Students should expect test questions that require synthesis of these objectives.

Unit 1

**QP 1, 2, 3, 4 (1.1)**  Work with the 4 presentations of a function
- Determine whether an presentation is a Function
  - Including Vertical line test
- Evaluate a function at a number, with a variable, with an expression
- Determine domain and range from a graph
- Determine domain from algebraic expression
  - Understand the basic absolute value function – piecewise definition (will come back to in QP 21)
  - Graph a piecewise function with linear pieces (will come back to in QP 21)
  - Know and use the Even and Odd function definitions (will come back to in App D and QP 24)

**QP 22, 23 (1.3)**  Add, subtract, multiply, divide functions
- State domain of each
- Compose two or three functions
  - State domain of composition function
- Evaluate function composition
- Decompose two or three functions

**QP 24 (1.3)**  Graph the basic unshifted graphs listed here, state domain, range, properties: linear, absolute value, x^-2, x^-3, square root, cube root, I/x, I/x^2  (will come back to many of these in detail as we go)
- Shift, reflect, and scale the basic graphs listed above.  (less concentration on scaling than the others)
- Determine if a function is even or odd graphically and algebraically

**QP 5, 6, App B (1.2)**  Know and use the Distance formula
- Know and use formula for slope and two forms of a line.  Work problems related to these.
Know and use properties related to parallel and perpendicular lines. Work problems related to these.

Graph lines of form \( y = mx + b \) \( y = \# \) \( x = \# \)
Work word problems related to lines including interpretations
Solve linear equations

Solve an equation for a certain variable
Graph parabolas: basic, reflected, shifted, scaled, sideways
Write equations given graph
Complete square to find parabola vertex and vertex form
Solve quadratic by factoring and quadratic formula
Know and use terminology: roots, intercepts

Know and use the results of the discriminant
Realize imaginary numbers and imaginary solutions exist but we do not concentrate on them in Calc I
Write equations for and graph circles and semi-circles
Shade region between functions: lines, parabolas, half circles
Add, subtract, multiply polynomials
Graph \( x^n \) for positive integer \( n \)
State domain, range, end behavior

Factor out common terms
Factor expressions resulting from product rule
Factor with difference of squares, difference of cubes, sum of cubes
Factor quadratic like equations with a different powers like \( x^4 - 2x^3 - 3 \)
Factor by grouping
Answer "Is this x-value a root of the polynomial?"
Write polynomial whose roots are . . .
Simplify the polynomial
Find roots by factoring
Factor completely with the assistance of polynomial long division. (Given root or make a guess)
Use of synthetic division is acceptable
Perform polynomial Long Division with more than just \( a \) is a root

Determine domain, roots, and y-intercept for rational function
Simplify fractional expressions involving rational functions
Simplify fractional expressions that have more than 1 variable
Note: be sure to do some problems with simplifying by dividing by monomial in denominator
Graph \( x \) and \( x^n \) for positive integer \( n \)
State domain, range, asymptotes, end behavior
Determine domain of more complicated functions with \( \sqrt[n]{x} \) or \( \sqrt{f(x)} \) including in denominator
<table>
<thead>
<tr>
<th>Section</th>
<th>Topic</th>
<th>Notes</th>
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<tbody>
<tr>
<td>1.2</td>
<td>Once related QP sections are done, classify type of function given algebraic presentation</td>
<td>1.2.001, 1.2.004, 1.2.JIT.008, 1.2.JIT.010</td>
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<td></td>
<td>Note: students will have to read the text in 1.2 about exponentials and logs. We will cover both in much more detail later.</td>
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<tr>
<td>QP 21 (1.3)</td>
<td>Sketch Absolute Value Functions. State domain, range, etc., be able to write as a piecewise function.</td>
<td>QP21.002, QP21.003</td>
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<td>Also sketch shifted absolute value, domain, range, be able to write as piecewise function</td>
<td>1.3.021</td>
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<td>Write a piecewise function for graph with linear and quadratic pieces</td>
<td>QP21.011</td>
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<tr>
<td>App D, QP 18, 19</td>
<td>Convert back and forth between radians and degrees</td>
<td>A.D.002, A.D.003, A.D.008, A.D.009, A.D.012, A.D.017, A.D.019, A.D.020, A.D.021</td>
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<td>locate angles on graph</td>
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<td>Should be able to find all 6 trig functions values at these points</td>
<td>QP18.007, QP18.008, QP18.010, QP18.011, QP18.012, QP20.006, QP20.007</td>
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<td>Evaluate trig at negative, positives, less than 2pi, greater than 2pi</td>
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<td>Know, sketch, and use basic graph of, , , and</td>
<td>Basic information will be used in many places</td>
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<td></td>
<td>Know and use the other three trig graphs</td>
<td>Basic information will be used in many places, instructor supplement</td>
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<td></td>
<td>Determine if a trig function is Even or Odd</td>
<td>A.D.084</td>
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<tr>
<td>Note: there is one problem in WebAssign concerning Law of Cosines for students to research on their own</td>
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</tr>
<tr>
<td>QP 24 w trig (problems in 18, 19)</td>
<td>Transform sine and cosine: shift left/right, vertical shift, change period, change amplitude</td>
<td>1.3.015, 1.3.017, QP19.004, QP19.005, QP19.007, A.D.077, A.D.082, A.D.081</td>
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<td>Answer questions about the above functions and graph by hand</td>
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<tr>
<td></td>
<td>Transform tangent, cotangent, cosecant, secant: shift left/right, vertical shift, change period, change amplitude (when applicable)</td>
<td>QP19.008, QP19.009, A.D.078, A.D.080</td>
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<td></td>
<td>Concentration is on sine and cosine</td>
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</table>
**App D, QP 20**

