**EL DORADO UNION HIGH SCHOOL DISTRICT**
**EDUCATIONAL SERVICES**

# Course of Study Information Page

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| COURSE TITLE<br>**Differential Calculus** | |
| DISTRICT COURSE NUMBER<br>**(#0232)** | 4-DIGIT STATE COURSE CODE (COMPLETED BY SILT)<br>**2415** |
| Rationale: | This course is designed to meet the needs of the college-bound students who would like to experience a college level Calculus course without the rigor and pace of an AP Calculus AB course. |
| Course Description that will be in the Course Directory: | This is an advanced high school math course for the student who wants exposure to the equivalent of a first-level college Calculus course. This course covers 18 of the 27 Common Core State Standards for Calculus. Topics included in this course are: limits, basic rules of differentiation, related rates, optimization, basic rules of integration, the Fundamental Theorem of Calculus, and volume of solids. |
| How Does this Course align with or meet State and District content standards? | This course covers 18 of the 27 Common Core State Standards for Calculus. |
| NCLB Core Subjects: | *Select up to two that apply:*<br>☐ Arts ☐ Civics and Government ☐ Not Core Subject<br>☐ Economics ☐ History<br>☐ English ☒ Mathematics<br>☐ Foreign Language ☐ Reading / Language Arts<br>☐ Geography ☐ Science |
| CDE CALPADS Course Descriptors:<br><br>(See Page 2 for Definitions) | CTE TECH PREP COURSE INDICATORS<br>☐ Tech Prep (32)<br>☐ Tech Prep & ROP (33)<br>☐ ROP<br>☐ N/A<br><br>CTE COURSE CONTENT CODE<br>☐ CTE Introductory (01)<br>☐ CTE Concentrator (02)<br>☐ CTE Completer (03)<br>☐ N/A<br><br>INSTRUCTIONAL LEVEL CODE<br>☐ Remedial (35)<br>☐ Honors UC-Certified (39)<br>☐ Honors Non UC-Certified (34)<br>☐ College (40)<br>☐ N/A |
| Length of Course: | ☒ Year ☐ Semester |
| Grade Level(s): | ☐ 9 ☒ 10 ☒ 11 ☒ 12 |
| Credit: | ☒ Number of units: **10**<br>☒ Meets graduation requirements<br>☒ Request for UC "a–g" requirements<br><br>☒ College Prep<br>☒ Elective<br>☐ Career Technical |
| Prerequisites: | C or better in Math Analysis |
| Department(s): | Mathematics |
| District Sites: | EDHS, ORHS, PHS, UMHS |
| Board of Trustees COS Adoption Date: | May 8, 2012 |
| Textbooks / Instructional Materials: | **Calculus I with Precalculus**, Brooks/Cole Cengage Learning Publishing, Larson & Edwards, ©2012, 3rd Edition, ISBN: 978-1-1115-7679-0 |
| Funding Source: | General Fund |

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| Board of Trustees<br>Textbook Adoption Date: | May 8, 2012 |

## Definitions

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| CALPADS | California Longitudinal Pupil Achievement Data System |
| CTE Technical Prep | A course within a CTE technical career pathway or program that has been articulated with a postsecondary education or through an apprenticeship program of at least 2 years following secondary instruction. |
| Instructional Level Code | Represents a nonstandard instructional level at which the content of a specific course is either above or below a 'standard' course instructional level. These levels may be identified by the actual level of instruction or identified by equating the course content and level of instruction with a state or nationally recognized advanced course of study, such as IB or AP. |
| Instructional Level Honors, UC Certified | Includes all AP courses. |
| Instructional Level Honors, non UC Certified | Requires Board approval. |
| Instructional Level College | Includes ACE courses. Equivalent to college course and content, but not an AP course. Not related to section, but to course. |

**EL DORADO UNION HIGH SCHOOL DISTRICT**

# EDUCATIONAL SERVICES

## Course Title: Differential Calculus

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**EL DORADO UNION HIGH SCHOOL DISTRICT**

