CALCULUS

DIFFERENTIATION FORMULA

1. $\frac{d}{dx}(x^n) = nx^{n-1}, \frac{d}{dx}\left(\frac{1}{x}\right) = \frac{-1}{x^2}, \frac{d}{dx}\left(\sqrt{x}\right) = \frac{1}{2\sqrt{x}}$
2. $\frac{d}{dx}(e^{ax}) = ae^{ax}, \frac{d}{dx}(e^x) = e^x, \frac{d}{dx}(e^{-x}) = -e^{-x}$
3. $\frac{d}{dx}(log(ax+b)) = \frac{a}{ax+b}, \frac{d}{dx}(logx) = \frac{1}{x}$
4. $\frac{d}{dx}(sinax) = a\,cosax, \frac{d}{dx}(sinx) = cosx$
5. $\frac{d}{dx}(cosax) = -a\sin ax, \frac{d}{dx}(cosx) = -sinx$
6. $\frac{d}{dx}(\tan ax) = asec^2 ax, \frac{d}{dx}(tanx) = sec^2x$
7. $\frac{d}{dx}(cosec\ ax) = -acosec\ ax \cot ax, \frac{d}{dx}(cosecx) = -cosecx\ cotx$
8. $\frac{d}{dx}(\sec ax) = a\sec ax \tan ax, \frac{d}{dx}(secx) = secxtanx$
9. $\frac{d}{dx}(\cot ax) = -a\ cosec^2 ax, \frac{d}{dx}(cotx) = -cosec^2x$
10. $\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx} = uv' + vu'$
11. $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2} = \frac{vu'-uv'}{v^2}$
12. $\frac{d}{dx}(\sin^{-1}x) = \frac{1}{\sqrt{1-x^2}}$
13. $\frac{d}{dx}(\cos^{-1}x) = \frac{-1}{\sqrt{1-x^2}}$
14. $\frac{d}{dx}(\tan^{-1}x) = \frac{1}{1+x^2}$
15. $\frac{d}{dx}(\cot^{-1}x) = \frac{-1}{1+x^2}$
16. $\frac{d}{dx}(\sec^{-1}x) = \frac{1}{x\sqrt{x^2-1}}$

17. $\frac{d}{dx}(cosec^{-1}x) = \frac{-1}{x\sqrt{x^2-1}}$

INTEGRATION FORMULA

1. $\int x^n\,dx = \frac{x^{n+1}}{n+1} + c\,, if\ n \neq -1$
2. $\int (ax+b)^n dx = \frac{(ax+b)^{n+1}}{a(n+1)} + c\ if\ n \neq -1$
3. $\int e^{ax} dx = \frac{e^{ax}}{a} + c\,, \int e^x dx = \frac{e^x}{1} = e^x + c\,, \int e^{-x} dx = \frac{e^{-x}}{-1} = -e^{-x}$
4. $\int \frac{dx}{x} = \frac{logx}{1} = logx + c\,, \int \frac{dx}{ax+b} = \frac{\log(ax+b)}{a} + c$
5. $\int \sin ax\,dx = \frac{-\cos ax}{a} + c\,, \int \sin x\,dx = -\cos x + c$
6. $\int \cos\ ax\ dx = \frac{sinax}{a} + c\,, \int \cos x\,dx = \sin x + c$
7. $\int \tan ax\,dx = \frac{\log(\sec ax)}{a} + c\,, \int \tan x\,dx = \log(\sec x) + c$
8. $\int \cot ax\,dx = \frac{\log(sinax)}{a} + c\,, \int \cot x\,dx = \log(\sin x) + c$
9. $\int \sec ax\,dx = \frac{\log(\sec ax + \tan ax)}{a} + c\,, \int \sec x\,dx = \log(\sec x + \tan x) + c$
10. $\int cosec\ ax\,dx = -\frac{\log(cosec\ ax + \cot ax)}{a} + c\,, \int cosec\ x\,dx = -\log(cosec\ x + cotx) + c$
11. $\int sec^2 ax\,dx = \frac{\tan ax}{a} + c\,, \int sec^2 x\,dx = \tan x + c$
12. $\int cosec^2 ax\,dx = \frac{-\cot ax}{a} + c\,, \int cosec^2 x\,dx = -\cot x + c$
13. $\int \sec ax \tan ax\,dx = \frac{\sec ax}{a} + c, \int \sec x \tan x\,dx = \sec x + c$
14. $\int cosec\ ax \cot ax\,dx = \frac{-cosecax}{a} + c\,, \int cosec\ x \cot x\,dx = -cosec\ x + c$
15. $\int \frac{dx}{x^2+a^2} = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right) + c$
16. $\int \frac{dx}{x^2-a^2} = \frac{1}{2a}\log\left(\frac{x-a}{x+a}\right) + c$

17. $\int \frac{dx}{a^2-x^2} = \frac{1}{2a}\log\left(\frac{a+x}{a-x}\right) + c$

18. $\int \frac{dx}{\sqrt{a^2-x^2}} = \sin^{-1}\left(\frac{x}{a}\right) + c$

19. $\int \frac{dx}{\sqrt{x^2+a^2}} = \sinh^{-1}\left(\frac{x}{a}\right) + c \ (or) \ log\left[\frac{x+\sqrt{x^2+a^2}}{a}\right] + c$

20. $\int \frac{dx}{\sqrt{x^2-a^2}} = \cosh^{-1}\left(\frac{x}{a}\right) + c \ \ (or) \ \ \log\left[\frac{x+\sqrt{x^2-a^2}}{a}\right] + \mathrm{c}$

21. $\int \sqrt{a^2-x^2}dx = \frac{\mathrm{x}}{2}\sqrt{a^2-x^2} + \frac{a^2}{2}\sin^{-1}\left(\frac{x}{a}\right) + c$

22. $\int \sqrt{a^2+x^2}dx = \frac{x}{2}\sqrt{a^2+x^2} + \frac{a^2}{2}\sinh^{-1}\left(\frac{x}{a}\right) + c$

23. $\int \sqrt{x^2-a^2}dx = \frac{\mathrm{x}}{2}\sqrt{x^2-a^2} - \frac{a^2}{2}\cosh^{-1}\left(\frac{x}{a}\right) + \mathrm{c}$

24. *Integration by parts*

$$\int u \ dv = uv - \int v \, du + c$$

Rules for choosing: ILATE

u ↓

I → Inverse trigonometry function $(\sin^{-1}x\,,\ \cos^{-1}x\,, \ldots\ldots)$

L → Logarithmic function $(\log x)$

A → Algebraic function $(x\,, x^2, x^3, \ldots.)$

T → Trigonometry function $(\sin x\,, \cos x\,, \tan x\,, \ldots.)$

E → Exponential function e^x

25. Bernoulli's formula

$$\int u\,dv = uv - u'v_1 + u''v_2 - u''v_3 + \cdots$$

Where, $u = \frac{du}{dx}$, $u'' = \frac{du'}{dx}$, $u''' = \frac{du''}{dx}$, …

And $v_1 = \int v\, dx$, $v_2 = \int v_1 dx$, $v_3 = \int v_2 dx$, ……

u → Algebraic function

dv → Either trigonometry function

(or) Exponential function