

Eligible Topics for the Kossack Exam

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Calculus I Topics

• **Limits**

- Limit of a function, understood graphically and conceptually
- Limit laws and continuity
- Squeeze Theorem (aka Sandwich Theorem)
- Intermediate Value and Extreme Value Theorems
- Limits involving infinity: horizontal and vertical asymptotes
- Indeterminate forms: $0/0$, ∞/∞ , etc.
- L'Hôpital's Rule
- More advanced indeterminate forms: $0 \cdot \infty$, $\infty - \infty$, 1^∞ , etc.

• **Derivatives**

- Definition of derivative (using limit of difference quotient)
- Tangent lines to a curve
- Differentiability
- Derivative Rules
- Implicit differentiation
- Derivatives of inverse functions (including $\ln(x)$ and inverse trig)

- **Derivative applications and theorems**

- Derivatives as Rates of Change (especially velocity and acceleration)
- Related Rates
- Linear estimation: Linearization, differentials
- Mean Value Theorem
- How signs of the first and second derivative affect a function
- Absolute and Local Extreme Values (critical points)
- Concavity and Inflection Points
- First and Second Derivative Tests (for local extrema)
- Applied Optimization

- **Fundamentals of Integration**

- Indefinite integrals and antiderivatives
- Area (signed or total) enclosed by a curve, estimated by rectangle sums
- Definite integral as a limit of Riemann sums
- Properties of the definite integral, like $\int_a^c f(x) dx = \int_a^b f(x) dx + \int_b^c f(x) dx$
- Fundamental Theorem of Calculus (both parts)
- Substitution

Calculus II Topics (No Sequences, Series, or anything further)

- **Applications of Integrals**

- Area enclosed by two curves
- Volume of solids by integrating cross-sectional area
- Volume of solids of revolution (disks, washers, shells)
- Arclength and surface area (of revolution) integrals
- Separable differential equations

- **Integration Techniques**

- Integration by Parts
- Integration of Trigonometric Powers
- Trigonometric Substitution
- Integration by Partial Fractions (includes long division)
- Improper Integrals