

1. What is the slope of the tangent line to the graph of $f(x) = x^2 \sin(x)$ at $x = \pi/2$?

(A) 0

(B) π

(C) $(\pi/2)^2$

(D) None of the above

2. True or False?

The tangent line to the graph of

$$f(x) = \frac{e^x}{e^x + x}$$

at $x = 1$ is horizontal.

3. If f and g are functions such that

$$f(0) = 5 \quad f'(0) = 2 \quad g(0) = 3 \quad g'(0) = 2$$

then which of the following is $(fg)'(0)$?

(A) 4

(B) 6

(C) 8

(D) None of the above

4. If f and g are functions such that

$$f(0) = 5 \quad f'(0) = 2 \quad g(0) = 3 \quad g'(0) = 2$$

then which of the following is $(f/g)'(0)$?

(A) -1

(B) $-4/9$

(C) $5/3$

(D) None of the above

5. True or False?

The function $f(x) = \sqrt[3]{x}$ is differentiable at $x = 0$.

6. Let $f(x) = |x^2 - 1|$. For how many values of a does $f'(a)$ not exist?

(A) None

(B) 1

(C) 2

(D) 3 or more

7. True or False?

Let $f(x) = \cos(x)$. Then $f^{(36)}(x) = \cos(x)$.

Note. $f^{(36)}$ means “take the derivative 36 times”.

8. Let $f(x) = 9 - x^2$. How many points P are there on the graph of f such that the tangent line at P passes through $(5, 0)$?

- (A) None
- (B) 1
- (C) 2
- (D) 3 or more

9. True or False?

The function f defined by $f(x) = x|x|$ is differentiable at $x = 0$.

10. Let f be the function $f(x) = \sin(x) \cos(x)$. For how many values between 0 and 2π is the tangent line to the graph of f horizontal?

- (A) None
- (B) 1
- (C) 2
- (D) 3 or more

10. Let f be the function $f(x) = \sin(x) \cos(x)$. For how many values between 0 and 2π is the tangent line to the graph of f horizontal?

- (A) None
- (B) 1
- (C) 2
- (D) 3 or more

Hint. $\cos(2x) = \cos^2(x) - \sin^2(x)$.

11. For how many values of λ does the equation $e^x = \lambda x$ have a unique solution?

(A) None

(B) 1

(C) Infinitely many

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(A) None

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(C) Infinitely many

Follow-up. For which values of λ does $e^x = \lambda x$ have no solutions? For which does it have two or more solutions?