

1. If $f(x) = \tan^{-1}(\sin x)$, then $f'(\frac{\pi}{3}) =$
- (a) $2/7$
 - (b) $2\sqrt{3}/5$
 - (c) $2/5$
 - (d) $4/5$
 - (e) $2/3$
2. The formula for the volume for a right circular cone is $V = \frac{1}{3} \pi r^2 h$ where r is the base radius and h is the height. Suppose the radius and height are changing but the volume is held constant at the instant $V = 5 m^3$. Find the rate of change of height with respect to radius when $r = 1 m$.
- (a) $-30/\pi$
 - (b) $10\pi/3$
 - (c) $-15/\pi$
 - (d) $18/\pi$
 - (e) $25\pi/3$

3. Let $f(x) = \begin{cases} \frac{\sin^2(3x)}{2x} & \text{if } x \neq 0 \\ 0 & \text{if } x = 0 \end{cases}$ Find $f'(0)$?

(a) $9/2$

(b) $9/4$

(c) $3/4$

(d) 0

(e) $81/4$

4. Let $y = x - \frac{1}{\sqrt{x}}$. Write $y'(4) = a/b$ in lowest terms, where a and b are positive integers. What is $a + b$?

(a) 33

(b) 32

(c) 31

(d) 30

(e) 29

5. If $y(x) = (1 - x^2)(x^3 - 3x + 1)$. Find $y''(2)$?
- (a) -114
 - (b) 114
 - (c) 111
 - (d) -111
 - (e) 100
6. If $y(x) = x^2 \tan\left(\frac{1}{x}\right)$. Write $y'\left(\frac{4}{\pi}\right) = \frac{a}{\pi} - b$, where a and b are two positive integers. What is ab ?
- (a) 16
 - (b) 8
 - (c) 2
 - (d) 32
 - (e) 4

7. A particle's position on a number line at time t seconds is $S(t) = t^3 - 12t^2 + 36t$ meters. Find the time when its acceleration is 0 ?

- (a) 4
- (b) 6
- (c) 3
- (d) 5
- (e) None of the above

8. $\lim_{x \rightarrow \pi} \frac{e^{\tan x} - 1}{x - \pi} =$ (Hint: this limit is a derivative)

- (a) 1
- (b) -1
- (c) e
- (d) $-e$
- (e) 0

9. Suppose that the functions $f(x)$, and $g(x)$ and their derivatives with respect to x have the following values at $x = 1$

x	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
1	-2	-1	2	7

The derivative of $f(\sec(\pi x) + g(x))$ with respect to x at $x = 1$ is

- (a) -7
- (b) -2
- (c) 1
- (d) 2
- (e) 0
10. Let $y(x) = \frac{1}{1 + \tan^2(x)}$. Suppose the y-intercept of the tangent line to the graph of $y(x)$ at $x = \frac{\pi}{4}$ is $\frac{a}{b} + \frac{\pi}{c}$, where a, b and c are positive integers with a/b in lowest terms. What is $a + b + c$?

- (a) 7
- (b) 8
- (c) 9
- (d) 10
- (e) 5

11. Let $h(x) = \frac{x + x^2}{1 + x^2}$. Find $h'(1)$?

(a) $1/2$

(b) $3/2$

(c) 1

(d) $5/2$

(e) $-1/2$

12. At the point $x = 0$, the tangent line to the graph of $f(x) = \frac{e^{ax}}{a(x+1)^3}$ is horizontal. What is a ?

(a) 3

(b) 2

(c) 1

(d) -1

(e) 0

13. If $f(x) = x^e e^x$. Calculate $f'(x)$?

(a) $x^{e-1} e^{x+1} + x^e e^x$

(b) $x^e e^x + x^{e+1} e^x$

(c) $e x^{e-1} e^x$

(d) $x^\pi e^x + x^e e^x$

(e) $x^{e+1} e^{x-1}$

14. Find the equation of the tangent line to the graph of $y = \ln(x^4 + 1)$ at $x = 1$?

(a) $y = 2x + \ln 2 - 2$

(b) $y = 2x + 2 - \ln 2$

(c) $y = 4x + \ln 2 - 2$

(d) $y = 4x + 2 - \ln 2$

(e) $y = (\ln 2)x - 2$

15. If $f(x) = \frac{1}{\sqrt[3]{x^2 + x + 2}}$. Then $f'(2) =$

(a) $-5/48$

(b) $-5/18$

(c) $-3/17$

(d) $3/25$

(e) $-1/2$

16. Find the slope of the tangent line to the graph of $x^2 \cos y = 2y - e^{3x}$ at $\left(1, \frac{\pi}{2}\right)$?

(a) e^3

(b) $3e$

(c) $\frac{2 + 3e^3}{2}$

(d) $\frac{2 + 3e}{2}$

(e) $\frac{3 + 2e}{2}$

17. Suppose that the length of a rectangle is decreasing at the rate of 3 cm/s while the width is increasing at a rate of 4 cm/s. Find the rate of change of the area when the length is 6 cm and the width is 4 cm ?

(a) $12\text{cm}^2/\text{s}$

(b) $36\text{cm}^2/\text{s}$

(c) $16\text{cm}^2/\text{s}$

(d) $8\text{cm}^2/\text{s}$

(e) $20\text{cm}^2/\text{s}$

18. Let $f(x) = \frac{\sin x}{1 - \cos x}$. Find $f' \left(\frac{\pi}{2} \right)$?

(a) -1

(b) 1

(c) $1/2$

(d) $-1/2$

(e) 0