- Integration is inverse process of differentiation.
- Integration is process of finding a function, whose d.c in known.

$$\int \boldsymbol{f'(x)\, dx = f(x) + c}$$

BASIC FORMULAE:

Derivatives

1. $\frac{d}{dx}\left(\frac{x^{n+1}}{n+1}\right) = x^n$
2. $\frac{d}{dx}(sinx) = cosx$
3. $\frac{d}{dx}(-cosx) = sinx$
4. $\frac{d}{dx}(tanx) = sec^2x$
5. $\frac{d}{dx}(-cotx) = cosec^2x$
6. $\frac{d}{dx}(secx) = secx.tanx$
7. $\frac{d}{dx}(-cosecx) = cosecx.cotx$
8. $\frac{d}{dx}(sin^{-1}x) = \frac{1}{\sqrt{1-x^2}}$
9. $\frac{d}{dx}(-cos^{-1}x) = \frac{1}{\sqrt{1-x^2}}$
10. $\frac{d}{dx}(tan^{-1}x) = \frac{1}{1+x^2}$
11. $\frac{d}{dx}(-cot^{-1}x) = \frac{1}{1+x^2}$
12. $\frac{d}{dx}(sec^{-1}x) = \frac{1}{x\sqrt{x^2-1}}$
13. $\frac{d}{dx}(-cosec^{-1}x) = \frac{1}{x\sqrt{x^2-1}}$
14. $\frac{d(e^x)}{dx} = e^x$
15. $\frac{d}{dx}(log|x|) = \frac{1}{x}$
16. $\frac{d}{dx}(a^x) = a^x loga$

Integrals(Anti derivatives)

1. $\int x^n\, dx = \frac{x^{n+1}}{n+1} + c$
2. $\int cosx\, dx = sinx + c$
3. $\int sinx\, dx = -cosx + c$
4. $\int sec^2x\, dx = tanx + c$
5. $\int cosec^2x\, dx = -cotx + c$
6. $\int secx.tanx\, dx = secx + c$
7. $\int cosecx.cotx\, dx = -cosecx + c$
8. $\int \frac{dx}{\sqrt{1-x^2}} = sin^{-1}x + c$
9. $\int \frac{dx}{\sqrt{1-x^2}} = -cos^{-1}x + c$
10. $\int \frac{dx}{1+x^2} = tan^{-1}x + c$
11. $\int \frac{dx}{1+x^2} = -cot^{-1}x + c$
12. $\int \frac{dx}{x\sqrt{x^2-1}} = sec^{-1}x + c$
13. $\int \frac{dx}{x\sqrt{x^2-1}} = -cosec^{-1}x + c$
14. $\int e^x dx = e^x + c$
15. $\int \frac{1}{x} dx = log|x| + c$
16. $\int a^x dx = \frac{a^x}{loga} + c$

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Integration of some other function:

1. $\int tanx\, dx = log|secx| + c$
2. $\int cotx\, dx = log|sinx| + c$
3. $\int secx\, dx = log|secx + tanx| + c$
4. $\int cosecx\, dx = log|cosecx - cotx| + c$
5. $\int \frac{dx}{x^2-1} = \frac{1}{2a} log\left|\frac{x-a}{x+a}\right| + c$
6. $\int \frac{dx}{a^2-x^2} = \frac{1}{2a} log\left|\frac{a+x}{a-x}\right| + c$
7. $\int \frac{dx}{x^2+a^2} = \frac{1}{a} tan^{-1}\frac{x}{a} + c$
8. $\int \frac{dx}{\sqrt{x^2-a^2}} = log\left|x + \sqrt{x^2-a^2}\right| + c$
9. $\int \frac{dx}{\sqrt{a^2-x^2}} = sin^{-1}\frac{x}{a} + c$
10. $\int \frac{dx}{\sqrt{x^2+a^2}} = log\left|x + \sqrt{x^2+a^2}\right| + c$

Method to find the Integration:

(1) Integration by parts:

$$\int u.v\, dx = u\int v\, dx - \int\left(\frac{du}{dx}\int v\, dx\right)dx$$

Note: we take u that function whose first letter first come in "ILATE"
I – Inverse Trigonometric function.
L – Logarithmic function.
A – Algebraic function.
T – Trigonometric function.
E – Exponential function.

