quotient, and Chain Rule
 - **Multiplicative Rule**: $[f(x)g(x)]' = f'(x)g(x) + f(x)g'(x)$.
Example: $[(x+1)(x^2+1)]' = (x+1)'(x^2+1) + (x+1)(x^2+1)' = (x^2+1) + (x+1) \times 2x = 3x^2 + 2x + 1$.
 - **Quotient Rule**: $[f(x)/g(x)]' = [f'(x)g(x) - f(x)g'(x)]/[g(x)]^2$
Example: $[x^2/(x+1)]' = [(x^2)'(x+1) - x^2(x+1)']/(x+1)^2 = [2x(x+1) - x^2]/(x+1)^2 = (x^2 + 2x)/(x+1)^2$.
 - **Chain Rule**: $[f \circ g(x)]' = [f(g(x))]' = f'(g(x)) \times g'(x)$. The key is to identify $f(x)$ [the outer function] and $g(x)$ [the inner function].
Example: $[\sqrt[3]{(x^2+1)^5}]' = [(x^2+1)^{5/3}]' = \frac{5}{3}(x^2+1) \times (x^2+1)' = \frac{5}{3}(x^2+1) \times (2x) = \frac{10x}{3}(x^2+1)$