

## Finding Calculus Success: Pre-calculus Skills Checklist

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Students entering Calculus need a strong mathematics foundation to have the best opportunity for success in Calculus. Below are the skills, content and understandings, along with sample problems, that students should demonstrate from pre-calculus to prepare them for the rigor and challenge of the Dual Enrollment Calculus.

**Multiple Representations**—Calculus will require students to demonstrate understanding of concepts across multiple representations. Students will see problems in the following representations:

- A. Numerical (through tables)
- B. Graphical (analyzing graphs without equations)
- C. Analytical (algebraic manipulation)
- D. Conceptual (understanding and solving problems at an abstract level)

Additionally, students will need to clearly communicate mathematical thinking and reasoning using precise language with mathematical theorems, definitions and justifications.

These practices should be modeled and utilized in the pre-calculus courses in order to ensure students mastery of material and true understanding of the foundational concepts leading up to Calculus. Following are specific content requirements and example questions the model the multiple representation approach above.

### 1. Write equations of linear functions

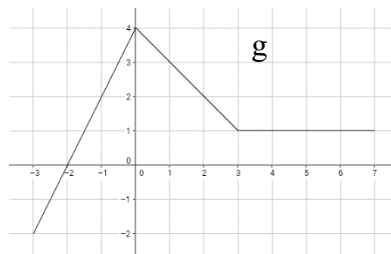
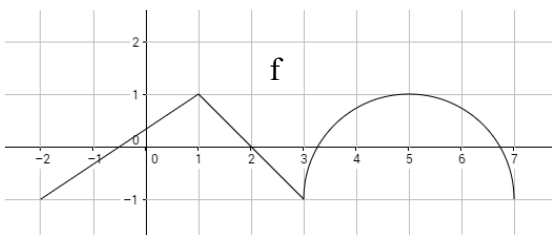
Example: Write a linear function  $y = f(x)$  in point-slope form with  $f(2) = 4$  and slope of  $-3$ .

### 2. Evaluate functions

Example: Given  $g(x) = x^2 - 3x + 1$ , find  $g(-1)$ ,  $g(2x-1)$  and  $g(x+h)$

### 3. Use composite functions

Example: Given the graphs of  $f$  and  $g$  below, find  $f(g(-1))$

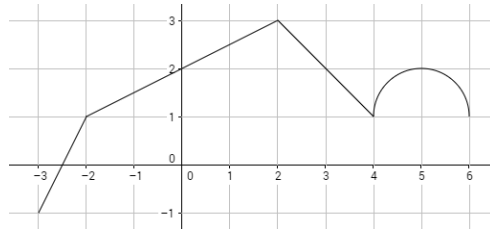


### 4. Evaluate piece-wise functions

Example: Given  $h(x) = \begin{cases} x^2 - 4 & x < -1 \\ 3 - \cos(x) & x \geq -1 \end{cases}$ , find  $h(0)$ .

## 5. Interpret and Analyze graphs

Examples: The graph of  $g(x)$  is below. Solve  $g(x) = 2$ .



## 6. Sketch family of functions (trig, exponentials, polynomials, absolute values, log, rational)

Example: Sketch the parent graphs for  $f(x) = e^x$ ,  $f(x) = \sin x$ ,  $f(x) = \ln(x)$

## 7. Graph transformations

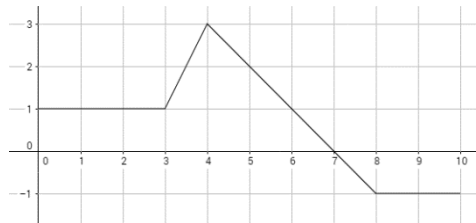
Example: Given  $y = f(x)$ , describe the graph of  $g(x) = f(2x)$  and  $h(x) = f(x) - 1$

## 8. Manipulate formulas

Example: Solve for  $b_1$  given  $A = \frac{1}{2}h(b_1 + b_2)$

## 9. Interpret graphs related to motion (position, velocity, acceleration)

Example: A bug's velocity is given in the graph below. At what time,  $t$ , did the bug turn around?



## 10. Find average Rate of Change

Example: Find the average rate of change of the function  $f(x) = x^3 - x^2 + x - 2$  on the interval  $[-1, 4]$ .

## 11. Utilize properties of lines

Example: Solve for "B" given that the lines below are parallel

$$y = 2x - 3, \quad 4x + By = 4$$

**12. Perform long division/synthetic division**

Example: Use long division to rewrite  $\frac{x^3 - 3x + 1}{2x + 3}$  without an improper fraction.

**13. Factor (basic trinomials, greatest common factors, common grouping)**

Example: Factor  $-6(x - 2)^3(x + 3)^4 + 15(x - 2)^5(x + 3)^2$

**14. Apply the unit circle**

Example: Evaluate  $\tan\left(\frac{5\pi}{6}\right)$

**15. Find inverse functions**

Example: Given  $f(x) = \frac{2x - 3}{3x + 1}$ , find  $f^{-1}(x)$

**16. Solve equations without a calculator**

Example: Solve for x:  $2x^2 - 5x = x^2 - 3x + 7$

**17. Use a graphing calculator to solve equations**

Example: Use a graphing calculator to solve the equation  $\sin(x^2) - e^x = 3.5$ .

**18. Use a graphing calculator to graph a function, find an appropriate window, find relative extrema, find points of intersection between two functions, find zeroes, evaluate a function at a given value.**

Example: Find the minimum value for  $f(x) = x^4 + 3x^3 - 1.3x - 7.8$

These specific skills, knowledge and understandings along with a rigorous pre-calculus course with opportunities for student discourse, higher level thinking and conceptual learning will best prepare students for the challenge and opportunity of a Dual enrollment Calculus course.

We have prepared some optional review materials for you to revisit Algebra and Precalculus topics as needed. Here is an excellent resource to review topics if needed. Units 1 – 11 are foundational topics for success in Calculus. Visit the [FlippedMath](https://precalculus.flippedmath.com/precalc-traditional.html) website to review. <https://precalculus.flippedmath.com/precalc-traditional.html>