



**SUBJECT: PreCalculus**

**GRADE LEVEL: 11**

**SCHOOL YEAR: 2023-24**

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**COURSE DESCRIPTION:**

Pre-Calculus serves as a transition between algebra and calculus. This course covers many important fundamental concepts that will prepare students for calculus and college-level mathematics. Students are expected to understand, analyze, and utilize basic functions. They are also expected to understand the relationship between exponential functions and logarithm. Trigonometric functions and identities will be included and students are expected to graph and analyze graph and prove identities. Analytic geometry in two dimension and discrete mathematics will also be covered.

**COURSE OBJECTIVES:**

The course objectives are defined in the Common Core State Standard high school domain.

**CCSS: Mathematics**

**CCSS: HS: Algebra**

**Seeing Structure in Expressions**

**HSA-SSE.A. Interpret the structure of expressions.**

HSA-SSE.A.1. Interpret expressions that represent a quantity in terms of its context.

HSA-SSE.A.1b. Interpret complicated expressions by viewing one or more of their parts as a single entity.

**HSA-SSE.B. Write expressions in equivalent forms to solve problems.**

HSA-SSE.B.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

HSA-SSE.B.3c. Use the properties of exponents to transform expressions for exponential functions.

## CCSS: HS: Functions

### Interpreting Functions

#### HSF-IF.B. Interpret functions that arise in applications in terms of the context.

HSF-IF.B.4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

#### HSF-IF.C. Analyze functions using different representations.

HSF-IF.C.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

HSF-IF.C.7c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

HSF-IF.C.7d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

HSF-IF.C.7e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

HSF-IF.C.8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

HSF-IF.C.8b. Use the properties of exponents to interpret expressions for exponential functions.

### Linear, Quadratic, and Exponential Models

#### HSF-LE.A. Construct and compare linear and exponential models and solve problems.

HSF-LE.A.1. Distinguish between situations that can be modeled with linear functions and with exponential functions.

HSF-LE.A.1a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.

HSF-LE.A.1c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

HSF-LE.A.2. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

HSF-LE.A.3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

HSF-LE.A.4. For exponential models, express as a logarithm the solution to  $ab^{ct} = d$  where  $a$ ,  $c$ , and  $d$  are numbers and the base  $b$  is 2, 10, or  $e$ ; evaluate the logarithm using technology.

#### HSF-LE.B. Interpret expressions for functions in terms of the situation they model.

HSF-LE.B.5. Interpret the parameters in a linear or exponential function in terms of a context.

### Trigonometric Functions

#### HSF-TF.A. Extend the domain of trigonometric functions using the unit circle.

HSF-TF.A.1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

HSF-TF.A.2. Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

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

HSF-TF.A.4. (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.

### **HSF-TF.B. Model periodic phenomena with trigonometric functions.**

HSF-TF.B.5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

HSF-TF.B.6. (+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.

HSF-TF.B.7. (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.

## **CCSS: Mathematics**

### **CCSS: HS: Num/Quantity**

#### **Vector & Matrix Quantities**

#### **HSN-VM.A. Represent and model with vector quantities.**

HSN-VM.A.1. (+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g.,  $v$ ,  $|v|$ ,  $\|v\|$ ,  $v$ ).

HSN-VM.A.2. (+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.

HSN-VM.A.3. (+) Solve problems involving velocity and other quantities that can be represented by vectors.

#### **HSN-VM.B. Perform operations on vectors.**

HSN-VM.B.4. (+) Add and subtract vectors.

HSN-VM.B.4a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.

HSN-VM.B.4b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.

HSN-VM.B.4c. Understand vector subtraction  $v - w$  as  $v + (-w)$ , where  $-w$  is the additive inverse of  $w$ , with the same magnitude as  $w$  and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.

HSN-VM.B.5. (+) Multiply a vector by a scalar.

HSN-VM.B.5a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as  $c(v_x, v_y) = (cv_x, cv_y)$ .

## **HSN-VM.C. Perform operations on matrices and use matrices in applications.**

HSN-VM.C.6. (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.

HSN-VM.C.7. (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.

HSN-VM.C.8. (+) Add, subtract, and multiply matrices of appropriate dimensions.

HSN-VM.C.9. (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.

HSN-VM.C.10. (+) Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.

## **CCSS: HS: Functions**

### **Trigonometric Functions**

#### **HSF-TF.C. Prove and apply trigonometric identities.**

HSF-TF.C.8. Prove the Pythagorean identity  $\sin^2(x) + \cos^2(x) = 1$  and use it to calculate trigonometric ratios.

