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 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. $y = e^x \sin(x)$
2. $y = \dfrac{\sin(x) - \cos(x)}{\sqrt{x}}$
3. $y = e^{\sqrt{x}}$

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. $y = \sec(5x - 3)$
2. $y = \ln(\tan(x))$
3. $y = (\arcsin(x) + x)^3$

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 $f(x) = 3x^4 - 16x^3 + 24x^2$.

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. Using either the First or Second Derivative Test (your choice), 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 $f(x) = 3x^4 - 16x^3 + 24x^2$. Use calculus (not visual estimation from a graph) to find the intervals on which f is concave up and the intervals on which f 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. $f(x) = 3x^4 - 16x^3 + 24x^2$ on $[-1, 1]$
2. $g(x) = \dfrac{x^2}{1+x}$ on $[-1/2, 1]$

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.

Learning Target 12 (Core): *I can set up and use derivatives to solve applied optimization problems.*

Set up and solve the optimization problem found below the bullet list. **In order for your work to meet quality standards, it needs to contain ALL of the following. Check carefully before turning in your work to make sure you've included each one.** A lengthy solution is not necessary, but the written solution for Exercise 3 that was posted earlier would be a good guide for you.

- A clear indication of what each variable in the solution represents;
- A clear statement of what quantity you are optimizing;

- A formula for the quantity you are optimizing and a clear indication of how you obtained it;
- If you use a constraint in the problem, a clear statement of what that constraint is and how you used it;
- The use of a derivative to find the input that optimizes your quantity;
- Reasoning that explains why your solution is correct — *don't just find a value but explain how you know that value optimizes the target quantity.*

Problem for this Learning Target: A rancher wants to fence in an area of 3,000,000 square feet in a rectangular field and then divide it in half with a fence down the middle, parallel to one side. What is the shortest length of fence that the rancher can use?

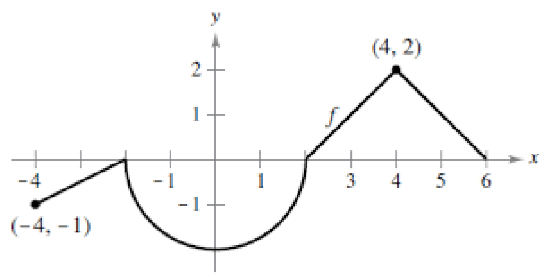
Learning Target 13: *I can calculate the area under a curve, net change, and displacement using geometric formulas and Riemann sums.*

Consider the function $f(x) = \dfrac{1}{x^2+1}$. Estimate the area under the curve, above the x-axis, and between $x = 0$ and $x = 2$, using the following Riemann sums. **On each one**: Clearly state the value of Δx, clearly state which points you are using to construct the rectangles, and show the setup of your calculation. **Keep all approximations to four (4) decimal places**.

1. M_4
2. L_3

Learning Target 14: *I can evaluate a definite integral using geometric formulas and the Properties of the Definite Integral.*

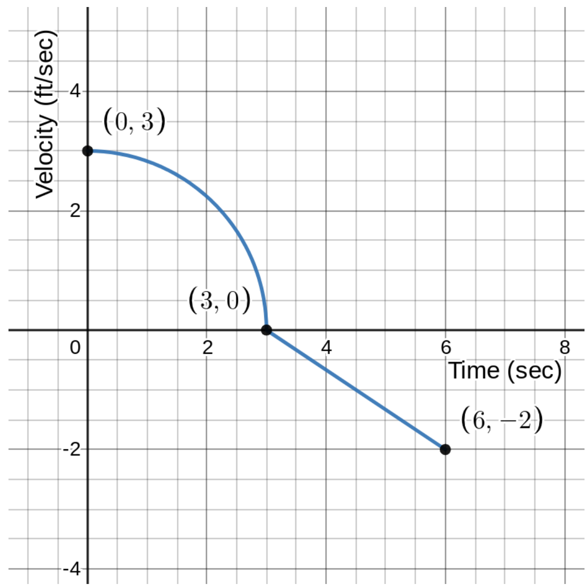
The graph of $f(x)$ is shown below. It is made up of line segments and parts of circles. **Using only the graph**, evaluate the **exact** value — no decimal approximations — of each of the integrals shown below. **Note: Antidifferentiation is not allowed in solutions to this problem**, **nor are decimal approximations**. Also, **show all your work** — answers with insufficient work or no work will not meet the grading criteria.



1. $\displaystyle\int_0^2 f(x)\,dx$
2. $\displaystyle\int_{-4}^0 f(x)\,dx$
3. $\displaystyle\int_{-4}^6 f(x)\,dx$

Learning Target 15: *I can explain the meaning of each part of the definition of the definite integral in terms of a graph, and interpret the definite integral in terms of areas, net change, and displacement.*

A dog is running in a straight line, and its velocity $v(t)$ in feet per second at time t seconds is shown by the graph below. The velocity graph is composed of a piece of a circle and a line segment, and three points on the graph are marked.



If the dog started off 30 feet from the front door and we interpret positive velocity as "away from the door" and negative velocity as "back toward the door", how far away is the dog from the front door after 5 seconds? (Again, we are assuming the dog only moves in a straight line.) State your answer clearly, explain your reasoning, and put correct units on the answer.

Learning Target 16 (Core): *I can find antiderivatives of a function and evaluate a definite integral using the Fundamental Theorem of Calculus.*

Find the exact value of each of the following definite integrals by using the Fundamental Theorem of Calculus (not geometry or Riemann sums).

A correct solution must do the following:

1. Clearly state the antiderivative of the integrand;
2. Show the "Fundamental Theorem step" explained in class and on the discussion board; and
3. Give an **exact value** of the answer with *no decimal approximations* that is **fully simplified**; *and*
4. Give a decimal form of the exact answer that agrees with the exact form to four decimal places.

Two sample solutions of this form are found on Campuswire in a post from April 12. If any of the solutions are missing any of these four items, the work will be considered to not meet the grading standard.

1. $\displaystyle\int_0^1 \left(-3x^4 + 4x^3 - x^2 + 5\right)\, dx$
2. $\displaystyle\int_1^4 \left(\frac{1}{x^2} + \frac{1}{\sqrt{x}}\right) dx$
3. $\displaystyle\int_0^{\pi/4} (x - \sin(x))\, dx$