1 Question No.2 - Easy (2 points)

Version 1
The slope $m_{\text{tan}}$ of the tangent line to the curve $y = g(x)$ at the point $R(x_0, g(x_0))$ is given by

$$m_{\text{tan}} = \lim_{x \to x_0} = \lim_{h \to 0}$$

Fill in the two blanks. You must clearly and coherently write your final answer with the appropriate limit in front of your final answer. Circle your final answers.

Version 2
The slope $m_{\text{tan}}$ of the tangent line to the curve $y = k(x)$ at the point $Q(x_0, k(x_0))$ is given by

$$m_{\text{tan}} = \lim_{x \to x_0} = \lim_{h \to 0}$$

Fill in the two blanks. You must clearly and coherently write your final answer with the appropriate limit in front of your final answer. Circle your final answers.

Version 3
The slope $m_{\text{tan}}$ of the tangent line to the curve $y = n(x)$ at the point $U(x_0, n(x_0))$ is given by

$$m_{\text{tan}} = \lim_{x \to x_0} = \lim_{h \to 0}$$

Fill in the two blanks. You must clearly and coherently write your final answer with the appropriate limit in front of your final answer. Circle your final answers.

Version 4
The slope $m_{\text{tan}}$ of the tangent line to the curve $y = s(x)$ at the point $T(x_0, s(x_0))$ is given by

$$m_{\text{tan}} = \lim_{x \to x_0} = \lim_{h \to 0}$$
Fill in the two blanks. You must clearly and coherently write your final answer with the appropriate limit in front of your final answer. Circle your final answers.

2 Question No.3 - Medium (3 points)

Version 1
Find an equation of the normal line to the graph of $y = u(x)$ at $x = -4$, if $u(-4) = 5$ and $u'(-4) = -3$.

You must clearly and coherently justify your work. You cannot provide only the final answer. Your final answer should be simplified to $y = mx + b$ form. Circle your final answer.

Version 2
Find an equation of the normal line to the graph of $y = g(x)$ at $x = -3$, if $g(-3) = 11$ and $g'(-3) = -2$.

You must clearly and coherently justify your work. You cannot provide only the final answer. Your final answer should be simplified to $y = mx + b$ form. Circle your final answer.

Version 3
Find an equation of the normal line to the graph of $y = k(x)$ at $x = 4$, if $k(4) = -5$ and $k'(4) = 5$.

You must clearly and coherently justify your work. You cannot provide only the final answer. Your final answer should be simplified to $y = mx + b$ form. Circle your final answer.

Version 4
Find an equation of the normal line to the graph of $y = n(x)$ at $x = -1$, if $n(-1) = -3$ and $n'(-1) = 10$.

You must clearly and coherently justify your work. You cannot provide only the final answer. Your final answer should be simplified to $y = mx + b$ form. Circle your final answer.

3 Question No.4 - Medium (3 points - 1.5 points for each part)

Version 1
Find $F''(\pi)$ given that $f(\pi) = 1$, $f'(\pi) = -2$, $g(\pi) = 2$, and $g'(\pi) = -1$. 
Part A: \( F(x) = x^2(4f(x) - 7g(x)) \)

Part B: \( F(x) = \frac{x f(x)}{tx + 2g(x)} \)

You must clearly and coherently justify your work. You cannot provide only the final answer. Circle your final answer for Part A and Part B.

**Version 2**

Find \( G'(\pi) \) given that \( f(\pi) = -2, \ f'(\pi) = 1, \ g(\pi) = -1, \) and \( g'(\pi) = 2. \)

Part A: \( G(x) = 5x(3f(x) - 8g(x)) \)

Part B: \( G(x) = \frac{2f(x)}{x^2 + 2g(x)} \)

You must clearly and coherently justify your work. You cannot provide only the final answer. Circle your final answer for Part A and Part B.

**Version 3**

Find \( H'(\pi) \) given that \( s(\pi) = 1, \ s'(\pi) = -1, \ t(\pi) = -2, \) and \( t'(\pi) = 2. \)

Part A: \( H(x) = 5x(3t(x) - 8s(x)) \)

Part B: \( H(x) = \frac{2s(x)}{x^2 + 2t(x)} \)

You must clearly and coherently justify your work. You cannot provide only the final answer. Circle your final answer for Part A and Part B.

**Version 4**

Find \( H'(\pi) \) given that \( s(\pi) = 2, \ s'(\pi) = -2, \ t(\pi) = -1, \) and \( t'(\pi) = 1. \)

Part A: \( H(x) = x^2(4t(x) - 7s(x)) \)

Part B: \( H(x) = \frac{xs(x)}{7x + 2t(x)} \)

You must clearly and coherently justify your work. You cannot provide only the final answer. Circle your final answer for Part A and Part B.

4 Question No.5 - Difficult (4 points)

**Version 1 & 2**

Let \( f(x) = \frac{-1}{\sqrt{3} - x}. \) Using the definition of the derivative, find \( f'(1). \)

You cannot use differentiation techniques.

You must clearly and coherently justify your work. You cannot provide only the final answer. Circle your final answer.
Let $f(x) = \frac{1}{\sqrt{4-x}}$. Using the definition of the derivative, find $f'(2)$.

You cannot use differentiation techniques.

You must clearly and coherently justify your work. You cannot provide only the final answer. Circle your final answer.

5 Question No.6 - Challenging (4 points)

Suppose that

$$f(x) = \begin{cases} 
5x + 2x^4 \cos \left(\frac{5}{x}\right) & \text{if } x \neq 0 \\
0 & \text{if } x = 0
\end{cases}$$

Is $f(x)$ differentiable at $x = 0$?

Hint: Squeeze theorem.

You must clearly and coherently justify your work. You cannot provide only the final answer. Circle your final answer.

Suppose that

$$f(x) = \begin{cases} 
-3x + 2x^4 \sin \left(\frac{4}{x^2}\right) & \text{if } x \neq 0 \\
0 & \text{if } x = 0
\end{cases}$$

Is $f(x)$ differentiable at $x = 0$?

Hint: Squeeze theorem.

You must clearly and coherently justify your work. You cannot provide only the final answer. Circle your final answer.