$= \sqrt{x}\cos x + \sin x \left(\frac{1}{2} x^{-1/2}\right)$

$= \sqrt{x}\cos x + \frac{1}{2x^{1/2}} \sin x$

$= \sqrt{x}\cos x + \frac{1}{2\sqrt{x}} \sin x$

Quotient rule.

If u and v any two functions of x then $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v \cdot \frac{d}{dx}(u) - u\frac{d}{dx}(v)}{v^2}$

or

$$\frac{d}{dx}\left(\frac{Nr}{Dr}\right) = \frac{Dr \cdot \frac{d}{dx}(Nr) - Nr \cdot \frac{d}{dx}(Dr)}{(Dr)^2}.$$

Q. $\frac{d}{dx}\left(\frac{x^2}{\sin x}\right) = \frac{\sin x \cdot \frac{d}{dx}(x^2) - x^2 \cdot \frac{d}{dx}(\sin x)}{(\sin x)^2}.$

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

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

Q. $\frac{d}{dx}\left(\frac{x-1}{x+1}\right) = \frac{(x+1)\frac{d}{dx}(x-1) - (x-1)\frac{d}{dx}(x+1)}{(x+1)^2}$

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$$= \frac{(x+1)\left(\frac{d}{dx}(x) - \frac{d}{dx}(1)\right) - (x-1)\left(\frac{d}{dx}(x) + \frac{d}{dx}(1)\right)}{(x+1)^2}.$$

$$= \frac{(x+1)(1) - (x-1)(1)}{(x+1)^2}.$$

$$= \frac{(x+1) - (x-1)}{(x+1)^2} = \frac{x+1-x+1}{(x+1)^2} = \frac{2}{(x+1)^2}.$$

$$\frac{d}{dx}\left(\frac{\cos x}{\sqrt{x}}\right) = \frac{\sqrt{x}\cdot\frac{d}{dx}(\cos x) - \cos x \frac{d}{dx}(\sqrt{x})}{(\sqrt{x})^2}.$$

$$= \frac{\sqrt{x}\cdot(-\sin x) - \cos x \cdot \frac{d}{dx}(x^{1/2})}{x}.$$

$$= \frac{-\sqrt{x}\sin x - \cos x\left(\frac{1}{2}x^{1/2-1}\right)}{x}.$$

$$= \frac{-\sqrt{x}\sin x - \cos x \cdot \frac{1}{2} \times x^{-1/2}}{x}$$

$$= \frac{-\sqrt{x}\sin x - \cos x \cdot \frac{1}{2x^{1/2}}}{x}$$

$$= \frac{-\sqrt{x}\sin x - \frac{1}{2\sqrt{x}}\cdot\cos x.}{x}$$

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Differential coefficient of cosec$x$, sec$x$, tan$x$ and cot$x$

1. $\frac{d}{dx}(\operatorname{cosec} x) = \frac{d}{dx}\left(\frac{1}{\sin x}\right)$

$= \frac{\sin x \cdot \frac{d}{dx}(1) - 1 \cdot \frac{d}{dx}(\sin x)}{(\sin x)^2}$

$= \frac{\sin x \times 0 - \cos x}{(\sin x)^2} = \frac{-\cos x}{(\sin x)^2}$

$= \frac{-\cos x}{\sin x} \times \frac{1}{\sin x}$

$= -\cot x \cdot \operatorname{cosec} x$

$\frac{d}{dx}(\operatorname{cosec} x) = -\operatorname{cosec} x \cot x$

2. $\frac{d}{dx}(\sec x) = \frac{d}{dx}\left(\frac{1}{\cos x}\right)$

$= \frac{\cos x \cdot \frac{d}{dx}(1) - 1 \cdot \frac{d}{dx}(\cos x)}{(\cos x)^2}$

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

$= \frac{\sin x}{(\cos x)^2} = \frac{\sin x}{\cos x} \cdot \frac{1}{\cos x}$

$= \tan x \sec x$

$\frac{d}{dx}(\sec x) = \sec x \tan x$

Q. $\frac{d}{dx}(\tan x) = \frac{d}{dx}\left(\frac{\sin x}{\cos x}\right)$.

$= \frac{\cos x \cdot \frac{d}{dx}(\sin x) - \sin x \cdot \frac{d}{dx}(\cos x)}{(\cos x)^2}$

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

$= \frac{\cos^2 x + \sin^2 x}{(\cos x)^2} = \frac{1}{\cos^2 x}$.