# EDUCATIONAL SERVICES

Department: Mathematics

Course Title: Differential Calculus (#0232)

UNIT #1: Math Analysis Review

LEARNING OUTCOME: Students will know how to simplify and solve rational, radical, and trigonometric expressions and equations.

| LEARNING OUTCOME | INSTRUCTIONAL STRATEGIES | ASSESSMENTS | INTERVENTIONS |
|---|---|---|---|
| 1. What students will learn, know, and be able to do? (Must be aligned to state content standards.)<br>Students will perform operations and simplify rational expressions. [A-APR]<br>Students will solve rational equations. [A-REI]<br>Students will perform operations and simplify radical expressions. [N-RN]<br>Students will solve radical equations. [A-REI]<br>Students will perform operations and simplify exponential and logarithmic expressions. [A-SSE] [A-CED]<br>Students will solve exponential and logarithmic equations. [F-BF]<br>Students will know how to find trigonometric angles and their values based on the unit circle. [G-SRT] [F-TF]<br>Students will know Pythagorean, double angle, and half-angle identities. [F-TF]<br>Students will perform operations and simplify trigonometric expressions. [F-TF]<br>Students will solve trigonometric equations. [F-TF] | 2. Instructional strategies that will be used to engage students.<br>Teachers will use direct instruction utilizing Smart Notebook software to teach and demonstrate each concept to students.<br>Students will work independently, in pairs and in groups to practice, apply and discuss each concept.<br>Warm-ups, quizzes, Smart Responder activities and teacher monitoring will assess progress and check for understanding. | 3. How will we know that students have learned? Include both Formative (for learning) and Summative (of learning) assessment examples.<br>Formative assessments will include warm-ups, homework, individual quizzes and partner quizzes.<br>Summative assessments will include chapter or unit tests. | 4. What will we do if students don't learn?<br>If many students demonstrate lack of understanding of a given topic re-teaching including warm-ups and other activities will occur.<br>If individual students demonstrate lack of understanding of a given topic teachers will advise options available by teacher/site. These may include peer-tutoring, Academic Recovery, D-Back hour, Blue Latte, teacher office hours.<br>5. What will we do if students already know it?<br>A minimum of independent practice problems will be provided then the students will be allowed to move to the next topic. |

## Content Area Standards (Please identify the source)

The students will demonstrate mastery of the following content standards:

Common Core Standards

[A-APR.7] Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

[A-REI.2] Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

[N-RN.2] Rewrite expressions involving radicals and rational exponents using the properties of exponents.

[A-SSE.3.c] Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

c. Use the properties of exponents to transform expressions for exponential functions. *For example, the expression* $1.15^t$ *can be rewritten as* $\left(1.15^{\frac{1}{12}}\right)^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is $15\%$.

[A-SSE.3.d] Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

d. Prove simple laws of logarithms.

[A-SSE.3.f] Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression

f. Understand and use the properties of logarithms to simplify logarithmic numeric expressions and to identify their approximate values.

[F-BF.5] Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

[A-CED.1.1] Judge the validity of an argument according to whether the properties of real numbers, exponents, and logarithms have been applied correctly at each step.

[G-SRT.6] Understand that by similarity, side ratios in the right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

[F-TF.3] Use special triangles to determine geometrically the values of sine, cosine, and tangent for $\pi/3, \pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi - x, \pi + x$ and $2\pi - x$ in terms of their value of $x$, where $x$ is any real number.

[F-TF.4] Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.

[F-TF.6.2] Compute, by hand, the values of the trigonometric functions and the inverse trigonometric functions at various standard points.

[F-TF.8] Prove the Pythagorean identity $sin^2(\theta) + cos^2(\theta) = 1$and use it to find $sin(\theta), cos(\theta)$ or $tan(\theta)$ given $sin(\theta), cos(\theta)$ or $tan(\theta)$ and the quadrant angle.

[F-TF.9] Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

[F-TF.10] Demonstrate an understanding of half-angle and double-angle formulas for sines and cosines and can use those formulas to prove and/or simplify other trigonometric identities.

