

1. $\lim_{x \rightarrow \infty} \frac{5x^2}{3x^2 + 100000x} =$

- A) 0
- B) 0.005
- C) 1
- D) 1.667
- E) does not exist

2. Which of the following functions are not differentiable at $x = \frac{2}{3}$?

I. $f(x) = \sqrt[3]{x-2}$

II. $g(x) = |3x-2|$

III. $h(x) = |9x^2-4|$

- A) I only
- B) II only
- C) I and II only
- D) II and III only
- E) I and III only

3. If $y = (\ln x)^3$, then $dy/dx =$

- A) $\frac{3}{x}(\ln x)^2$
- B) $3(\ln x)^2$
- C) $3x(\ln x)^2 + (\ln x)^3$
- D) $3(\ln x + 1)$
- E) None of these

4. If $F(x) = x \sin x$, then find $F'(3\pi/2)$.

- A) 0
- B) 1
- C) -1
- D) $3\pi/2$
- E) $-3\pi/2$

5. The approximate equation of the tangent line to $f(x) = \cos^2(3x)$ at $x = \pi/18$ is

- A) $y = -2.598x + 1.203$
- B) $y = 2.598x - 1.203$
- C) $y = -2.598x + 0.575$
- D) $y = 2.598x - 0.575$
- E) None of these

6. The slope of the tangent to the curve $y^3x + y^2x^2 = 6$ at the point $(2, 1)$ is

- A) $-\frac{3}{2}$
- B) -1
- C) $-\frac{5}{14}$
- D) $-\frac{3}{14}$
- E) 0

7. Which of the following functions has a derivative at $x = 0$?

- I. $y = \arcsin(x^2 - 1) - x$
- II. $y = x|x|$
- III. $y = \sqrt{x^4}$

- A) I only
 - B) II only
 - C) III only
 - D) II and III only
 - E) I, II, and III
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Let f be the function given by $f(x) = 3e^{2x}$ and let g be the function given by $g(x) = 6x^3$. At what value of x do the graphs of f and g have parallel tangent lines?

- (A) -0.701
- (B) -0.567
- (C) -0.391
- (D) -0.302
- (E) -0.258

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Which of the following is an equation of the line tangent to the graph of $f(x) = x^4 + 2x^2$ at the point where $f'(x) = 1$?

- (A) $y = 8x - 5$
- (B) $y = x + 7$
- (C) $y = x + 0.763$
- (D) $y = x - 0.122$
- (E) $y = x - 2.146$

10. A tangent line drawn to the graph of $y = \frac{4x}{1+x^3}$ at the point $(1, 2)$ forms a right triangle with the coordinate axes. The area of the triangle is

- A) 3
 - B) 3.5
 - C) 4
 - D) 4.5
 - E) 5
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11. The function

$$f(x) = \begin{cases} 4 - x^2 & x \leq 1 \\ mx + b & x > 1 \end{cases}$$

is continuous and differentiable for all real numbers. What must be the values of m and b ?

- A) $m = 2, b = 1$
 - B) $m = 2, b = 5$
 - C) $m = -2, b = 1$
 - D) $m = -2, b = 5$
 - E) None of these
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12. If $f(x) = -x^2 + x$, then which of the following expressions represents $f'(x)$?

- A) $\lim_{h \rightarrow 0} \frac{(-x^2 + x + h) - (-x^2 + x)}{h}$
- B) $\lim_{h \rightarrow x} \frac{(-x^2 + x + h) - (-x^2 + x)}{h}$
- C) $\frac{[-(x+h)^2 + (x+h)] - (-x^2 + x)}{h}$
- D) $\lim_{h \rightarrow 0} \frac{[-(x+h)^2 + (x+h)] - (-x^2 + x)}{h}$
- E) None of these

13. All the functions below, except one, have the property that $f(x)$ is equal to its fourth derivative, $f^{(4)}(x)$. Which one does not have this property?

A) $f(x) = \sin x$

B) $f(x) = \cos x$

C) $f(x) = -5e^x$

D) $f(x) = e^{2x}$

E) $f(x) = e^{-x}$

14. If $g(t) = \frac{\ln t}{e^t}$, then $g'(t) =$

A) $\frac{1 - \ln t}{e^t}$

B) $\frac{1 - t \ln t}{e^t}$

C) $\frac{t \ln t - 1}{te^t}$

D) $\frac{1 - t \ln t}{te^t}$

E) $\frac{1 - e^t \ln t}{e^{2t}}$

15. If $H(x) = x^3 - x^2 + \frac{1}{x}$, which of the following is $H''(2)$?

A) $\frac{31}{4}$

B) $\frac{39}{4}$

C) $\frac{79}{8}$

D) $\frac{81}{8}$

E) $\frac{41}{4}$