HSF-TF.C.9. (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

## **CCSS: HS: Geometry**

### **Similarity, Right Triangles, & Trigonometry**

#### **HSG-SRT.C. Define trigonometric ratios and solve problems involving right triangles**

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

HSG-SRT.C.7. Explain and use the relationship between the sine and cosine of complementary angles.

HSG-SRT.C.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

#### **HSG-SRT.D. Apply trigonometry to general triangles**

HSG-SRT.D.10. (+) Prove the Laws of Sines and Cosines and use them to solve problems.

HSG-SRT.D.11. (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

### **Expressing Geometric Properties with Equations**

#### **HSG-GPE.A. Translate between the geometric description and the equation for a conic section**

HSG-GPE.A.2. Derive the equation of a parabola given a focus and directrix.

HSG-GPE.A.3. (+) Derive the equations of ellipses and hyperbolas given two foci for the ellipse, and two directrices of a hyperbola.

## **CCSS: HS: Stats/Probabilities**

### **Using Probability to Make Decisions**

#### **HSS-MD.A. Calculate expected values and use them to solve problems**

HSS-MD.A.1. (+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.

HSS-MD.A.2. (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.

HSS-MD.A.3. (+) Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value.

HSS-MD.A.4. (+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value.

#### **HSS-MD.B. Use probability to evaluate outcomes of decisions**

HSS-MD.B.5a. Find the expected payoff for a game of chance.

HSS-MD.B.5b. Evaluate and compare strategies on the basis of expected values.

### **Mathematical Practice**

#### **MP. The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.**

MP.1. Make sense of problems and persevere in solving them.

MP.2. Reason abstractly and quantitatively.

MP.4. Model with mathematics.

MP.5. Use appropriate tools strategically.

### **PRIMARY TEXTBOOK & OTHER RESOURCES:**

Students are responsible for coming to class prepared with all the required supplies. Laptops or equivalent devices are permitted for some activities based on the Teacher's instructions.

- Textbook – Ron Larson, Paul Battaglia. PreCalculus with Limits: A Graphing Approach 8th ed. 2020.
- Ti-nspireCX Graphing calculator
- Khan Academy



**Ti-nspire CX Calculator I/II (non-CAS)** is a required supply at the Dominican International School-Taipei for the classes:

9-Math (2<sup>nd</sup> semester)

10-Math

11-Math

12-Math

9-Biology

10-Chemistry/Earth Science

11-Physics

AP Calculus AB

AP Calculus BC

AP Biology

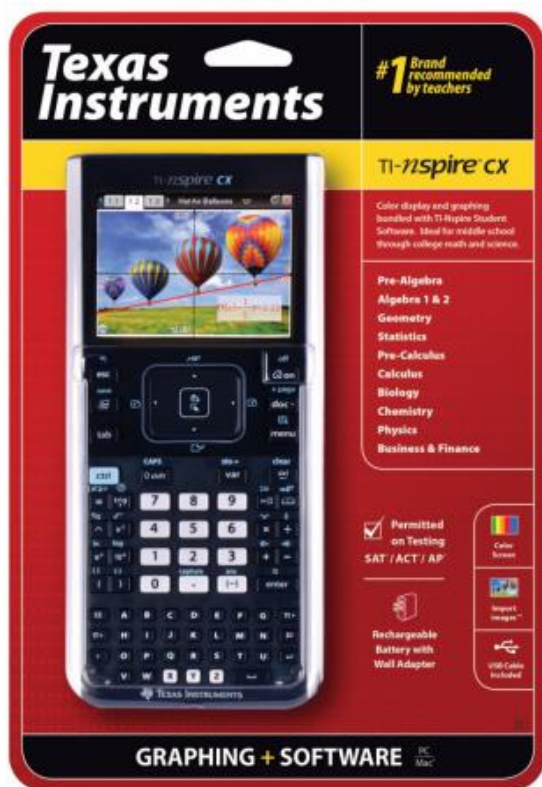
AP Chemistry

AP Physics

AP Statistics

Do **NOT** buy the Ti-nspire CAS model, Ti-84+, Ti-89, Ti-92, or other models!!! Some of the class instructions may be based on understanding how to use the Ti-nspire CX Calculator. Not having the required calculator could affect the student academic understanding (and grades). Not having the required calculator when the Teacher instructs is equivalent to not being prepared for class, which may count off in the Department grade. Tests and Exams may allow only the use of the **Ti-nspire CX** calculator.

