Show all your work on the exam paper, legibly and in detail, to receive full credit. The use of a calculator or any other electronic device is prohibited. You may only use techniques discussed to date in class.

1. Given the function \( f(x) = \sqrt{x} \):

   a. (6 points) Find the average rate of change of \( f \) with respect to \( x \) over the interval \([1, 4]\).

   b. (6 points) Find the instantaneous rate of change of \( f \) with respect to \( x \) at \( x = 4 \).

   c. (6 points) Find an equation for the tangent line to the curve \( f(x) = \sqrt{x} \) at \( x = 4 \).
2a. (8 points) Use the fundamental definition of the derivative to find the derivative of \( f(x) = 4x^2 + x \).

2b (8 points) Find all values of \( x \) in \([0, 2\pi]\) at which the tangent line to \( f(x) = 2\sin x - x \) is horizontal.
3 Find $\frac{dy}{dx}$. Note: you do not have to simplify your answers.

a. (7 points) $y = -\frac{1}{3}(x^7 + 2x - 9)$

b. (7 points) $y = x^{-3} + \frac{1}{x^7}$

c. (8 points) $y = \sin x \cos x$

d. (8 points) $y = \frac{\sec x}{1 + \tan x}$
4 Find \( f'(\pi) \) given that \( h(\pi) = 10, \ h'(\pi) = -1, \ g(\pi) = -3, \) and \( g'(\pi) = 2 \)

a. (7 points) \( f(x) = x(h(x) + g(x)) \)

b. (7 points) \( f(x) = \frac{h(x)}{4 + g(x)} \)
5. Find $\frac{d^2 y}{dx^2}$. Note: you do not have to simplify your answers.

a. (7 points) $y = x^5 - 5x^3 + 2x$

b. (8 points) $y = x \cos x$
6. (7 points) The graph of $f(x) = |x|$ is given below.

On the axes below, give a graph of $f'(x)$. 