**Roanoke Valley Governor’s School for Science and Technology**

**AP Calculus AB Competency List**

(Last Updated: June, 2022)

AP Calculus AB emphasizes a multi-representational approach to college level calculus with concepts, results, and problems expressed graphically, analytically, numerically, and verbally. Topics include limits, derivatives and their applications, integration techniques, differential equations and modeling, approximation techniques, area and volume. Students are expected to obtain a qualifying score of 3, 4, or 5 on the AP Calculus AB exam at the end of this course.

This course is taught using best practices in gifted education. Each competency is aligned with

Hockett’s five principles of gifted education:

**Gifted Education Principles:**

Hockett, J.A. (2009) “Curriculum for Highly Able Learners That Conforms to General Education and Gifted Education Quality Indicators.” *Journal of Education for the Gifted***.** Vol. 32, No. 3, p. 394-440

* 1. High-quality curriculum for gifted learners uses a conceptual approach to organize or explore content that is discipline based and integrative.
  2. High-quality curriculum for gifted learners pursues advanced levels of understanding beyond the general education curriculum through abstraction, depth, breadth, and complexity.
  3. High-quality curriculum for gifted learners asks students to use processes and materials that approximate those of an expert, disciplinarian, or practicing professional.
  4. High-quality curriculum for gifted learners emphasizes problems, products, and performances that are true to life, and outcomes that are transformational.
  5. High-quality curriculum for gifted learners is flexible enough to accommodate self-directed learning fueled by student interests, adjustments for pacing, and variety.

*External standards from The College Board Advanced Placement (AP) Program were referenced when reviewing these competencies. To the right of each Enabling Objective is notation indicating a relative priority/proficiency rating from A (highest) to D (lowest).*

COMPETENCY 1

**Limits and Continuity.**

*Enabling Objectives:*

|  |  |  |
| --- | --- | --- |
| Introducing Calculus: Can Change Occur at an Instant? | 1.1 | B |
| Defining Limits and Using Limit Notation | 1.2 | B |
| Estimating Limit Values from Graphs | 1.3 | B |
| Estimating Limit Values from Tables | 1.4 | B |
| Determining Limits Using Algebraic Properties of Limits | 1.5 | A |
| Determining Limits Using Algebraic Manipulation | 1.6 | A |
| Selecting Procedures for Determining Limits | 1.7 | A |
| Determining Limits Using the Squeeze Theorem | 1.8 | C |
| Connecting Multiple Representations of Limits | 1.9 | C |
| Exploring Types of Discontinuities | 1.10 | B |
| Defining Continuity at a Point | 1.11 | B |
| Confirming Continuity over an Interval | 1.12 | B |
| Removing Discontinuities | 1.13 | B |
| Connecting Infinite Limits and Vertical Asymptotes | 1.14 | B |
| Connecting Limits at Infinity and Horizontal Asymptotes | 1.15 | B |
| Working with the Intermediate Value Theorem | 1.16 | B |

COMPETENCY 2

**Differentiation: Definition and Fundamental Properties.**

*Enabling Objectives:*

|  |  |  |
| --- | --- | --- |
| Defining Average and Instantaneous Rates of Change at a Point | 2.1 | A |
| Defining the Derivative of a Function and Using Derivative Notation | 2.2 | A |
| Estimating Derivatives of a Function at a Point | 2.3 | C |
| Connecting Differentiability and Continuity: Determining When Derivatives Do  and Do Not Exist | 2.4 | B |
| Applying the Power Rule | 2.5 | A |
| Derivative Rules: Constant, Sum, Difference, and Constant Multiple | 2.6 | A |
| Derivatives of cosx, sinx, e^x, and lnx | 2.7 | A |
| Calculate the derivatives of hybrid functions via log differentiation | Ext | C |
| The Product Rule | 2.8 | A |
| The Quotient Rule | 2.9 | A |
| Finding the Derivatives of Tangent, Cotangent, Secant, and/or Cosecant  Functions | 2.10 | C |

COMPETENCY 3

**Differentiation: Composite, Implicit, and Inverse Functions.**

*Enabling Objectives:*

|  |  |  |
| --- | --- | --- |
| The Chain Rule | 3.1 | A |
| Implicit Differentiation | 3.2 | B |
| Differentiating Inverse Functions | 3.3 | C |
| Differentiating Inverse Trig Functions | 3.4 | C |
| Selecting Procedures for Calculating Derivatives | 3.5 | A |
| Calculating Higher-Order Derivatives | 3.6 | A |

