

September 28, 2026

National Drink Beer Day

Today in History:

William the Conqueror invades England (1066)

Ted Williams becomes last player to hit .400 (1941)

Number of the Day: 573

$$573 = 3 \times 191$$

$$573^3 = 188,132,517 = (188 - 132 + 517)^3.$$

Fun Fact:

Anatidaephobia is the fear that somewhere in the world, there is a duck watching you.

Quote of the Day:

“The fact that we live at the bottom of a deep gravity well, on the surface of a gas covered planet going around a nuclear fireball 90 million miles away and think this to be normal is obviously some indication of how skewed our perspective tends to be.”

—Douglas Adams

Today's Weather:

Sunny, high 69°

Math 121

Quiz #17

Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for

$$y = x^5 e^x$$

$$\begin{aligned}\frac{dy}{dx} &= x^5 e^x + 5x^4 e^x \\ &= (x^5 + 5x^4) e^x\end{aligned}$$

$$\begin{aligned}\frac{d^2y}{dx^2} &= (x^5 + 5x^4) e^x + (5x^4 + 20x^3) e^x \\ &= (x^5 + 10x^4 + 20x^3) e^x\end{aligned}$$

TRIG DERIVATIVES

① $f(x) = \sin x$

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$= \lim_{h \rightarrow 0} \frac{\sin(x+h) - \sin x}{h}$$

$$= \lim_{h \rightarrow 0} \frac{\sin x \cosh + \cos x \sin h - \sin x}{h}$$

$$= \lim_{h \rightarrow 0} \frac{\sin x \cosh - \sin x + \cos x \sinh}{h}$$

$$= \lim_{h \rightarrow 0} \sin x \left(\frac{\cosh - 1}{h} \right) + \lim_{h \rightarrow 0} \frac{\cos x \sinh}{h}$$

$\downarrow 0$
 $\downarrow 1$

$$= \cos x$$

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

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

② $f(x) = \cos x$

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$= \lim_{h \rightarrow 0} \frac{\cos(x+h) - \cos x}{h}$$

$$= \lim_{h \rightarrow 0} \frac{\cos x \cosh - \sin x \sinh - \cos x}{h}$$

$$= \lim_{h \rightarrow 0} \frac{\cos x \cosh - \cos x - \sin x \sinh}{h}$$

$$= \lim_{h \rightarrow 0} \cos x \left(\frac{\cosh - 1}{h} \right) - \lim_{h \rightarrow 0} \frac{\sin x \sinh}{h}$$

$\downarrow 0$
 $\downarrow 1$

$$= -\sin x$$

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

$$f'(x) = -\sin x$$

$$(3) \quad f(x) = \tan x = \frac{\sin x}{\cos x}$$

$$f'(x) = \frac{(\cos x)(\cos x) + (\sin x)(+\sin x)}{(\cos x)^2}$$

$$= \frac{1}{\cos^2 x} = \sec^2 x$$

$$f(x) = \tan x$$

$$f'(x) = \sec^2 x$$

$$(4) \quad f(x) = \cot x = \frac{\cos x}{\sin x}$$

$$f'(x) = \frac{(\sin x)(-\sin x) - (\cos x)(\cos x)}{\sin^2 x}$$

$$= \frac{-\sin^2 x - \cos^2 x}{\sin^2 x} = \frac{-(\sin^2 x + \cos^2 x)}{\sin^2 x}$$

$$= \frac{-1}{\sin^2 x} = -\csc^2 x$$

$$(5) \quad f(x) = \sec x = \frac{1}{\cos x}$$

$$f'(x) = \frac{\cancel{(\cos x)(0)} - (1)(-\sin x)}{\cos^2 x} = \frac{\sin x}{\cos^2 x}$$

$$= \frac{\sin x}{(\cos x)(\cos x)} = \tan x \cdot \sec x$$

$$f(x) = \sec x$$

$$f'(x) = \sec x \tan x$$

$$f(x) = \csc x = \frac{1}{\sin x}$$

$$f'(x) = \frac{(\sin x)(0) - (1)(\cos x)}{\sin^2 x} = \frac{-\cos x}{\sin^2 x}$$

$$= \frac{-\cos x}{\sin x} \cdot \frac{1}{\sin x} = -\cot x \csc x$$

$$f(x) = \csc x$$

$$f'(x) = -\csc x \cot x$$

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

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

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

$$f'(x) = -\sin x$$

$$f(x) = \tan x$$

$$f'(x) = \sec^2 x$$

$$f(x) = \cot x$$

$$f'(x) = -\csc^2 x$$

$$f(x) = \sec x$$

$$f'(x) = \sec x \tan x$$

$$f(x) = \csc x$$

$$f'(x) = -\csc x \cot x$$

EXAMPLE 1

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

$$f'(x) = \underbrace{x \cos x} + \sin x$$

~~$$\cos x \cdot x$$~~

$$x \cos x$$

EXAMPLE 2

$$f(x) = \frac{x^2 + x}{\cos x}$$

$$f'(x) = \frac{(2x+1)\cos x - (x^2+x)(-\sin x)}{\cos^2 x}$$

EXAMPLE 3

$$f(x) = 3 \sec x - 10 \cot x$$

$$f'(x) = 3 \sec x \tan x - 10(-\csc^2 x)$$

$$= 3 \sec x \tan x + 10 \csc^2 x$$

EXAMPLE 4

$$y = \frac{\sin x + \csc x}{e^x + x}$$

$$\frac{dy}{dx} = \frac{(e^x + x)(\cos x - \csc x \cot x) - (\sin x + \csc x)(e^x + 1)}{(e^x + x)^2}$$