# EDUCATIONAL SERVICES

Department: Mathematics

Course Title: Differential Calculus (#0232)

UNIT #2: Limits

LEARNING OUTCOME: Students will find limits of functions graphically, analytically, and algebraically.

| LEARNING OUTCOME | INSTRUCTIONAL STRATEGIES | ASSESSMENTS | INTERVENTIONS |
|---|---|---|---|
| 1. What students will learn, know, and be able to do? (Must be aligned to state content standards.)<br>Students will find limits of functions by using a table of values. [1.2]<br>Students will find limits of functions by analyzing graphs. [1.2]<br>Students will find limits of functions algebraically. [1.1]<br>Students will know how to find left-sided and right-sided limits. [1.0] [1.2]<br>Students will show the formal definition of limits using delta-epsilon proofs. [1.0]<br>Students will find limits of trigonometric functions, i.e. sinx/x as x approaches zero. [1.3]<br>Students will know the meaning of a continuity to determine if a function is continuous. [2.0]<br>Students will determine different types of continuity, i.e. step/jump and removable discontinuity. [2.0]<br>Students will find limits of functions involving infinity. [1.0] [1.2]<br>Students will use L'Hopital's rule for indeterminate forms of limits. [8.0] | 2. Instructional strategies that will be used to engage students.<br>Teachers will use direct instruction utilizing Smart Notebook software to teach and demonstrate each concept to students.<br>Teachers will utilize the Internet to find applets to help reinforce concepts.<br>Students will work independently, in pairs and in groups to practice, apply and discuss each concept.<br>Warm-ups, quizzes, Smart Responder activities and teacher monitoring will assess progress and check for understanding. | 3. How will we know that students have learned? Include both Formative (for learning) and Summative (of learning) assessment examples.<br>Formative assessments will include warm-ups, homework, individual quizzes, partner quizzes, and group discussion of solutions.<br>Summative assessments will include chapter or unit tests. | 4. What will we do if students don't learn?<br>If many students demonstrate lack of understanding of a given topic re-teaching including warm-ups and other activities will occur.<br>If individual students demonstrate lack of understanding of a given topic teachers will advise options available by teacher/site. These may include peer-tutoring, Academic Recovery, D-Back hour, Blue Latte, teacher office hours.<br>5. What will we do if students already know it?<br>A minimum of independent practice problems will be provided then the students will be allowed to move to the next topic. |

## Content Area Standards (Please identify the source)

The students will demonstrate mastery of the following content standards:

Common Core Calculus Standards

1.0 – Students demonstrate knowledge of both formal definition and the graphical interpretation of limit of values of functions. This knowledge includes one-sided limits, infinite limits, and limits at infinity. Students know the definition of convergence and divergence of a function as the domain variable approaches either a number or infinity.

1.1 – Students prove and use theorems evaluating the limits of sums, products, quotients, and composition of functions.

1.2 – Students use graphical calculators to verify and estimate limits.

1.3 – Students prove and use special limits, such as the limits of (sinx/x) and (1-cos(x)/x) as x tends to 0.

2.0 – Students demonstrate knowledge of both the formal definition and the graphical interpretation of continuity of a function.

8.0 – Students know and can apply Rolle's theorem, the mean value theorem, and L'Hopital's rule.

# EDUCATIONAL SERVICES

Department: Mathematics

Course Title: Differential Calculus (#0232)

UNIT #3: Differentiation Rules

LEARNING OUTCOME: Students will know the basic rules of differentiation.

