MATHEMATICS-1

FORMULAE TO BE REMEMBERED

TRIGONOMETRY:

1. $\sin^2 x + \cos^2 x = 1 \Rightarrow \begin{cases} 1 - \sin^2 x = \cos^2 x \\ 1 - \cos^2 x = \sin^2 x \end{cases}$
2. $1 + \tan^2 x = \sec^2 x \Rightarrow \begin{cases} \sec^2 x - 1 = \tan^2 x \\ \sec^2 x - \tan^2 x = 1 \end{cases}$
3. $1 + \cot^2 x = \cos ec^2 x \Rightarrow \begin{cases} \text{cosec}^2 x - 1 = \cot^2 x \\ \text{cosec}^2 x - \cot^2 x = 1 \end{cases}$

Addition and subtraction of two angles

1. $\sin(x + y) = \sin x \cos y + \cos x \sin y$
2. $\sin(x - y) = \sin x \cos y - \cos x \sin y$
3. $\cos(x + y) = \cos x \cos y - \sin x \sin y$
4. $\cos(x - y) = \cos x \cos y + \sin x \sin y$
5. $\tan(x + y) = \dfrac{\tan x + \tan y}{1 - \tan x \tan y}$
6. $\tan(x - y) = \dfrac{\tan x - \tan y}{1 + \tan x \tan y}$

Sum and difference into products

1. $\sin x + \sin y = 2 \sin\left(\dfrac{x + y}{2}\right) \cos\left(\dfrac{x - y}{2}\right)$
2. $\sin x - \sin y = 2 \cos\left(\dfrac{x + y}{2}\right) \sin\left(\dfrac{x - y}{2}\right)$
3. $\cos x + \cos y = 2 \cos\left(\dfrac{x + y}{2}\right) \cos\left(\dfrac{x - y}{2}\right)$
4. $\cos x - \cos y = -2 \sin\left(\dfrac{x + y}{2}\right) \sin\left(\dfrac{x - y}{2}\right)$

Product into sum or difference

1. $\sin A \cos B = \dfrac{1}{2}\left[\sin(A + B) + \sin(A - B)\right]$
2. $\cos A \sin B = \dfrac{1}{2}\left[\sin(A + B) - \sin(A - B)\right]$
3. $\cos A \cos B = \dfrac{1}{2}\left[\cos(A + B) + \cos(A - B)\right]$
4. $\sin A \sin B = -\dfrac{1}{2}\left[\cos(A + B) - \cos(A - B)\right]$

Trigonometric ratios of multiple angles

1. $\sin 2x = \begin{cases} 2\sin x \cos x \\ \dfrac{2\tan x}{1+\tan^2 x} \end{cases}$

2. $\cos 2x = \begin{cases} \cos^2 x - \sin^2 x \\ 1 - 2\sin^2 x \\ 2\cos^2 x - 1 \\ \dfrac{1-\tan^2 x}{1+\tan^2 x} \end{cases}$

3. $\tan 2x = \dfrac{2\tan x}{1-\tan^2 x}$

4. $\sin 3x = 3\sin x - 4\sin^3 x$

5. $\cos 3x = 4\cos^3 x - 3\cos x$

6. $\tan 3x = \dfrac{3\tan x - \tan^3 x}{1-3\tan^2 x}$

7. $1 - \cos 2x = 2\sin^2 x$

8. $1 + \cos 2x = 2\cos^2 x$

Half angle formulae

1. $\sin x = 2\sin\left(\dfrac{x}{2}\right)\cos\left(\dfrac{x}{2}\right)$

2. $\cos x = \cos^2\left(\dfrac{x}{2}\right) - \sin^2\left(\dfrac{x}{2}\right)$

3. $\cos^2\left(\dfrac{x}{2}\right) + \sin^2\left(\dfrac{x}{2}\right) = 1$

4. $1 - \cos x = 2\sin^2\left(\dfrac{x}{2}\right)$

5. $1 + \cos x = 2\cos^2\left(\dfrac{x}{2}\right)$

Trigonometric ratios

function	$0°$	$30°\ \left(\frac{\pi}{6}\right)$	$45°\ \left(\frac{\pi}{4}\right)$	$60°\ \left(\frac{\pi}{3}\right)$	$90°\ \left(\frac{\pi}{2}\right)$
sin	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
cos	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
tan	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	∞
cosec	∞	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1

sec	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	∞
cot	∞	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

Trigonometric ratios of complementary angles

1. $\sin(90-x)=\cos x$
2. $\cos(90-x)=\sin x$
3. $\tan(90-x)=\cot x$
4. $\cot(90-x)=\tan x$
5. $\sec(90-x)=\cos ecx$
6. $\text{cosec}(90-x)=\sec cx$

DIFFERENTIATION

1. $\frac{d}{dx}\left(x^n\right)=nx^{n-1}$
2. $\frac{d}{dx}\left(\frac{1}{x}\right)=-\frac{1}{x^2}$
3. $\frac{d}{dx}\left(x\right)=1$
4. $\frac{d}{dx}\left(cons\tan t\right)=0$
5. $\frac{d}{dx}\left(e^x\right)=e^x$
6. $\frac{d}{dx}\left(\log x\right)=\frac{1}{x}$
7. $\frac{d}{dx}\left(\sqrt{x}\right)=\frac{1}{2\sqrt{x}}$
8. $\frac{d}{dx}\left(\sin x\right)=\cos x$
9. $\frac{d}{dx}\left(\cos x\right)=-\sin x$
10. $\frac{d}{dx}\left(\tan x\right)=\sec^2 x$
11. $\frac{d}{dx}\left(\cot x\right)=-\cos ec^2 x$
12. $\frac{d}{dx}\left(\sec x\right)=\sec x\tan x$
13. $\frac{d}{dx}\left(\text{cosec}\,x\right)=-\cos ec\,x\cot x$
14. $\frac{d}{dx}\left(a^x\right)=a^x\log a$
15. $\frac{d}{dx}\left(\sin^{-1}x\right)=\frac{1}{\sqrt{1-x^2}}$
16. $\frac{d}{dx}\left(\cos^{-1}x\right)=\frac{-1}{\sqrt{1-x^2}}$
17. $\frac{d}{dx}\left(\tan^{-1}x\right)=\frac{1}{1+x^2}$
18. $\frac{d}{dx}\left(\cot^{-1}x\right)=\frac{-1}{1+x^2}$
19. $\frac{d}{dx}\left(\sec^{-1}x\right)=\frac{1}{x\sqrt{x^2-1}}$
20. $\frac{d}{dx}\left(\text{cosec}^{-1}x\right)=\frac{-1}{x\sqrt{x^2-1}}$
21. $\frac{d}{dx}\left(uv\right)=u\frac{dv}{dx}+v\frac{du}{dx}$ (PRODUCT RULE)
22. $\frac{d}{dx}\left(\frac{u}{v}\right)=\frac{v\frac{du}{dx}-u\frac{dv}{dx}}{v^2}$ (QUOTIENT RULE)