ADVANCED CALCULUS

Topic: Differential Equations

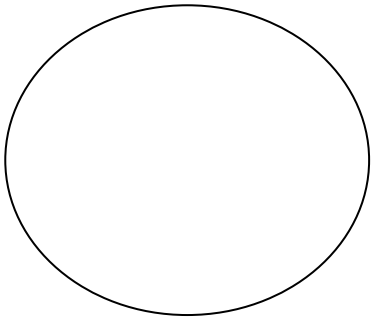
Subject(s): :

Grade(s): 12

Days:(14)

Key Learning(s): The solution of first-order, variable separable differential equation and applications of same.

Unit Essential Question(s): What are the characteristics of solutions to differential equations? What circumstances require the use of differential equations in their solution?



Concept: slope fields	**Concept:** growth and decay	**Concept:** logistic equation
Lesson Essential Questions: What is the nature of a solution of a differential equation? How does a slope field emulate the shape of the solution curves to a particular differential equation?	**Lesson Essential Questions:** What is "Newton's Law of Cooling"?	**Lesson Essential Questions:** What is the shape of the logistics curve? What is meant by "carrying capacity"?
Vocabulary: slope field general solution particular solution initial condition	**Vocabulary:**	**Vocabulary:** logistics curve carrying capacity

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Concept: separation of variables first order linear differential equations	**Concept:**	**Concept:**
Lesson Essential Questions: What is meant by "separation of variables" as a process for solving a differential equation? A "first order linear differential equation" meets what criteria?	**Lesson Essential Questions:**	**Lesson Essential Questions:**
Vocabulary: first order linear diff equn separation of variables	**Vocabulary:**	**Vocabulary:**

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Topic: Differentiation

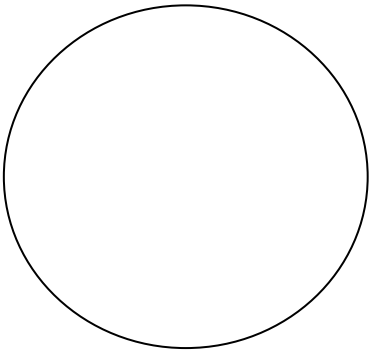
Subject(s): :

Grade(s): 12

Days:(43)

Key Learning(s): The mastery of the processes of differentiation of algebraic functions; differentiation of transcendental functions; applications of differentiation

Unit Essential Question(s): What techniques are used to differentiate?
What applications/real world problems require differentiation for solution?



Concept: power rule product rule quotient rule	**Concept:** Rolle's Theorem Mean Value Theorem	**Concept:** chain rule implicit differentiation
Lesson Essential Questions: How is the power rule derived from the definition of the derivative? What are the product rule and the quotient rule? How are the product rule and the quotient rule used to find a derivative?	**Lesson Essential Questions:** Under what criteria may Rolle's theorem and the Mean Value theorem be applied?	**Lesson Essential Questions:** What is the criteria for using implicit differentiation? How are composite functions and the chain rule related?
Vocabulary: quotient product denominator factor power	**Vocabulary:** slope tangent line secant line	**Vocabulary:** composition of functions explicit implicit differentials

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Concept: exponential functions logarithmic functions natural logarithmic functions	**Concept:** trigonometric functions inverse trigonometric functions	**Concept:** logarithmic differentiation
Lesson Essential Questions: How does the relationship between exponential and logarithmic functions impact their derivatives?	**Lesson Essential Questions:** Why are the derivatives of trig functions not unique representations? Why are derivatives of tanx, cotx, secx, and cscx dependent on the derivatives of the sinx and cosx?	**Lesson Essential Questions:** What conditions need to be present for the use of logarithmic differentiation to be appropriate? What is the advantage gained in using logarithmic differentiation to find a derivative?
Vocabulary: e to the x a to the x log base e of x ln x	**Vocabulary:** arcsinx arccosx arctanx sinx cosx tanx secx cscx cotx complete the square trigonometric identities	**Vocabulary:** laws of exponents laws of logarithms

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Concept: Optimization	**Concept:** Curve Sketching	**Concept:** Related Rates
Lesson Essential Questions: How is differentiation employed to determine maximum or minimum values of applied functions?	**Lesson Essential Questions:** How is differentiation used to determine extrema of a graph? How is differentiation used to determine inflection points of a graph? How is differentiation used to determine the monotonicity of a graph? How is differentiation used to determine the concavity of a graph?	**Lesson Essential Questions:** What is the strategy employed to solve problems involving related rates of change?
Vocabulary: maximim point minimum point maximum function value minimum function value	**Vocabulary:** monotonicity concavity maximum point minimum point increasing decreasing point of inflection vertical asymptote horizontal asymptote zeros x-intercepts y-intercepts extrema	**Vocabulary:** rate of change

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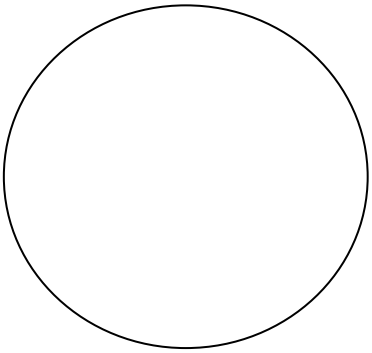
Topic: Integration

Subject(s): :

Grade(s): 12

Days:(72)



Key Learning(s): The mastery of the processes of integration of algebraic functions; integration of transcendental functions; applications of integration

Unit Essential Question(s): What techniques are used to integrate?
What applications/real world problems require integration for solution?