Ti-nspire CX (non-CAS model)  
DIS approved



Ti-nspire CAS or  
Ti-nspireCX CAS model are  
NOT DIS approved and  
NOT Permitted on the ACT



## **ASSESSMENT:**

Tests and Quarterly Exams are scheduled and announced in advance. Pop Quizzes are unannounced and can be given at any time during the class so the students must come to class prepared. ALL Tests, Exams and Quizzes may be cumulative so students are responsible for staying prepared for the previous scopes and lessons learned.

Homeworks/Classworks/Seatworks are graded based on the completion and whether it is completed by the due dates. Students are responsible for checking the assignments' due dates posted on Google Classroom. Students are expected to be prepared to turn in any work by the due date class time even if the Teacher did not instruct them to turn in the due date. Any Missing, Incomplete, or Late works are counted with 10% or more penalty with due dates as posted on the Google Classroom. Students MUST submit "Mark as Done" in Google Classroom for each assignment posted. Not submitting "Done" count as Incomplete with 10% penalty. An additional 10% are penalized for each day for late turn-in work.

The student who misses the scheduled Test or Quarterly Exam with legit reason may write a makeup test/exam right after the student returns back to school. The make-up test/exam may be different and more challenging than the originally scheduled test/exam. The student grades are assigned as the following:

1. Tests and Pop Quizzes	30%
2. Homework/Classwork/Seatwork /Projects	30%
3. Quarterly Exam	30%
4. Department	<u>10%</u>
Total Grade	100%

## **ADDITIONAL INFORMATION:**

**Academic Dishonesty** means employing a method or technique or engaging in conduct in an academic endeavor that contravenes the standards of ethical integrity expected at DIS. Academic dishonesty includes but is not limited to, the following:

1. Purposely incorporating the ideas, words of sentences, paragraphs, or parts thereof without appropriate acknowledgment and representing the product as one's own work; and
1. Representing another's intellectual work such as photographs, paintings, drawings, sculpture, or research or the like as one's own, including failure to attribute content to an AI.
2. Employing a tutor, making use of Artificial Intelligence without acknowledgement, getting a parent to write a paper or do an assignment, paying for an essay to be written by someone else and presented as the student's own work.
3. Committing any act that a reasonable person would conclude, when informed of the evidence, to be a dishonest means of obtaining or attempting to obtain credit for academic work.

**Any act of academic dishonesty will result in an automatic zero on the entire assignment**

# 1<sup>st</sup> QUARTER – TENTATIVE COURSE CONTENT

*(NB: Depending on time and interest, the teacher may delete and/or add other selections.)*

Week / Date	Topic / Projects / Assessments
<b>Week 1</b> <b>Aug 12<sup>th</sup> to 16<sup>th</sup></b> <b>4 Days of Class</b> 12~ First Day / Orientation Day 15~ Opening Mass & Assumption of Our Lady 8:00 15~ Induction of Class, Student Council Officers and DYM	1.1 Lines in the Plane 1.2 Functions
<b>Week 2</b> <b>Aug 19<sup>th</sup> to 23<sup>rd</sup></b>	1.3 Graphs of Functions 1.4 Shifting, Reflecting, and Stretching Graphs
<b>Week 3</b> <b>Aug 26<sup>st</sup> to 30<sup>th</sup></b> 26~Fire drill? 26~Middle and High School Catholic Bridge Program (after assembly) 28~St. Dominic de Guzman Feast Day Celebration	1.5 Combinations of Functions 1.6 Inverse Functions 1.7 Linear Models and Scatter Plots
<b>Week 4</b> <b>Sep 2<sup>nd</sup> to 6<sup>th</sup></b> 2~House Ceremony	Chapter 1 Test 2.1 Quadratic Functions 2.2 Polynomial Functions of Higher Degree
<b>Week 5</b> <b>Sep 9<sup>th</sup> to 13<sup>th</sup></b> 9~ Mass & Birthday Mother Mary & VIP Induction	2.3 Real Zeros of Polynomial Functions 2.4 Complex Numbers
<b>Week 6</b> <b>Sep 16<sup>th</sup> to 20<sup>th</sup></b> <b>1 Day of Class</b> 17~Moon Festival 18-20~ Teacher's Conference	2.5 The Fundamental Theorem of Algebra
<b>Week 7</b> <b>Sep 23<sup>rd</sup> to 27<sup>th</sup></b> 24-26~Pre-Exam Days	2.5 The Fundamental Theorem of Algebra (continue) 2.6 Rational Functions and Asymptotes
<b>Week 8</b> <b>Sep 30<sup>th</sup> to Oct 4<sup>th</sup></b>	2.7 Graphs of Rational Functions 2.8 Quadratic Models
<b>Week 9</b> <b>Oct 7<sup>th</sup> to 11<sup>th</sup></b> <b>1 Day of Class</b> 7~Launching - Rosary Month and Bullying Prevention Day 8-9 ~Q1 Exams 10~Double Ten 11~Record Day	<b>Quarter Exam</b>