$\int e^{ax} sinbx\, dx = \frac{e^{ax}}{a^2+b^2}(asinbx - bcosbx)$

$\int e^{ax} cosbx\, dx = \frac{e^{ax}}{a^2+b^2}(acosbx + bsinbx)$

(2) Integration by substitution:
To Evaluate $\int\{f(x).\varphi'(x)\}\, dx$
Put $\varphi(x) = t\ and\ \varphi'(x)dx = dt$

Where $\varphi'(x)$ is the differential coefficient of $\varphi(x)$ with respect to x

(3) Integration by Partial fraction:

Form of Rational fraction	Form of Partial fraction
1. $\frac{px+q}{(x-a)(x-b)}$ $a \neq b$	$\frac{A}{(x-a)} + \frac{B}{(x-b)}$
2. $\frac{px+q}{(x-a)^2}$	$\frac{A}{(x-a)} + \frac{B}{(x-a)^2}$

3. $\frac{px^2+qx+r}{(x-a)(x-b)(x-c)}$ $\quad \frac{A}{(x-a)}+\frac{B}{(x-b)}+\frac{C}{(x-c)}$
4. $\frac{px+qx+r}{(x-a)^2(x-b)}$ $\quad \frac{A}{(x-a)}+\frac{B}{(x-a)^2}+\frac{C}{(x-c)}$
5. $\frac{px^2+qx+r}{(x-a)(x^2+bx+c)}$ $\quad \frac{A}{(x-a)}+\frac{Bx+c}{(x^2+bx+c)}$

where (x^2+bx+c) can not be factorize

Some Properties of Definite Integrals:

1. $\int_a^b f(x)dx = \int_a^b f(t)dt$
2. $\int_a^b f(x)dx = -\int_b^a f(x)dx$
3. $\int_a^a f(x)dx = 0$
4. $\int_a^b f(x)dx = \int_a^c f(x)dx + \int_c^b f(x)dx$
5. $\int_a^b f(x)dx = \int_a^b f(a+b-x)dx$
6. $\int_0^b f(x)dx = \int_0^b f(a-x)dx$
7. $\int_0^{2a} f(x)dx = \int_0^a f(x)dx + \int_0^a f(2a-x)dx$
8. $\int_0^{2a} f(x)dx = \begin{cases} 2\int_0^a f(x)dx, & if (2a-x) = f(x) \\ 0, & if\ f(2a-x) = -f(x) \end{cases}$
9. $\int_{-a}^a f(x)dx = \begin{cases} 2\int_0^a f(x)dx, & if\ f\ is\ even\ function\ f(-x) = f(x) \\ 0, & if\ is\ odd\ function\ f(-x) = -f(x) \end{cases}$

Important formula

1. 2sinA.SinB= cos(A-B)-cos(A+B)
2. 2sinA.cosB= sin(A+B)+sin(A-B)
3. 2cosA.sinB=sin(A+B)-sin(A-B)
4. 2cosA.cosB=cos(A+B)+cos(A-B)
5. Sin3A= 3sinA-4sin^{3}A
6. Cos3A= 4cos^{3}A-3cosA
7. Tan3A= $\frac{3tanA-tan^3A}{1-3tan^2A}$
8. Cos2A=2cos^{2}A-1=1-2sin^{2}A=cos^{2}A-sin^{2}A=$\frac{1-tan^2A}{1+tan^2A}$
9. Sin2A= 2sinA.cosA = $\frac{2tanA}{1+tan^2A}$

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