Concept: indefinite integration basic integration	**Concept:** definite integration the Fundamental Theorem of Calculus trig integrals area under a curve	**Concept:** integration techniques substitution by parts trig substitution partial fractions
Lesson Essential Questions: How can you verify that integration and differentiation are inverse processes?	**Lesson Essential Questions:** What does an integral represent? How can the "area under a curve" be represented using integration?	**Lesson Essential Questions:** What criteria indicates that each of the following techinques of integration must be employed? basic substitution integration by parts trig substitution partial fractions
Vocabulary: antidifferentiation rationalize the denominator rationalize the numerator complete the square separating a numerator long division	**Vocabulary:** trigonometric identities	**Vocabulary:** conjugate complete the square rationalize separate the numerator long division

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Concept: applications: area between volume - disk volume - shell arc length surface area work center of mass centroid fluid pressure fluid force	**Concept:**	**Concept:**
Lesson Essential Questions: How are the processes of finding volume by disk or shell alike and different? What is the process used to determine the area between two curves? What are the components of work as determined by Calculus? Once determined, what is the significance of a centroid or center of mass? Why is Calculus needed to determine the fluid force (pressure) on a vertical plate? What is the relationship between arc length and surface area?	**Lesson Essential Questions:**	**Lesson Essential Questions:**
Vocabulary: height thickness outer radius inner radius slice axis of revolution force displacement	**Vocabulary:**	**Vocabulary:**

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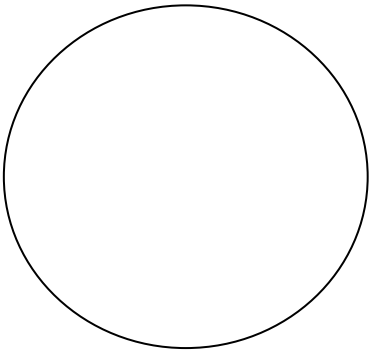
Topic: Parametric, Vector, and Polar Equations

Subject(s): :

Grade(s): 12

Days:(15)



Key Learning(s): The use of Calculus with parametric equations and their graphs, with polar equations and their graphs, and with vectors

Unit Essential Question(s): Hows does differentiation apply to parametric and polar equations? What relationship exists between derivatives of position vectors and their velocity vectors?

Concept: parametric equations	**Concept:** polar equations area in polar coord.	**Concept:** vectors differentiation of vector-valued func integration of vector-valued func
Lesson Essential Questions: How is the derivative of a parametric equation determined? How are parametric graphs obtained on a graphing calculator?	**Lesson Essential Questions:** How are polar graphs obtained on a graphing calculator? How is the area enclosed by multiple polar equations found? How is the length of an arc of a polar curve determined?	**Lesson Essential Questions:** How are the derivative and integral of a vector determined?
Vocabulary: graphs cycloid derivatives of parametric cycloid tangent line to parametric arc length of parametric	**Vocabulary:** polar coordinates	**Vocabulary:** vector components vector magnitude position vector vector direction initial conditions

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Concept: velocity acceleration	**Concept:**	**Concept:**
Lesson Essential Questions: What are the derivative of a position vector and the derivative of a velocity vector called?	**Lesson Essential Questions:**	**Lesson Essential Questions:**
Vocabulary: velocity vector acceleration vector	**Vocabulary:**	**Vocabulary:**

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Topic: Sequences and Series

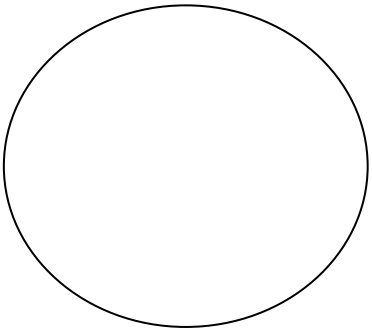
Subject(s): :

Grade(s): 12

Days:(26)

Key Learning(s): Recognition of infinite series and their convergence tests; representation of transcendental functions by polynomial approximations

Unit Essential Question(s): How are infinite series related to transcendental functions? What is the significance a convergent series?



Concept: sequences	**Concept:** series convergence *p* -series power series Taylor series Maclaurin series functions represented by power series	**Concept:** integral test ratio test
Lesson Essential Questions: How is the limit of a sequence determined?	**Lesson Essential Questions:** What process is used to detemine whether a series converges? What is the relationship between a sequence and a series?	**Lesson Essential Questions:** How is the appropriate test for convergence determined?
Vocabulary: term position	**Vocabulary:** converge diverge sequence of partial sums geometric series harmonic series alternating harmonic series *p* -series power series Tatlor series Maclaurin series	**Vocabulary:**

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Concept: Taylor polynomials	**Concept:**	**Concept:**
Lesson Essential Questions: What is the procedure for determining the Taylor/Maclaurin polynomial for a function?	**Lesson Essential Questions:**	**Lesson Essential Questions:**
Vocabulary: Taylor polynomial	**Vocabulary:**	**Vocabulary:**

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