| LEARNING OUTCOME | INSTRUCTIONAL STRATEGIES | ASSESSMENTS | INTERVENTIONS |
|---|---|---|---|
| 1. What students will learn, know, and be able to do? (Must be aligned to state content standards.)<br>Students will define the meaning of a derivative as the slope of the tangent line to the graph of a function. [4.1]<br>Students will use the limit of the difference quotient to show the limit definition of a derivative. [4.0]<br>Students will be able to interpret derivatives as the instantaneous rate of change. [4.2]<br>Students will know various notations for showing a derivative. [4.0]<br>Students will be able to know the relationship between continuity and differentiability. [2.0] [4.3]<br>Students will be able to find the derivatives of functions using basic rules – power, product, quotient, and chain rules. [4.4] [5.0]<br>Students will be able to find the derivatives of trigonometric, exponential, logarithmic, and inverse trigonometric functions. [4.4] [5.0]<br>Students will be able to compute higher | 2. Instructional strategies that will be used to engage students.<br>Teachers will use direct instruction utilizing Smart Notebook software to teach and demonstrate each concept to students.<br>Students will work independently, in pairs and in groups to practice, apply and discuss each concept.<br>Warm-ups, quizzes, Smart Responder activities and teacher monitoring will assess progress and check for understanding. | 3. How will we know that students have learned? Include both Formative (for learning) and Summative (of learning) assessment examples.<br>Formative assessments will include warm-ups, homework, individual quizzes, partner quizzes, and group discussion of solutions.<br>Summative assessments will include chapter or unit tests. | 4. What will we do if students don't learn?<br>If many students demonstrate lack of understanding of a given topic re-teaching including warm-ups and other activities will occur.<br>If individual students demonstrate lack of understanding of a given topic teachers will advise options available by teacher/site. These may include peer-tutoring, Academic Recovery, D-Back hour, Blue Latte, teacher office hours.<br>5. What will we do if students already know it?<br>A minimum of independent practice problems will be provided then the students will be allowed to move to the next topic. |

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| order derivatives. [7.0]<br>Students will use derivatives to solve a variety of problems from physics, chemistry, economics, and so forth involving rate of change. [4.2]<br>Students will be able to graphically represent the derivative of the function given a graph of the function. [4.0]<br>Students will find derivatives of functions implicitly. [6.0] | | | |

## Content Area Standards (Please identify the source)

The students will demonstrate mastery of the following content standards:

Common Core Calculus Standards

2.0 – Students demonstrate knowledge of both the formal definition and the graphical interpretation of continuity of a function.
3.0 – Students demonstrate an understanding and application of the intermediate value theorem and the extreme value theorem.
4.0 – Students demonstrate an understanding of the formal definition of the derivative of a function at a point and the notion of differentiability.
4.1 – Students demonstrate an understanding of the derivative of a function as the slope of the tangent line to the graph of the function.
4.2 – Students demonstrate an understanding of the interpretation of the derivative as an instantaneous rate of change. Students can use derivatives to solve a variety of problems from physics, chemistry, economics, and so forth that involve the rate of change of a function.
4.3 – Students understand the relation between differentiability and continuity.
4.4 – Students derive derivative formulas and use them to find the derivatives of algebraic, trigonometric, inverse trigonometric, exponential, and logarithmic function.
5.0 – Students know the chain rule and its proof and applications to the calculation of the derivative of a variety of composite functions.
6.0 – Students find the derivatives of parametrically defined functions and use implicit differentiation in a wide variety of problems in physics, chemistry, economics, and so forth.
7.0 – Students compute derivatives of higher orders.

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# EDUCATIONAL SERVICES

Department: Mathematics

Course Title: Differential Calculus (#0232)

UNIT #4: Applications of Differentiation

LEARNING OUTCOME: Students will use differentiation to solve real world applications.