COMPETENCY 4

**Contextual Applications of Differentiation.**

*Enabling Objectives:*

|  |  |  |
| --- | --- | --- |
| Interpreting the Meaning of the Derivative in Context | 4.1 | A |
| Straight-Line Motion: Connecting Position, Velocity, and Acceleration | 4.2 | A |
| Rates of Change in Applied Contexts Other Than Motion | 4.3 | B |
| Introduction to Related Rates | 4.4 | B |
| Solving Related Rates Problems | 4.5 | B |
| Approximating Values of a Function Using Local Linearity and Linearization | 4.6 | B |
| Using L’Hopital’s Rule for Determining Limits of Indeterminate Forms | 4.7 | B |

COMPETENCY 5

**Analytical Applications of Differentiation.**

*Enabling Objectives:*

|  |  |  |
| --- | --- | --- |
| Using the Mean Value Theorem | 5.1 | B |
| Extreme Value Theorem, Global Versus Local Extrema, and Critical Points | 5.2 | A |
| Determining Intervals on Which a Function is Increasing or Decreasing | 5.3 | A |
| Using the First Derivative Test to Determine Relative (Local) Extrema | 5.4 | A |
| Using the Candidates Test to Determine Absolute (Global) Extrema | 5.5 | A |
| Determining the Concavity of Functions over Their Domains | 5.6 | A |
| Using the Second Derivative Test to Determine Extrema | 5.7 | C |
| Sketching Graphs of Functions and Their Derivatives | 5.8 | B |
| Connecting a Function, Its First Derivative, and Its Second Derivative | 5.9 | B |
| Introduction to Optimization Problems | 5.10 | C |
| Solving Optimization Problems | 5.11 | C |
| Exploring Behaviors of Implicit Relations | 5.12 | C |

COMPETENCY 6

**Integration and Accumulation of Change.**

*Enabling Objectives:*

|  |  |  |
| --- | --- | --- |
| Exploring Accumulations of Change | 6.1 | B |
| Approximating Areas with Riemann Sums | 6.2 | B |
| Riemann Sums, Summation Notation, and Definite Integral Notation | 6.3 | A |
| The Fundamental Theorem of Calculus and Accumulation Functions | 6.4 | A |
| Interpreting the Behavior of Accumulation Functions Involving Area | 6.5 | B |
| Applying Properties of Definite Integrals | 6.6 | A |
| The Fundamental Theorem of Calculus and Definite Integrals | 6.7 | A |
| Finding Antiderivatives and Indefinite Integrals: Basic Rules and Notation | 6.8 | A |
| Integration by Substitution | 6.9 | A |
| Integrating Functions Using Long Division and Completing the Square | 6.10 | B |
| Selecting Techniques for Antidifferentiation | 6.14 | B |

COMPETENCY 7

**Differential Equations.**

*Enabling Objectives:*

|  |  |  |
| --- | --- | --- |
| Modeling Situations with Differential Equations | 7.1 | C |
| Verifying Solutions for Differential Equations | 7.2 | B |
| Sketching Slope Fields | 7.3 | B |
| Reasoning Using Slope Fields | 7.4 | B |
| Finding General Solutions Using Separation of Variables | 7.6 | A |
| Finding Particular Solutions Using Initial Conditions and Separation of  Variables | 7.7 | A |
| Exponential Models with Differential Equations | 7.8 | C |

COMPETENCY 8

**Applications of Integration.**

*Enabling Objectives:*

|  |  |  |
| --- | --- | --- |
| Finding the Average Value of a Function on an Interval | 8.1 | B |
| Connecting Position, Velocity, and Acceleration of Functions Using Integrals | 8.2 | A |
| Using Accumulation Functions and Definite Integrals in Applied Contexts | 8.3 | B |
| Finding the Area Between Curves Expressed as Functions of x | 8.4 | B |
| Finding the Area Between Curves Expressed as Functions of y | 8.5 | B |
| Finding the Area Between Curves That Intersect at More Than Two Points | 8.6 | B |
| Volumes with Cross Sections: Squares and Rectangles | 8.7 | B |
| Volumes with Cross Sections: Triangles and Semicircles | 8.8 | B |
| Volume with Disc Method: Revolving Around the x or y-axis | 8.9 | B |
| Volume with Disc Method: Revolving Around Other Axes | 8.10 | B |
| Volume with Washer Method: Revolving Around the x or y-axis | 8.11 | B |
| Volume with Washer Method: Revolving Around Other Axes | 8.12 | B |
| Volume with Cylindrical Shells: Revolving Around the x or y-axis | Ext | B |
| Volume with Cylindrical Shells: Revolving Around Other Axes | Ext | B |