## 2<sup>nd</sup> QUARTER – TENTATIVE COURSE CONTENT

*(NB: Depending on time and interest, the teacher may delete and/or add other selections.)*

Week / Date	Topic / Projects / Assessments
<b>Week 1 (10)</b> <b>Oct 14<sup>th</sup> to 18<sup>th</sup></b> <i>14~ Second Quarter Begins</i>	4.1 Radian and Degree Measure 4.2 Trigonometric Functions: The Unit Circle
<b>Week 2 (11)</b> <b>Oct 21<sup>st</sup> to 25<sup>th</sup></b> <i>25 – Book Fair</i> <i>25- Masquerade Night</i>	4.3 Right Triangle Trigonometry 4.4 Trigonometric Functions of Any Angle
<b>Week 3 (12)</b> <b>Oct 28<sup>th</sup> to Nov 1<sup>st</sup></b> <i>1-All Saint's Day Mass</i>	4.5 Graphs of Sine and Cosine Functions 4.6 Graphs of Other Trigonometric Functions
<b>Week 4 (13)</b> <b>Nov 4<sup>th</sup> to Nov 8<sup>th</sup></b>	4.7 Inverse Trigonometric Functions 4.8 Applications and Models
<b>Week 5 (14)</b> <b>Nov 11<sup>th</sup> to 15<sup>th</sup></b>	5.1 Using Fundamental Identities 5.2 Verifying Trigonometric Identities
<b>Week 6 (15)</b> <b>Nov 18<sup>th</sup> to 22<sup>nd</sup></b> <i>22-Gr.12 Q2 Exam</i> <i>22 - YSC Contest</i>	5.3 Solving Trigonometric Equations 5.4 Sum and Difference Formulas
<b>Week 7 (16)</b> <b>Nov 25<sup>th</sup> to 29<sup>th</sup></b> <i>25-Gr.12 Q2 Exam</i> <i>26-28~Pre-Exam Day</i>	5.5 Multiple-Angle and Product-to-Sum Formulas Chapter 5 Test
<b>Week 8 (17)</b> <b>Dec 2<sup>nd</sup> to Dec 6<sup>th</sup></b> <b><u>6~Half Day</u></b> <i>Foundation Day Celebrations</i>	6.1 Law of Sines 6.2 Law of Cosines
<b>Week 9 (18)</b> <b>Dec 9<sup>th</sup> to 13<sup>th</sup></b> <b><u>3 Days of Class</u></b> <i>12-13 ~Q2 Exams</i>	<b>Quarter Exam</b>
<b>Dec 16<sup>th</sup> to Jan 3<sup>rd</sup></b>	<b>Christmas Break</b>

## 3<sup>rd</sup> QUARTER – TENTATIVE COURSE CONTENT

*(NB: Depending on time and interest, the teacher may delete and/or add other selections.)*

