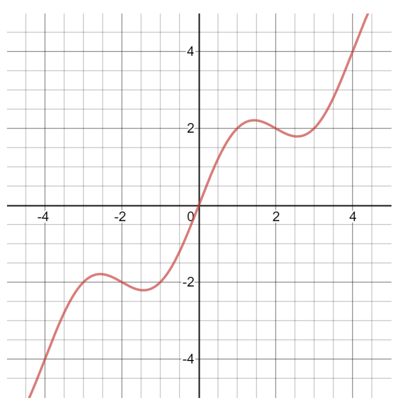
Directions:

- 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 1: *I can find the average rate of change of a function and the average velocity of an object on an interval.*

1. Let $f(x) = 1 - 2^x$. Find the average rate of change in f on the intervals $[1, 3]$ and $[1, 1.01]$. If you round, round your decimals to four places.
2. Let $g(x)$ be the graph shown below. Find the average rate of change in g on the intervals $[-2, 0]$ and $[1, 4]$.



3. A car is moving down a straight racetrack, and its distance s (in feet) from an observation booth on the track at time t seconds is given by the following table:

Time	0	15	30	45	60
Distance	10	90	200	450	550

Find the student's average velocity from $t = 15$ to $t = 30$ and from $t = 30$ to $t = 60$.

Learning Target 2 (Core): *I can find one- and two-sided limits of a function at a point and at infinity using numerical, graphical, and algebraic methods.*

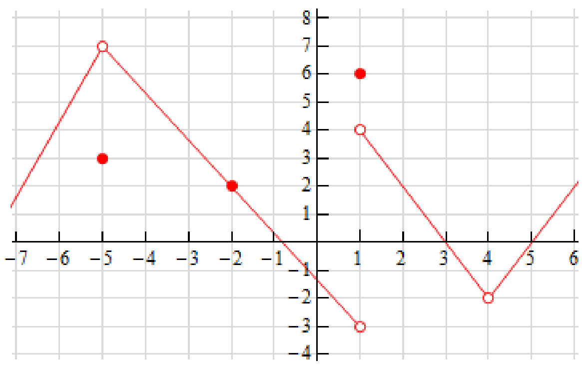
1. Complete the table of values below using the function $f(x) = \dfrac{2^x - 4}{x - 2}$. Then state the value of $\lim_{x \to 2} f(x)$ and explain your reasoning. You do not need to show your work on computing the table values, but they must all be correct.

x	-2.5	-2.1	-2.01	2.01	2.1	2.5
$f(x)$						

2. Using only algebra (no graphs, tables, or estimates), evaluate

$$\lim_{z \to 8} \frac{2z^2 - 17z + 8}{8 - z}$$

3. The function $h(x)$ is shown below. State the value of each limit shown below the graph. If the limit doesn't exist, write "does not exist" and then explain why.



(a) $\lim_{x \to -5} h(x)$

(b) $\lim_{x \to 1^+} h(x)$

(c) $\lim_{x \to 1} h(x)$

(d) $\lim_{x \to 4} h(x)$

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 $f(x) = 3x^2 - 2x - 7$.

1. Write out the correct limit expression that would compute $f'(1)$.
2. Find the exact value of $f'(1)$ 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.*

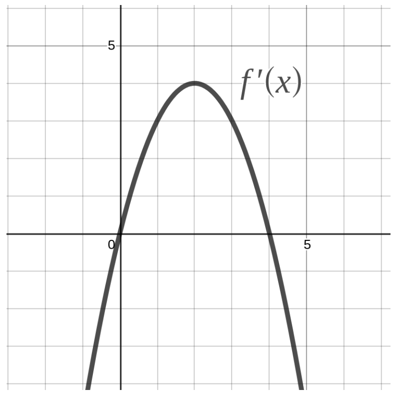
Bob is running on the treadmill, and his heart rate (R, in beats per minute) is a function of his speed (v, in miles per hour). Denote this relationship $R = f(v)$.

1. Suppose $f'(5) = 10$. State the units of measurement for the numbers 5 and 10. (Clearly indicate which is which.)
2. Still assuming $f'(5) = 10$, explain the meaning of this statement in ordinary terms (that is, in terms of heart rate and speed) and without using any technical math jargon.

3. Suppose $f(2) = 8$, $f(3) = 12$, and $f(4) = 15$. Use forward, backward, and central differences to estimate $f'(3)$. 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).*

Here is the graph of the *derivative f'* of a function f. *To repeat*: This is **not** the graph of f, it is the graph of f'.



1. On what interval or intervals is the original function f increasing? State your answer and give a clear, single sentence explaining your reasoning using the graph of f'.
2. On what interval or intervals is the original function f concave up? State your answer and give a clear, single sentence explaining your reasoning using the graph of f'.

Important note: *Your explanations must refer to all functions explicitly by name.* Refer to f, f', or f''; or "the original", or "the first derivative", "the second derivative". Do not refer to "it", "the graph", "the function", "the line", etc. without also making it explicit which function 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) $y = \sin(4) + \sin(x) + 4^x + x^4 + 4x$
   (b) $g(x) = 2\cos(x) + 12\sin(x)$
   (c) $h(x) = \dfrac{x^2 + x}{x}$ (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 $y = 4x - x^2$ 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 $t = 2$ 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. $y = x^5 e^x$
2. $y = \dfrac{\sin(x)}{\cos(x) + 1}$
3. $y = e^{x^2+x+1}$
4. $y = \sqrt[3]{1 - 8x}$

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. $y = \cos(e^{5x})$
2. $y = \arctan(\sqrt{x})$
3. $y = \dfrac{x^2}{\ln(x)}$