| LEARNING OUTCOME | INSTRUCTIONAL STRATEGIES | ASSESSMENTS | INTERVENTIONS |
|---|---|---|---|
| 1. What students will learn, know, and be able to do? (Must be aligned to state content standards.)<br>Students will know and apply the Intermediate Value Theorem, Rolle's Theorem, and the Mean Value Theorem. [8.0]<br>Students will be able to determine absolute extrema in a closed interval. (Candidate's Test) [9.0]<br>Students will be able to determine where a function is increasing or decreasing using the first derivative and critical numbers. [9.0]<br>Students will be able to apply the 1st Derivative Test to determine relative extrema. [9.0]<br>Students will be able to determine where a function is concave up or concave down using the second derivative using possible points of inflections. [9.0]<br>Students will be able to apply the 2nd Derivative Test to determine relative extrema. [9.0]<br>Students will be able to graph a function using the first and second derivatives. [9.0] | 2. Instructional strategies that will be used to engage students.<br>Teachers will use direct instruction utilizing Smart Notebook software to teach and demonstrate each concept to students.<br>Students will work independently, in pairs and in groups to practice, apply and discuss each concept.<br>Warm-ups, quizzes, Smart Responder activities and teacher monitoring will assess progress and check for understanding. | 3. How will we know that students have learned? Include both Formative (for learning) and Summative (of learning) assessment examples.<br>Formative assessments will include warm-ups, homework, individual quizzes, partner quizzes, and group discussion of solutions.<br>Summative assessments will include chapter or unit tests. | 4. What will we do if students don't learn?<br>If many students demonstrate lack of understanding of a given topic re-teaching including warm-ups and other activities will occur.<br>If individual students demonstrate lack of understanding of a given topic teachers will advise options available by teacher/site. These may include peer-tutoring, Academic Recovery, D-Back hour, Blue Latte, teacher office hours.<br>5. What will we do if students already know it?<br>A minimum of independent practice problems will be provided then the students will be allowed to move to the next topic. |

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| Students will use the first and second derivatives to find characteristics of the original function. [9.0]<br>Students will be able to identify/match a graph of a function with its appropriate first and second derivative graphs. [9.0]<br>Students will be able to use derivatives to solve related rate problems. [4.2] [12.0]<br>Students will be able to use derivatives to solve optimization problems. [11.0] | | | |

## Content Area Standards (Please identify the source)

The students will demonstrate mastery of the following content standards:

Common Core Calculus Standards

4.2 – Students demonstrate an understanding of the interpretation of the derivative as an instantaneous rate of change. Students can use derivatives to solve a variety of problems from physics, chemistry, economics, and so forth that involve the rate of change of a function.

8.0 – Students know and can apply Rolle's Theorem, the Mean Value Theorem, and L'Hopital's rule.

9.0 – Students use differentiation to sketch, by hand, graphs of functions. They can identify maxima, minima, inflection points, and intervals in which the function is increasing and decreasing.

11.0 – Students use differentiation to solve optimization (maximum-minimum problems) in a variety of pure and applied context.

12.0 – Student use differentiation to solve related rate problems in a variety of pure and applied contexts.

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# EDUCATIONAL SERVICES

Department: Mathematics

Course Title: Differential Calculus (#0232)

UNIT #5: Integration Rules

LEARNING OUTCOME: Students know the basic rules of integration.

| LEARNING OUTCOME | INSTRUCTIONAL STRATEGIES | ASSESSMENTS | INTERVENTIONS |
|---|---|---|---|
| 1. What students will learn, know, and be able to do? (Must be aligned to state content standards.)<br>Students will use Riemann Sums (left, right, midpoint, and trapezoidal) to approximate area under the curve. [13.0]<br>Students will use the limits of Riemann Sums to formally define an integral. [13.0]<br>Students will be able to use integration to find the total and net distance traveled for an object. [14.0]<br>Students will be able to define and apply the Fundamental Theorem of Calculus. [15.0]<br>Students will know the difference between an indefinite integral and a definite integral. [14.0]<br>Students will use the definite integrals to find exact areas under a curve. [16.0]<br>Students will use integration to find basic antiderivatives of polynomial, trigonometric, inverse trigonometric, exponential, and logarithmic functions. [17.0]<br>Students will use the substitution method to find more complex antiderivatives. [17.0] | 2. Instructional strategies that will be used to engage students.<br>Teachers will use direct instruction utilizing Smart Notebook software to teach and demonstrate each concept to students.<br>Students will work independently, in pairs and in groups to practice, apply and discuss each concept.<br>Warm-ups, quizzes, Smart Responder activities and teacher monitoring will assess progress and check for understanding. | 3. How will we know that students have learned? Include both Formative (for learning) and Summative (of learning) assessment examples.<br>Formative assessments will include warm-ups, homework, individual quizzes, partner quizzes, and group discussion of solutions.<br>Summative assessments will include chapter or unit tests. | 4. What will we do if students don't learn?<br>If many students demonstrate lack of understanding of a given topic re-teaching including warm-ups and other activities will occur.<br>If individual students demonstrate lack of understanding of a given topic teachers will advise options available by teacher/site. These may include peer-tutoring, Academic Recovery, D-Back hour, Blue Latte, teacher office hours.<br>5. What will we do if students already know it?<br>A minimum of independent practice problems will be provided then the students will be allowed to move to the next topic. |

