Iowa Mathematics

Calculus

Functions C.F

F-LC. Limits and Continuity C.F-LC

1. Compute limits of functions. C.F-LC.A
   1. Define limits and explain their significance in calculus. C.F-LC.A.1
   2. Evaluate limits algebraically, graphically, and numerically. C.F-LC.A.2
2. Solve problems involving continuity and determine the continuity of functions. C.F-LC.B
   1. Use limits to define continuity at a point. C.F-LC.B.1
   2. Apply the concepts of continuity and the Intermediate Value Theorem. C.F-LC.B.2

F-D. Derivatives C.F-D

1. Use limits to compute derivatives. C.F-D.A
   1. Estimate derivatives using difference quotients. C.F-D.A.1
   2. Define the instantaneous rate of change at a point as the limit of average rates of change. C.F-D.A.2
   3. Identify the derivative of a function using appropriate strategies. For example, rules for sums, differences, products, quotients, and limits of functions. C.F-D.A.3
   4. Interpret derivatives as instantaneous rates of change. C.F-D.A.4
   5. Explain the relationship between continuity and differentiability at a point. C.F-D.A.5
   6. Use limits to define the derivative function. C.F-D.A.6
   7. Use limits to find derivatives of simple algebraic functions. C.F-D.A.7
2. Compute derivatives. C.F-D.B
   1. Compute derivatives of algebraic, trigonometric, inverse, exponential, and logarithmic functions. C.F-D.B.1
   2. Apply the rules of differentiation, including the product rule, quotient rule, and chain rule. C.F-D.B.2
   3. Compute derivatives of general inverse and implicitly defined functions. C.F-D.B.3
   4. Compute higher-order derivatives. C.F-D.B.4

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C. Apply the concept of the derivative. C.F-DF.C

1. Find the slope of a tangent line at a point. C.F-DF.C.1
2. Determine analytically and graphically where a function, or derivative function, is positive or negative, increasing or decreasing, and/or concave up or concave down. C.F-DF.C.2
3. Explain the relationships among the behaviors of ff, ff', $aaaaaa$ ff''; for example, if ff'' is positive, then ff' is increasing and ff is concave up. C.F-DF.C.3
4. Analyze and sketch graphs of ff, ff', $aaaaaa$ ff''. C.F-DF.C.4
5. Use the first and second derivative tests to find and classify critical points. C.F-DF.C.5
6. Apply the Mean Value Theorem and Extreme Value Theorem. C.F-DF.C.6
7. Solve optimization problems involving maxima and minima. C.F-DF.C.7
8. Solve related rate problems. C.F-DF.C.8
9. Use L'Hospital's rule to compute limits. C.F-DF.C.9
10. Interpret derivatives in real-world contexts, such as motion and growth problems. C.F-DF.C.10

F-I. Integrals C.F-I

1. Define and interpret integrals. C.F-I.A
    1. Use definite integrals to determine net change over an interval. C.F-I.A.1
    2. Approximate definite integrals using finite Riemann Sums. C.F-I.A.2
    3. Define the definite integral as a limit of a finite Riemann Sum. C.F-I.A.3
    4. Interpret definite integrals as net change. C.F-I.A.4
    5. State the Fundamental Theorem of Calculus and use it to evaluate definite integrals and construct antiderivatives. C.F-I.A.5
2. Compute integrals. C.F-I.B
    1. Compute indefinite and definite integrals of algebraic, trigonometric, exponential, inverse, and logarithmic functions. C.F-I.B.1
    2. Apply integration techniques, including substitution and integration by parts. C.F-I.B.2
    3. Determine if an improper integral converges or diverges using limits of definite integrals. C.F-I.B.3
    4. Transform integrands (using substitution and other techniques) to find antiderivatives using a table of integrals. C.F-I.B.4

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3 Use integrals to solve problems. C.F-I.C

1 Solve problems involving area, volume, and average value of functions. C.F-I.C.1

2 Use integrals to find the area between curves and volume of solids of revolution. C.F-I.C.2

3 Use integrals to solve problems in physics, economics, and other fields. C.F-I.C.3

F-DE. Differential Equations C.F-DE

1 Solve and interpret solutions of differential equations. C.F-DE.A

1 Explain the concept of a differential equation. C.F-DE.A.1

2 Solve first-order differential equations, including linear and exponential growth and decay models. C.F-DE.A.2

3 Interpret solutions of differential equations in real-world contexts. C.F-DE.A.3

AT. Advanced Topics C.AT

1 Apply calculus and related skills to advanced topics. C.F-AT.A

1 Explore additional topics such as sequences and series, Taylor polynomials, and polar coordinates (optional depending on course length and student readiness). C.F-AT.A.1

2 Apply calculus concepts to interdisciplinary problems and projects. C.F-AT.A.2

3 Prepare for further study in mathematics, science, engineering, and related fields. C.F-AT.A.3