Given one trig function and a quadrant, find the other five

Know, be able to prove, and be able to use the 3 Pythagorean trig identities.

Use the Addition and Subtraction Formulas (will be given if needed on a test)

Know and use the Double Angle Formulas and the Half Angle Formulas (will NOT be given if needed on test)

"Prove" some trig statements - try not to be too hard, but what instructors think is hard and what students think is hard . . .

Solve equations involving trig - try not to be too hard, but what instructors think is hard and what students think is hard . . .

**1.5, QP 16**

Graph exponentials and natural exponential functions. Know and use properties including stating domain and range and performing function evaluation.

Shift exponential and natural exponential functions and graphs

Work with exponentials and natural exponential algebraically

Solve exponential equations with "the one to one property"

Simplify an expression using Laws of Exponents

**1.6, QP 25**

Determine if a function is one to one (graphically with help of horizontal line test)

Know and use definitions and properties of inverse functions

Know properties of and determine Domain and Range of inverse functions

Perform evaluations with inverse functions: from table, algebraically

Find inverse graphically and algebraically

State a restricted domain where function is 1-1

**1.6, QP 17**

Understand and use logarithms as inverses of exponentials

Graph logarithmic and natural logarithmic functions. Know and use properties including stating domain and range and performing function evaluation.

Shift logarithmix and natural logarithmic functions and graphs

Work with logs and natural log properties algebraically

Solve equations involving logs

Evaluate Inverse trig expressions

Sketch a trigonometric function and its inverse.

**2.1**

Find the average rate of change of a function over a given interval, and use it to estimate the slope of the tangent line.

Using technology, calculate the average velocity of shorter and shorter time intervals in order to estimate the instantaneous

**2.2**

Explain what a limit means in ordinary language.

Given a graph of a function, find limits, or explain why a limit does not exist.
Using technology, calculate the value of a function closer and closer
to a given input value in order to estimate the limit.

Given select function values and limit statements about a function,
sketch a graph with the given properties.

Recognize and evaluate an infinite limit.

Sketch a piecewise function and determine limits.

QP 15

Rationalizing expressions with conjugation

Know and use properties of fractional and negative exponents.

Simplify expressions with fractional and negative exponents.

2.3

Find the limit of a function using the algebraic techniques and Limit Laws.

Find the limit of a function using the Squeeze Theorem.

Apply theorems of limits to find unknown limits.

2.4

Given \( \varepsilon \) and the limit value, use a graph to find a specific \( \delta \) that satisfies the \( \varepsilon - \delta \) definition of a limit.

Apply the \( \varepsilon - \delta \) definition of a limit to a real world problem.

Prove a limit using the \( \varepsilon - \delta \) definition.

Find a value for \( \delta \) in an infinite limit problem.

2.5

Given a graph, determine the points at which the function has discontinuities.

Given a function, determine the points at which the function has discontinuities.

Determine if a function is continuous at a point by definition.

Find the points (intervals) at which a function is continuous. Justify with continuity theorems.

Use the Intermediate Value Theorem to show that an equation has at least one solution or a given number of solutions.

Determine the value of a constant so that a function is continuous at a point or on an interval.

Verify or classify discontinuities.

Sketch a function that satisfies given criteria.

Relate continuity to a real world problem.

Apply theorems of limits and continuity to find unknown function values.
Unit 3

2.6  
Find a limit at infinity for a given function.  
Find limits at infinity using a given graph.  
Find all vertical and horizontal asymptotes of a function.  
Given select function values and limit statements about a function, sketch a graph with the given properties.  
Apply the Squeeze Theorem to a limit at infinity problem.  