$= \sec^2 x$ //

$\frac{d}{dx}(\tan x) = \sec^2 x$

Q. $\frac{d}{dx}(\cot x) = \frac{d}{dx}\left(\frac{\cos x}{\sin x}\right)$.

$= \frac{\sin x \cdot \frac{d}{dx}(\cos x) - \cos x \cdot \frac{d}{dx}(\sin x)}{(\sin x)^2}$

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

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

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

$\frac{d}{dx}(\cot x) = -\operatorname{cosec}^2 x$

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Result

1. $\frac{d}{dx}(x^n) = n \cdot x^{n-1}$ 2. $\frac{d}{dx}(K) = 0$.

3. $\frac{d}{dx}(\sin x) = \cos x$ 4. $\frac{d}{dx}(\cos x) = -\sin x$.

5. $\frac{d}{dx}(\tan x) = \sec^2 x$ 6. $\frac{d}{dx}(\cot x) = -\operatorname{cosec}^2 x$

7. $\frac{d}{dx}(\sec x) = \sec x \tan x$. 8. $\frac{d}{dx}(\operatorname{cosec} x) = -\operatorname{cosec} x$.

8. $\frac{d}{dx}(\operatorname{cosec} x) = -\operatorname{cosec} x \cot x$

9. $\frac{d}{dx}(e^x) = e^x$ 10. $\frac{d}{dx}(\log x) = \frac{1}{x}$.

Q. $\frac{d}{dx}(x + \sin x + 5\tan x)$.

$= \frac{d}{dx}(x) + \frac{d}{dx}(\sin x) + \frac{d}{dx}(5\tan x)$

$= 1 + \cos x + 5 \cdot \frac{d}{dx}(\tan x)$

$= 1 + \cos x + 5 \cdot \sec^2 x$

Q. $\frac{d}{dx}(4e^x - 3\operatorname{cosec} x)$.

$= \frac{d}{dx}(4e^x) - \frac{d}{dx}(3\operatorname{cosec} x)$

$= 4 \cdot \frac{d}{dx}(e^x) - 3 \cdot \frac{d}{dx}(\operatorname{cosec} x)$

$= 4 \cdot e^x - 3 \cdot (-\operatorname{cosec} x \cot x)$

$= 4e^x + 3\operatorname{cosec} x \cot x$

Q. $\frac{d}{dx}\left(\frac{\tan x}{x}\right)$

$= \frac{x \cdot \frac{d}{dx}(\tan x) - \tan x \cdot \frac{d}{dx}(x)}{x^2}$

$= \frac{x \cdot (\sec^2 x) - \tan x \cdot 1}{x^2}$

$= \frac{x \sec^2 x - \tan x}{x^2}$

Q. $\frac{d}{dx}(x^n \log x)$

$= x^n \cdot \frac{d}{dx}(\log x) + \log x \cdot \frac{d}{dx}(x^n)$

$= x^n \cdot \frac{1}{x} + \log x \cdot n \cdot x^{n-1}$

$= x^n \cdot x^{-1} + n \cdot x^{n-1} \log x.$

$= x^{n-1} + n x^{n-1} \log x$

$= x^{n-1}(1 + n \log x)$

Q. $\frac{d}{dx}(x^3 e^x)$

$= x^3 \cdot \frac{d}{dx}(e^x) + e^x \cdot \frac{d}{dx}(x^3)$

$= x^3 \cdot e^x + e^x \cdot 3 \cdot x^{3-1}$

$$= x^3 e^x + e^x \cdot 3x^2.$$
$$= e^x(x^3 + 3x^2)$$

Q. $\frac{d}{dx}\left(\frac{\cos x}{x+\sin x}\right)$

$$= \frac{(x+\sin x)\cdot\frac{d}{dx}(\cos x) - \cos x\cdot\frac{d}{dx}(x+\sin x)}{(x+\sin x)^2}.$$

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

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

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

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

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

Q. $\frac{d}{dx}\left(\frac{x\sec x}{3x+2}\right)$

$$= \frac{(3x+2)\frac{d}{dx}(x\sec x) - x\sec x \cdot \frac{d}{dx}(3x+2)}{(3x+2)^2}.$$

$$= \frac{(3x+2)\left[x\frac{d}{dx}\sec x + \sec x \cdot \frac{d}{dx}(x)\right] - x\sec x\left(3\cdot\frac{d}{dx}(x) + \frac{d}{dx}(2)\right)}{(3x+2)^2}.$$

$$= \frac{(3x+2)(x\cdot\sec x\tan x + \sec x) - x\sec x(3+0)}{(3x+2)^2}.$$

$$= \frac{(3x+2)(x\sec x\tan x + \sec x) - 3x\sec x}{(3x+2)^2}.$$