7. [6 points] Consider the function \( W(t) = 3 \ln(\sin(t)^2 + 2) \). Write down the limit definition of \( W'(\pi) \). (You do not need to estimate or compute the derivative.)

Solution: Using the limit definition, we have
\[
W'(\pi) = \lim_{h \to 0} \frac{3\ln(\sin(\pi + h)^2 + 2) - 3\ln(\pi^2 + 2)}{h}.
\]

8. [9 points] The three graphs labeled A, B, and C below depict a function \( g \) along with its first and second derivatives \( g' \) and \( g'' \). Determine which is which.

Your answer to parts (a)–(c) should be a single legible capital letter (A, B, or C).

a. [2 points] The graph of \( g \) is labeled _______.

Solution: A

b. [2 points] The graph of \( g' \) is labeled _______.

Solution: C

c. [2 points] The graph of \( g'' \) is labeled _______.

Solution: B

d. [3 points] Briefly explain your reasoning.

Solution: Graph A cannot be the derivative of either B or C, because Graph A is positive for \( x < 0 \) and both Graphs B and C have intervals where the function is decreasing for \( x < 0 \). Thus, Graph A must be \( g \). Graph C is positive where Graph A is increasing, negative where Graph A is decreasing and is crossing the \( x \)-axis at the peak and low point of Graph A. Note, also, Graph C cannot be the graph of the derivative of B, because, for example, C is negative to the left of \( x = 0 \) where Graph B is increasing. Graph B, however, can be the graph of the derivative of C—once again, by checking the sign of B when Graph C is increasing or decreasing, and looking for zeros of B when graph C has a peak or a valley. Thus, Graph A is \( g \), Graph C is \( g' \), and Graph B is \( g'' \).