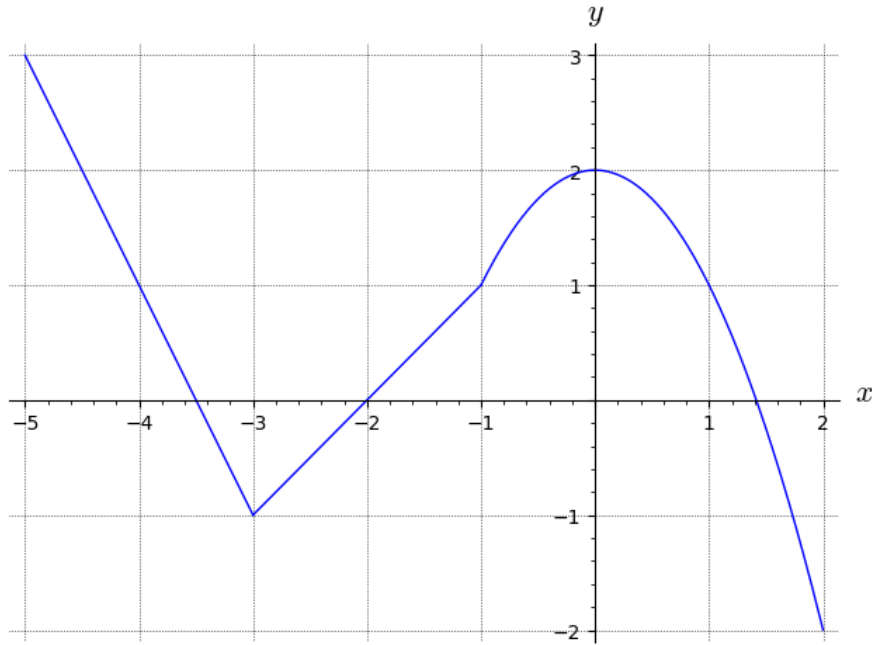# Math 131 - Test 2

March 10, 2021

Name _____

Score _____

Show all work to receive full credit. Supply explanations where necessary. Unless otherwise indicated, use differentiation rules for all derivatives, and do not simplify.

1. (8 points) Let $f(x) = x^2 + x$. Use a limit definition of the derivative to compute $f'(1)$. Show all work.

2. (4 points) Use your result from above to find an equation of the line tangent to the graph of $f(x) = x^2 + x$ at the point where $x = 1$.

3. (12 points) Shown below is the graph of the function g on the interval $[-5, 2]$. Use the graph for each part below.

(a) Identify a point at which $g'(x)$ does not exist and carefully explain how you know.
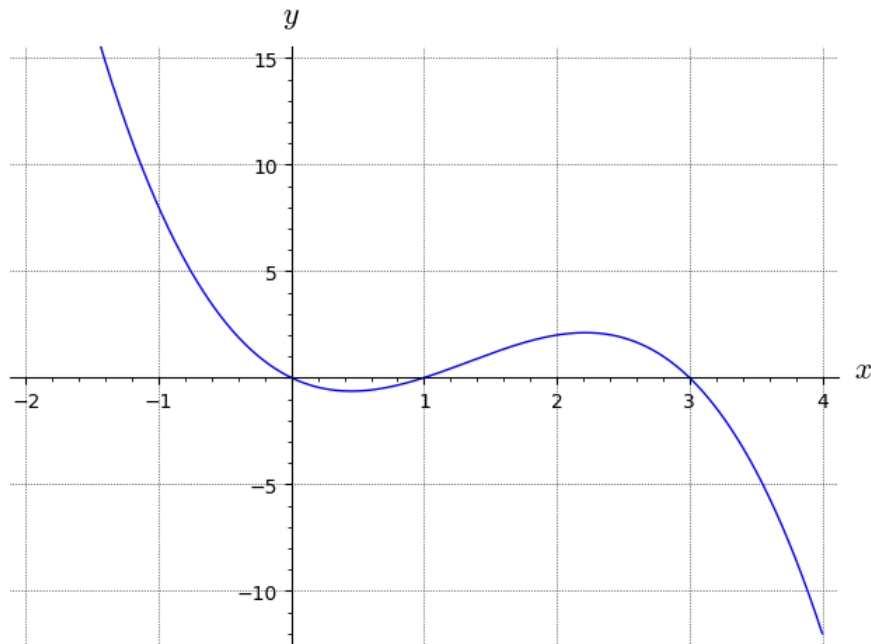
(b) Estimate the value of $g'(1)$. Explain your reasoning or show work.

(c) Determine the value of $g'(-4)$. Explain your reasoning or show work.

(d) Identify a point at which $g'(x) = 0$ and carefully explain how you know.

4. (6 points) The graph of the function $y = f(x)$ is shown below. Using the graph, place the following values in order from least to greatest. Explain or show work.

$$f'(-1), \qquad f'(1), \qquad f'(3)$$

5. (6 points) Find an equation of the tangent line to the graph of $y = 2x^3 - 4x^2 - 5x - 3$ at the point where $x = -1$.

6. (12 points) The following table gives information about the functions f and g and their derivatives at selected points.

x	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
0	6	0	-6	-3
1	7	2	-3	-1
2	-7	4	0	1
3	-4	8	1	5

(a) Find $h'(1)$ if $h(x) = xf(x) + 4g(x)$.

(b) Find $h'(2)$ if $h(x) = f(x)/g(x)$.

(c) Find $h'(0)$ if $h(x) = [g(x)]^2$.

7. (5 points) Use trig identities and the quotient rule to derive our formula for the derivative of $y = \cot x$ from the basic rules for the sine and cosine.

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8. (12 points) A potato is launched vertically upward with an initial velocity of $80\,\text{ft/s}$ from a potato gun at the top of an 96-foot-tall building. The distance in feet that the potato travels from the ground after t seconds is given by $s(t) = -16t^2 + 80t + 96$.

(a) Determine when the potato hits the ground.

(b) Determine the speed of the potato when it hits the ground.

(c) Determine the maximum height of the potato.

9. (5 points) Let $r(x) = x^5 + x^2 - 7\sin x$. Find $r''(x)$.

10. (7 points) Let $W(x) = \cos^3(x^2 + 1)$. Compute $W'(x)$. (Hint: You'll need the chain rule twice.)

11. (15 points) Differentiate. Do not simplify.

(a) $\dfrac{d}{dx}(x + \csc x)(1 - \tan x)$

(b) $\dfrac{d}{d\theta}\sec(\theta^2)$

(c) $\dfrac{d}{dt}\sqrt{t^3 + 2t + 1}$

12. (8 points) Assume that y is implicitly defined as a function of x by the equation $x^4 y + y^3 = -2$. Use implicit differentiation to find dy/dx at $(-1, -1)$.