Week / Date	Topic / Projects / Assessments
<b>Week 1 (19)</b> <b>Jan 6<sup>th</sup> to 10<sup>th</sup></b> <u>4 Days of Class</u> 6~Record Day 7~Third Quarter Begins 10 ~ New Year Mass	6.3 Vector in the Plane 6.4 Vectors and Dot Products
<b>Week 2 (20)</b> <b>Jan 13<sup>th</sup> to 17<sup>th</sup></b>	6.3 – 6.4 Quiz 3.1 Exponential Functions and Their Graphs 3.2 Logarithmic Functions and their Graphs
<b>Week 3 (21)</b> <b>Jan 20<sup>th</sup> to 24<sup>th</sup></b>	3.3 Properties of Logarithms 3.4 Solving Exponential and Logarithmic Equations
<b>Jan 27<sup>th</sup> to Jan 31<sup>st</sup></b>	<b>Chinese New Year</b>
<b>Week 4 (22)</b> <b>Feb 3<sup>rd</sup> to 7<sup>th</sup></b>	3.5 Exponential and Logarithmic Models 3.6 Nonlinear Models Chapter 3 Test
<b>Week 5 (23)</b> <b>Feb 10<sup>th</sup> to 14<sup>th</sup></b> 1-14~Catholic Week	7.1 Solving Systems of Equations 7.2 Systems of Linear Equations in Two Variables
<b>Week 6 (24)</b> <b>Feb 17<sup>th</sup> to 21<sup>st</sup></b>	7.3 Multivariable Linear Systems 7.4 Matrices and Systems of Equations
<b>Week 7 (25)</b> <b>Feb 24<sup>th</sup> to 28<sup>th</sup></b> <u>4 Days of Class</u> 24~Lenten Mass? 25-27 ~ Pre-Exam Days 24-27~IOWA Assessments 28 ~ Memorial Day Holiday	7.5 Operations with Matrices 7.6 The Inverse of Square Matrix
<b>Week 8 (26)</b> <b>March 3<sup>rd</sup> to 7<sup>th</sup></b> 5~ Ash Wednesday	7.7 The Determinant of a Square Matrix 7.8 Applications of Matrices and Determinants
<b>Week 9 (27)</b> <b>March 10<sup>th</sup> to 14<sup>th</sup></b> <u>4 Days of Class</u> 14 – Q3 Exams	Quarter Exam

## 4<sup>th</sup> QUARTER – TENTATIVE COURSE CONTENT

*(NB: Depending on time and interest, the teacher may delete and/or add other selections.)*

Week / Date	Topic / Projects / Assessments
<b>Week 1 (28)</b> <b>March 17<sup>th</sup> to 21<sup>st</sup></b> <u>4 Days of Class</u> 17 – Q3 Exams 18~ Fourth Quarter Begins 18~ Fire Drill? 19~ Feast of St. Joseph	8.1 Sequences and Series 8.2 Arithmetic Sequences and Partial Sums
<b>Week 2 (29)</b> <b>March 24<sup>th</sup> to 28<sup>th</sup></b>	8.3 Geometric Sequences and Series 8.4 The Binomial Theorem
<b>Week 3 (30)</b> <b>March 31<sup>st</sup> to April 4<sup>th</sup></b> <u>4 Days of Class</u> 4~Tomb Sweeping	8.5 Counting Principles 8.6 Probability
<b>Week 4 (31)</b> <b>Apr 7<sup>th</sup> to 11<sup>th</sup></b>	Chapter 8 Test 9.1 Circles and Parabolas
<b>April 14<sup>th</sup> to April 18<sup>th</sup></b>	<b>Easter Break</b>
<b>Week 5 (32)</b> <b>Apr 21<sup>st</sup> to 25<sup>th</sup></b> 23~Easter Mass 21-25 ~ AP Mock Exams 26~Spring Fair	9.2 Ellipses 9.3 Hyperbola and Rotation of Conics
<b>Week 6 (33)</b> <b>Apr 28<sup>th</sup> to May 2<sup>nd</sup></b> 4/29-5/1~ Pre-Exam Days 1-2~ Final Exams (K, 5, 8, 12 only)	9.4 Parametric Equations
<b>Week 7 (34)</b> <b>May 5<sup>th</sup> to 9<sup>th</sup></b> 5-9~ Final Exams (K, 5, 8, 12 only) 5-9 ~ AP Exams	9.5 Polar Coordinates
<b>Week 8 (35)</b> <b>May 12<sup>th</sup> to 16<sup>th</sup></b> <u>4 Days of Class</u> 14-15~ Q4 Exam 16~ Record Day 12-16 ~ AP Exams	Quarter Exam
<b>Week 9 (36)</b> <b>May 19<sup>th</sup> to 23<sup>rd</sup></b>	----- 19-23 ~ Student Clearance 19~ Baccalaureate Mass 23~Gr. 6 – 7 Recognition and Gr. 8 Graduation
<b>Week 10 (37)</b> <b>May 26<sup>th</sup> to 30<sup>th</sup></b> <u>4 Days of Class</u>	----- 26~House Culminating Activity 27~Gr. 9-11 Recognition and Gr. 12 Graduation 28! Class Party 29- ~ Students Last Day 30~ Teachers/Staff Meeting