Directions:

- Do only the problems that you need to take and feel ready to take. If you have already earned Mastery on a Learning Target, do not attempt a problem for that Target! You can skip a Target if you need more time to practice with it, and take it on the next round.
- Each Learning Target problem is to be written up on a separate sheet, scanned to separate PDF files, and submitted to the appropriate Learning Target "assignment" on Blackboard. **Please do not submit more than one Learning Target in the same PDF, and make sure you are submitting it to the right Blackboard area.**
- If you are handwriting, submit your work by **scanning your work** using a scanning app or scanning device; **do not just take a picture** but scan your work to a clear, legible, black and white PDF file of size less than 100 MB. **Work submitted as an image file (JPG, PNG, etc.) will not be graded.**
- Please consult the grading criteria found in the Information on Learning Targets and Checkpoints document found in the *Learning Targets* area on Blackboard prior to submitting your work, to make sure your submission has met all the requirements.
- Please use the approved resources to double-check your work against errors prior to submitting your work.

Learning Target 3: *I can find the derivative of a function (both at a point and as a function) and the instantaneous velocity of an object using the definition of the derivative.*

Consider the function $f(x) = 4x^2 - 3x - 10$.

1. Write out the correct limit expression that would compute $f'(2)$.
2. Find the exact value of $f'(2)$ by computing the limit from part (a), using algebraic techniques.

Note: Your solution *must* begin with a correct statement of the limit. Your solution *can only* be found by evaluating the limit; no "shortcut" methods from later parts of this course are allowed (except in your notes to check your answer). *All significant algebra steps* must be shown and done correctly.

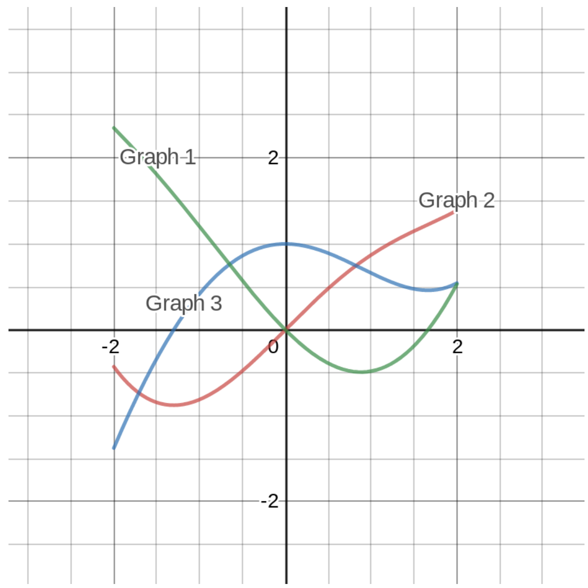
Learning Target 4 (Core): *I can use derivative notation correctly, state the units of a derivative, estimate the value of a derivative using difference quotients, and correctly interpret the meaning of a derivative in context.*

David is washing dishes, and the time it takes him to complete the task (t, measured in minutes) is a function of the amount of water (w, in gallons) he uses in the sink. Denote this relationship $t = f(w)$.

1. Suppose $f'(5) = 8$. State the units of measurement for the numbers 5 and 8. (Clearly indicate which is which.)
2. Still assuming $f'(5) = 8$, explain the meaning of this statement in ordinary terms (that is, in terms of time and water) and without using any technical math jargon.
3. Suppose $f(1) = 3$, $f(4) = 4$, and $f(6) = 5$. Use forward, backward, and central differences to estimate $f'(4)$. Clearly indicate which estimate is which.

Learning Target 5: *Given information about f, f', or f'', I can correctly give information about f, f', or f'' and the increasing/decreasing behavior and concavity of f (and vice versa).*

Below are three graphs on the interval $[-2, 2]$: One of them is a function f, another is its first derivative f', and the the third is its second derivative f''. They are labelled Graph 1, Graph 2, and Graph 3, but not necessarily in the correct order of derivatives. State which graph is which function and provide a brief but complete, corret, and clear explanation.



Important note: *Your explanations must refer to all functions explicitly by name.* Do not refer to "it", "the graph", "the function", "the line", etc. without also making it explicit which function you are referring to. Otherwise your work will not meet the grading standards since it won't be possible to tell which graph you are referring to.

