

Part I: Multiple Choice. Circle the correct answer.

1. If $f(x) = \sqrt{4 \sin x + 2}$, then $f'(0) =$

A. -2

B. 0

C. 1

D. $\frac{2}{\sqrt{2}}$ E. $\frac{\sqrt{2}}{2}$

For # 2 and 3 use the following information:

Let f and g be differentiable functions such that

$f(2) = 5$

$f'(6) = -2$

$f'(2) = -5$

$g(2) = 6$

$g'(2) = -4$

$g'(6) = 4$

2. If $h(x) = f(g(x))$, then $h'(2) =$

A. 8

B. -8

C. 0

D. -50

E. -2

3. If $j(x) = \frac{f(x)}{g(x)}$, find $j'(2)$.

A. $-\frac{5}{4}$

B. 0

C. $-\frac{5}{18}$ D. $\frac{5}{4}$

E. undefined

4. Given $f(x) = \frac{1}{x} + 6x - 5$, find $f'(1)$.

A. 2

B. -2

C. 5

D. 0

E. undefined

5. The equation of the line tangent to the curve $y = \frac{kx+8}{x+k}$ at $x = -2$ is $y = x + 4$. What is the value of k ?

- A. -3 B. -1 C. 1 D. 3 E. 4
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6. If $y = \frac{1-x}{x-1}$, then $\frac{dy}{dx} =$

- A. -1 B. 0 C. $\frac{-1}{x-1}$ D. $\frac{-2}{x-1}$ E. $\frac{-2x}{(x-1)^2}$
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7. Let $f(x)$ be a continuous and differentiable function. The table below gives the value of $f(x)$ and $f'(x)$ at several values. If $g(x) = \frac{1}{f(x)}$, what is the value of $g'(2)$?

x	1	2	3	4
$f(x)$	-3	-8	-9	0
$f'(x)$	-5	-4	3	16

- A. $\frac{1}{16}$ B. 0 C. $-\frac{1}{8}$ D. $-\frac{1}{4}$ E. undefined
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8. If $y = (2x^2 + 1)^4$, then $\frac{dy}{dx} =$

- A. $16x^3$ B. $4(2x^2 + 1)^3$ C. $4x(2x^2 + 1)^3$ D. $16(2x^2 + 1)^3$ E. $16x(2x^2 + 1)^3$

Part II: Show all work and keep it organized.

9. Find the equation of the tangent line to the graph of $y(x) = \cos x + \tan(2x)$ at $x = 0$.

10. Given $V = \frac{3}{4}\pi r^3$, find $\frac{dV}{dr}$ and then find $\left.\frac{dV}{dr}\right|_{r=2}$

11. Find the derivative of $f(x) = x^2 - x$ the long way. Use limits and h notation and show all work.

12. If $y = \csc x$, find y' and y'' .

13. Let $y = x^2 + 1$.

a. Find the average rate of change of y with respect to x over the interval $[2, 6]$. Show work.

b. Find the instantaneous rate of change of y with respect to x when $x = -3$. Show work.

In #14-19, find the derivative of each function.

14. $y = 6x^5 - x + 10$

15. $y = 10 \cot(2x - 1)$

16. $y = 5x^{-7}$

17. $f(x) = \cos^3(2x^4)$

18. $p(x) = (x^2 - 5)(3x^{-2} + x^{-3})$

19. $h(x) = (2x - 7)^4(x^2 + 3)$

20. Find the **slope** of the line that is tangent to $y = 2x \sin x$ at $x = \frac{\pi}{4}$.

Suppose that functions f and g and their derivatives have the following values at $x = 2$ and $x = 3$.

x	$f(x)$	$g(x)$	$f'(x)$	$g'(x)$
2	8	2	$\frac{1}{3}$	-3
3	3	-4	2π	5

21. If $k(x) = f(x) \cdot g(x)$, find $k'(3)$.

22. If $j(x) = \sqrt{f(x)}$, find $j'(2)$.

23. a. Determine if $f(x) = \begin{cases} x^2 - 4, & x \leq 2 \\ \frac{3}{2}x - 3, & x > 2 \end{cases}$ is continuous at $x = 2$. Show detailed work.

b. Determine if $f(x)$ is differentiable at $x = 2$. Show detailed work.