l'Hôpital's Rule:

- Know the indeterminate forms: $\frac{0}{0}$, $\pm\frac{\infty}{\infty}$, $0\cdot\infty$, $\infty-\infty$, 1^∞, 0^0, ∞^0
- Be able to find limits using l'Hôpital's Rule, especially when more than one application of l'Hôpital's Rule is needed.
- Know how to compute limits involving each of the indeterminate forms above:
  (i) $\frac{0}{0}$, $\pm\frac{\infty}{\infty}$: Handled 'normally.'
  (ii) $0\cdot\infty$: Move either the 0 or ∞ term into the denominator to obtain one of the above forms.
  (iii) $\infty-\infty$: Combine terms or factor out something to obtain one of the forms above.
  (iv) $0\cdot\infty$, $\infty-\infty$, 1^∞, 0^0, ∞^0: Use logarithms, i.e. set $L = \lim f(x)^{g(x)}$, take logs to obtain $\lim g(x)\ln f(x)$. Then compute this limit, which is now one of the above indeterminate forms above. If this limit is W, then the original limit is e^W.
- Know how to find limits involving indeterminate forms without l'Hôpital's Rule, i.e. multiply by $\frac{1/x^{\text{deg dem}}}{1/x^{\text{deg den}}}$. This is especially true when l'Hôpital's Rule is difficult or otherwise loops, especially with roots, e.g. $\lim_{x\to\infty} \frac{x+1}{\sqrt{x^2+4}}$.
- Know when l'Hôpital's Rule does not apply, e.g. $\lim_{x\to\infty} \frac{x+\sin x}{x+\cos x}$, and why l'Hôpital's Rule does not apply.

Mean Value Theorem:

- Know the statement of the Mean Value Theorem (MVT).
- Be able to check whether the MVT can applied to a function on a given interval.
- Be able to apply the MVT to a function on a given interval.
- Know 'real life' applications and statements of the MVT.
- Be able to find values c that satisfy the statement of the MVT on a given interval.
- Be able to use the MVT to prove inequalities.
- Be able to use the MVT to bound function values on a given interval.

Derivatives:

- Know the statements of the First and Second Derivative Tests.
- Know how to apply the First and Second Derivative Tests.
- Be able to find critical values for functions and classify whether they are a maximum, minimum, or neither.

- Be able to use the derivative to find the intervals where a function is increasing and decreasing.
- Be able to use the second derivative to find the intervals where a function is concave and convex.
- Be able to find points of inflection.
- Be able to find the maximum/minimum values of a function on a closed interval, i.e. find max/min of $f(x)$ on $[a, b]$. [The usual work along with comparing the endpoint values.]
- Given a graph of $f(x)$, be able to find where...
  - (i) intervals where $f(x)$ is increasing/decreasing
  - (ii) intervals where $f(x)$ is concave/convex
  - (iii) points of maximum/minimum
  - (iv) points of inflection
  - (v) Sketch a graph of $f'(x)$
- Given a graph of $f'(x)$, be able to find where...
  - (i) intervals where $f(x)$ is increasing/decreasing
  - (ii) intervals where $f(x)$ is concave/convex
  - (iii) points of maximum/minimum
  - (iv) points of inflection
  - (v) Sketch a possible graph of $f(x)$
  - (vi) Sketch a graph of $f''(x)$
- Given a function $f(x)$, be able to provide a detailed sketch of $f(x)$, including finding: vertical/horizontal asymptotes, maximum/minimum values, points of inflection, intervals of increasing/decreasing, intervals where $f(x)$ is concave/convex

Optimization:

- Be able to identify quantities to be optimized in a given problem.
- Be able to give rough sketches of various scenarios in an optimization problem.
- Know various area & volume formulas:
  - Volume Cube: $V = s^3$
  - Surface Area Cube: $SA = 6s^2$
  - Volume Rectangular Prism: $V = lwh$
  - Surface Area Rectangular Prism: $SA = 2(lw + lh + hw)$
  - Area Square: $A = s^2$
  - Perimeter Square: $L = 4s$
  - Area Rectangle: $A = lw$
  - Perimeter Rectangle: $L = 2l + 2w$
  - Area Circle: $A = \pi r^2$
  - Circumference Circle: $C = 2\pi r$

- Volume Right Circular Cone: $V = \frac{\pi r^2 h}{3}$
- Surface Area Right Circular Cone: $S = \pi r \sqrt{r^2 + h^2} + \pi r^2$
- Volume Cylinder: $V = \pi r^2 h$
- Surface Area Cylinder: $S = 2\pi r h + 2\pi r^2$
- Volume Sphere: $V = \frac{4}{3}\pi r^3$
- Surface Area Sphere: $S = 4\pi r^2$
- Area Triangle: $A = \frac{bh}{2}$

- Be able to find maximum or minimum values of an optimized quantity in an applied problem.
- Be able to confirm a value is a maximum/minimum value in an applied problem.