## Content Area Standards (Please identify the source)

The students will demonstrate mastery of the following content standards:

Common Core Calculus Standards

13.0 – Student know the definition of the definite integral by using Riemann sums. They use this definition to approximate integrals.

14.0 – Students apply the definition of the integral to model problems in physics, economics, and so forth, obtaining results in terms of integrals.

15.0 – Students demonstrate knowledge and proof of the Fundamental Theorem of Calculus and use it to interpret integrals as antiderivatives.

16.0 – Students use definite integrals in problems involving area, velocity, acceleration, volume of a solid, area of a surface, length of a curve, and work.

17.0 – Students compute, by hand, the integrals of a wide variety of functions by using techniques of integration, such as substitution, integration by parts, and trigonometric substitution. They can also combine these techniques when appropriate.

18.0 – Students know the definition and properties of inverse trigonometric functions and the expression of these functions as indefinite integrals.

20.0 – Students compute the integral of trigonometric functions by using various techniques noted above (in previous standards).

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# EDUCATIONAL SERVICES

Department: Mathematics

Course Title: Differential Calculus (#0232)

UNIT #6: Applications of Integration

LEARNING OUTCOME: Students will use integration to solve real world applications.

| LEARNING OUTCOME | INSTRUCTIONAL STRATEGIES | ASSESSMENTS | INTERVENTIONS |
|---|---|---|---|
| 1. What students will learn, know, and be able to do? (Must be aligned to state content standards.)<br>Students will be able to use integration in applied models concerning rates of change.[14.0] [16.0]<br>Students will use integration to find the area between curves. [16.0]<br>Students will use integration to find the arc length of a curve. [16.0]<br>Students will find the volume of a solid using the Disk and Washer Methods. [16.0]<br>Students will be able to find the volume of known cross-sections. [16.0] | 2. Instructional strategies that will be used to engage students.<br>Teachers will use direct instruction utilizing Smart Notebook software to teach and demonstrate each concept to students.<br>Students will work independently, in pairs and in groups to practice, apply and discuss each concept.<br>Warm-ups, quizzes, Smart Responder activities and teacher monitoring will assess progress and check for understanding. | 3. How will we know that students have learned? Include both Formative (for learning) and Summative (of learning) assessment examples.<br>Formative assessments will include warm-ups, homework, individual quizzes, partner quizzes, and group discussion of solutions.<br>Summative assessments will include chapter or unit tests. | 4. What will we do if students don't learn?<br>If many students demonstrate lack of understanding of a given topic re-teaching including warm-ups and other activities will occur.<br>If individual students demonstrate lack of understanding of a given topic teachers will advise options available by teacher/site. These may include peer-tutoring, Academic Recovery, D-Back hour, Blue Latte, teacher office hours.<br>5. What will we do if students already know it?<br>A minimum of independent practice problems will be provided then the students will be allowed to move to the next topic. |

## Content Area Standards (Please identify the source)

The students will demonstrate mastery of the following content standards:

Common Core Calculus Standards

14.0 – Students apply the definition of the integral to model problems in physics, economics, and so forth, obtaining results in terms of integrals.

16.0 – Students use definite integrals in problems involving area, velocity, acceleration, volume of a solid, area of a surface, length of a curve, and work.