2.7  
Find the value of the derivative of a function at a given value of \( x \) using one of the limit definitions.  
Find the equation for a tangent line to a curve at a given point.  
Use the derivative definition to find instantaneous velocity.  
Given a graph of a function, approximate the derivative at various points.  
Determine slopes and function values using a give tangent line.  
Sketch a function that satisfies given conditions on \( f \) and \( f' \).  
Recognize a given limit as a derivative.  
Determine average rates of change and instantaneous rates of change for a given real-world function.  

2.8  
Find the derivative function using the limit definition.  
Given a graph of a function, sketch a graph of its derivative.  
Interpret the derivative if the function models real-world phenomena.  
Match the graph of a function with the graph of its derivative.  
Given a graph, find the values where a function is not differentiable.  
Given a graph, analyze the slope of the curve at given points.  
Given three graphs, determine which one is position, which one is velocity, and which one is acceleration.  

3.1  
Find the derivative of a function using the differentiation rules.  
Find the second derivative of a function.  
Find the equation for a tangent or normal line to a curve.  
Find equations for the tangents to a curve having specified slope.  
Find velocity and acceleration functions for a given position function.  
Given certain conditions, determine parameters for a quadratic function.  

3.2  
Find the derivative of a function using the differentiation rules.  
Find the tangent or normal lines to a curve at a given point.  
Find higher-order derivatives of a function.  
Given values for functions and their derivatives at a point, find the value of a derivative at that given point for a new function.  
Given values for functions and their derivatives at a point, find the tangent line at that given point for a new function.  

3.3  
Evaluate a limit involving \( \frac{\sin x}{x} \) or \( \frac{\cos x - 1}{x} \).  
Differentiate a function involving trigonometric functions.  
Find the tangents to a curve at a given point. Graph the curve and the tangent line on the same set of axes.  
Determine if and where a graph has a tangent line of given slope.  
Use derivatives to answer questions involving the position, velocity, and acceleration of an object.  

3.4  
Use the Chain Rule to differentiate a composite function.  

WebAssign problems  
Stewart book problems  

15, 17, 19, 23, 31, 33, 35  
3  
43  
7  
9  
61  
QP3.9.009, QP3.9.010  
3  
5  
13  
17  
19  
21  
33, 35, 37  
45, 51  
21, 23, 27  
5, 9, 11, 13, 15  
3  
37, 39  
1  
45  
3, 5, 7, 9, 11, 13, 15, 19, 23, 29, 31  
17, 21, 25  
43  
35  
51  
47  
71  
9, 11, 13, 15, 21  
31, 33  
3, 5, 7, 17, 19, 23, 51  
43, 45  
47  
39, 41  
1-11 odd, 15, 29, 49  
21  
13  
23  
33  
35  
1, 5, 7, 13, 15, 17, 21, 23, 27-39  
add, 47, 61, 63, 71  
3, 9, 11, 19, 25
<table>
<thead>
<tr>
<th>Topic</th>
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<tbody>
<tr>
<td>Find the tangents to a curve at a given point.</td>
<td>51, 53</td>
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<tr>
<td>Determine where a graph has a given slope.</td>
<td>59</td>
</tr>
<tr>
<td>Use a graph to evaluate the derivative of a composite function.</td>
<td>67</td>
</tr>
<tr>
<td>Use implicit differentiation to find dy/dx</td>
<td>1, 5-21 odd</td>
</tr>
<tr>
<td>Use implicit differentiation to find the second derivative.</td>
<td>35</td>
</tr>
<tr>
<td>Find the lines that are tangent and/or normal to a curve at a given</td>
<td>25, 27</td>
</tr>
<tr>
<td>point.</td>
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<tr>
<td>Find where a curve has a given slope.</td>
<td>75</td>
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**Unit 4**

<table>
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<td>Stewart book problems</td>
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</tr>
<tr>
<td>3.5a Use implicit differentiation to find dy/dx</td>
<td>1, 5-21 odd</td>
</tr>
<tr>
<td>Use implicit differentiation to find the second derivative.</td>
<td>35</td>
</tr>
<tr>
<td>Find the lines that are tangent and/or normal to a curve at a given</td>
<td>25, 27</td>
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<tr>
<td>point.</td>
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</tr>
<tr>
<td>Find where a curve has a given slope.</td>
<td>75</td>
</tr>
<tr>
<td>3.5b Find derivatives involving inverse trig functions</td>
<td>49-55 odd</td>
</tr>
<tr>
<td>3.6 Find the tangent to a logarithmic function at a given point.</td>
<td>33</td>
</tr>
<tr>
<td>Find the derivative of a logarithmic function or functions involving</td>
<td>3, 7-23 odd, 27, 29</td>
</tr>
<tr>
<td>logarithms.</td>
<td>5</td>
</tr>
<tr>
<td>Use logarithmic differentiation to find the derivative.</td>
<td>39, 43, 45</td>
</tr>
<tr>
<td>WebAssign problems</td>
<td></td>
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<tr>
<td>Stewart book problems</td>
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