

Math 100: Core Examinable Topics

- Find the **limits** (one- and two-sided) of rational functions that have the forms: $\frac{0}{c}, \frac{c}{0}, \frac{0}{0}, \frac{\infty}{c}, \frac{c}{\infty}, \frac{\infty}{\infty}$.
- Find the **limits** (one- and two-sided) of trigonometric functions that have the form: $\frac{0}{0}$ and $\frac{\infty}{\infty}$.
- Find the **limits** of expressions of the form $\infty - \infty$ (usually containing radicals $\sqrt{\quad}$).
- Locate the **discontinuities** in a function and determine whether they are removable.
- Find the **average rate of change** of a function over an interval, $\frac{\Delta y}{\Delta x}$, and the **instantaneous rate of change** of a function at a point, $\left. \frac{dy}{dx} \right|_{x=c}$.
- Find the **slope of the tangent line** to a function by finding the derivative of the function.
- Derive key derivatives using the definition of the derivative, $\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ (including but not limited to ...).
- Find derivatives** using the power, sum, difference, product and quotient rules and the known derivatives of the trigonometric functions.
- Use the **chain rule** “the derivative of the outside times the derivative of the inside”, $\frac{dy}{dx} = \frac{dy}{du} \frac{du}{dx}$, to find the derivatives of compositions.
- Find derivatives using **implicit differentiation**.
- Solve **related rates** problems in which one rate is given and a second, related, rate is to be found (including similar triangles, cones, and the cosine law $c^2 = a^2 + b^2 - 2ab \cos \theta$).
- ~~Use the derivative to find **local linear approximations** $f(x_0 + \Delta x) \approx f(x_0) + f'(x_0)\Delta x$ (remembering to use radians in trig functions).~~

13. Use **differentials** to approximate differences ~~$\Delta y \approx dy = f'(x)dx$~~ including propagation of error (relative error $\frac{\Delta x}{x}$ and percentage error $\frac{\Delta x}{x} \times 100$).
14. Use **Newton's method** $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$ to find approximate values for the x intercepts of functions.
15. Use intercepts, symmetry, vertical and horizontal asymptotes, and the first and second derivatives to **sketch functions**.
16. Solve **optimization** problems using differentiation.
17. Find the **antiderivatives** $\int f(x)dx$ of functions using substitution where necessary.
18. Solve equations containing **sigma** $\sum$ expressions.
19. Evaluate **definite integrals** $\int_a^b f(x)dx$ using substitution or geometric formulae where necessary.
20. Derive definite integral formulae using the Fundamental Theorem of Calculus (including but not limited to ...).
21. Use definite integrals to find the volumes of solids using general **cross-sections**
 $V = \int_a^b A(x) dx$, circular **disks** $V = \pi \int_a^b [f(x)]^2 dx$, circular **washers**
 $V = \pi \int_a^b [f(x)]^2 - [g(x)]^2 dx$, or **cylinders** $V = 2\pi \int_a^b xf(x) dx$ (with respect to either x or y).
22. Find the **area between two curves** (with respect to either x or y).
23. Find the **length of a plane curve** $L = \int_a^b \sqrt{1 + [f'(x)]^2} dx$ (with respect to either x or y).
24. Find the **surface area of a solid of revolution** $S = 2\pi \int_a^b f(x) \sqrt{1 + [f'(x)]^2} dx$ (with respect to either x or y).
25. Find the **work** done $W = \int F(x) dx$ in several physical situations e.g. stretching/compressing springs, lifting weights, pumping out containers.