Learning Target 6 (Core): *I can compute basic-level derivatives using algebraic shortcut methods and solve simple application problems. (Functions involved will include constant, power, polynomial, exponential, and sine/cosine functions; applications include rates of change and slopes/equations of tangent lines).*

In each of the items below, use only the derivative computation rules found in Sections 2.1 and 2.2 of the text. **Do not use the limit definition or any rules not found in Sections 2.1 and 2.2**. Use of these will result in the work being marked as not having met the grading standards. **If algebra is needed to simplify the function before taking its derivative, show all your algebra work.**

1. Compute the derivatives of the following functions.
   (a) $y = 3^x + x^3 + 3 + 3x$
   (b) $g(x) = 3\cos(x) - 2\sin(x)$
   (c) $h(x) = (x+2)^3$ (Remember, use only the rules from Sections 2.1 and 2.2. The Product, Quotient, and Chain Rules are off limits.)
2. Find an equation for the tangent line to the graph of $y = 3x - 3x^3$ at $x = 1$. Show all your work on this part.
3. The height (h, in meters) of a projectile that is fired straight up at time t seconds is $h(t) = 64x - 64x^2$. Find the instantaneous velocity of the ball at $t = 0.5$ seconds. Show all your work on this part.

Learning Target 7 (Core) : *I can compute derivatives involving the Product, Quotient, and Chain Rules.*

Find the derivatives of each of the following. **In each, state the rules you are using, in the correct order of use. You need only list when you use the Product, Quotient, or Chain Rules. In the case of the Chain Rule, clearly indicate the decomposition of the function by stating the "inner" and "outer" functions first. Correct answers given without this information will not meet the criteria for acceptability**. Show your work in a clear and logical order and circle/box off your answer. DO NOT simplify your answers.

1. $y = \dfrac{e^x}{\sqrt{x}+1}$

2. $y = \sqrt{x}\sin(x)$
3. $y = e^{3x}$
4. $y = \sin(x^3 + x + 1)$

Learning Target 8: *I can compute advanced-level derivatives using algebraic shortcut methods.*

Find the derivatives of each of the following. **In each, state the rules you are using, in the correct order of use. You need only list when you use the Product, Quotient, or Chain Rules. In the case of the Chain Rule, clearly indicate the decomposition of the function by stating the "inner" and "outer" functions first. Correct answers given without this information will not meet the criteria for acceptability.** Show your work in a clear and logical order and circle/box off your answer. DO NOT simplify your answers.

1. $y = \sin(x\sin(x))$
2. $y = \ln(\cos(x))$
3. $y = (\arcsin(x))^2$

Learning Target 9: *I can find the critical values of a function, determine where the function is increasing and decreasing, and apply the First and Second Derivative Tests to classify the critical points as local extrema.*

Consider the function $g(w) = 2w^3 - 7w^2 - 3w - 2$

1. Find all the critical values of the function. Make your reasoning clear by giving all calculus and algebra steps clearly and neatly.
2. Make a first derivative sign chart for the function and use it to determine the intervals on which the function is increasing and decreasing. Your sign chart must be legible and formatted using the rules we discussed in class, and you must state which points you are using as test points.
3. Classify each critical value as a local maximum, local minimum, or neither and explain your reasoning.

Acceptable work requires showing ALL Calculus steps used to arrive at your answer; however, you may use technology to perform any non-calculus task, like finding output values of functions, without showing the steps.

Learning Target 10: *I can determine the intervals of concavity of a function and find all of its points of inflection.*

Consider the function $g(w) = 2w^3 - 7w^2 - 3w - 2$. Use calculus (not visual estimation from a graph) to find the intervals on which g is concave up and the intervals on which g is concave down, and state its inflection points.

If you construct a sign chart, make sure the chart has all the required properties that we have discussed. **Acceptable work requires showing ALL Calculus steps used** to arrive at your answer; however, you may use technology to perform any non-calculus task, like finding output values of functions, without showing the steps.

This is the same function used in Learning Target 9. If you attempted that problem and showed work there, you do not need to do that work again here.

Learning Target 11: *I can use the Extreme Value Theorem to find the absolute maximum and minimum values of a continuous function on a closed interval.*

For each of the following, use Calculus (not visual estimation from a graph) to determine the absolute extreme values of the given function on the specified interval. You may assume that each function is continuous on the interval. **Acceptable work requires showing ALL Calculus steps used** to arrive at your answer; however, you may use technology to perform any non-calculus task, like finding output values of functions, without showing the steps.

1. $g(w) = 2w^3 - 7w^2 - 3w - 2$ on $[-5, 3]$
2. $R(x) = \ln(x^2 + 1)$ on $[-4, 2]$

The first function above is the same function used in Learning Targets 9 and 10. If you attempted that problem and showed work there, you do not need to do that work again here.