MATHEMATICS FORMULA LIST

FOR CLASS XI (For First Term)

Geometry

- In a clock, a minute hand rotates through an angle of 6° in one minute.
- In a clock, an hour hand rotates through an angle of $\left(\frac{1}{2}\right)^0$ in one minute.

Set Theory

The total number of subsets of a finite set consisting of n elements is 2^n.

For any three sets A, B and C:

$(i)\ (A\cup B)\cup C = A\cup(B\cup C)$

$(ii)\ (A\cap B)\cap C = A\cap(B\cap C)$

$(iii)\ A\cup(B\cap C) = (A\cup B)\cap(A\cup C)$

$(iv)\ A\cap(B\cup C) = (A\cap B)\cup(A\cap C)$

$(v)\ (A\cup B)' = A'\cap B'$

$(vi)\ (A\cap B)' = A'\cup B'$ (De Morgan's Law)

$(vii)\ A-(B\cup C) = (A-B)\cap(A-C)$

$(viii)\ A-(B\cap C) = (A-B)\cup(A-C)$

$n(A \cup B) = n(A) + n(B) - n(A \cap B)$

$n(A-B) = n(A) - n(A\cap B)$

$n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(A \cap C) - n(B \cap C) + n(A \cap B \cap C)$

Number of elements in exactly two of the sets A, B and C =

$n(A\cap B) + n(B\cap C) + n(C\cap A) - 3n(A\cap B\cap C)$

Number of elements in exactly one of the sets A, B and C =

$n(A) + n(B) + n(C) - 2n(A\cap B) - 2n(B\cap C) - 2n(C\cap A) + 3n(A\cap B\cap C)$

Relations and Functions

For any three sets A, B and C:

$(i)\ A\times(B\cup C)=(A\times B)\cup(A\times C)$

$(ii)\ A\times(B\cap C)=(A\times B)\cap(A\times C)$

$(iii)\ (A-B)\times C=(A\times C)-(B\times C)$

$(iv)\ (A\cap B)\times C=(A\times C)\cap(B\times C)$

If A and B are two non-empty finite sets consisting of m and n elements respectively, then the total number of relations from A to B is 2^{mn}

Trigonometry

$180^0 = \pi$ radians ; $\theta = \frac{l}{r}$, θ is measured in radians

In a right triangle: $\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$ $\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$ $\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$

Pythagoras' Theorem:

In a right triangle ABC, where a,b are the short sides and c is the hypotenuse then $c^2 = a^2 + b^2$

Trigonometric Ratios of Special Angles

$\cos 45° = \frac{1}{\sqrt{2}}$ $\cos 60° = \frac{1}{2}$ $\cos 30° = \frac{\sqrt{3}}{2}$

$\sin 45° = \frac{1}{\sqrt{2}}$ $\sin 60° = \frac{\sqrt{3}}{2}$ $\sin 30° = \frac{1}{2}$

$\tan 45° = 1$ $\tan 60° = \sqrt{3}$ $\tan 30° = \frac{1}{\sqrt{3}}$

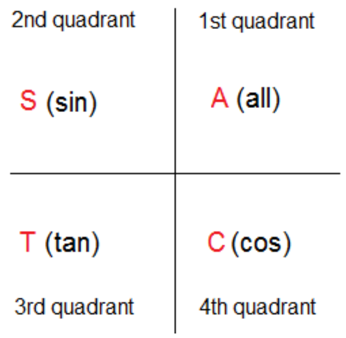
Trigonometric Ratios of Complementary Angles

$\sin(90° - \theta) = \cos\theta$; $\cos(90° - \theta) = \sin\theta$

$\tan(90° - \theta) = \cot\theta$; $\cot(90^0 - \theta) = \tan\theta$

$\sec(90° - \theta) = \cos ec\theta$; $\text{cosec}(90° - \theta) = \sec\theta$

Signs of Trigonometric Ratios in Quadrants



$\cos(-\theta) = \cos\theta$; $\sin(-\theta) = -\sin\theta$; $\tan(-\theta) = -\tan\theta$

$\sec\theta = \frac{1}{\cos\theta}$; $\text{cosec}\theta = \frac{1}{\sin\theta}$; $\cot\theta = \frac{1}{\tan\theta}$; $\tan\theta = \frac{\sin\theta}{\cos\theta}$; $\cot\theta = \frac{\cos\theta}{\sin\theta}$

$\sin^2\theta + \cos^2\theta = 1$; $1 + \tan^2\theta = \sec^2\theta$; $1 + \cot^2\theta = \cos ec^2\theta$

$-1 \le \sin x \le 1$; $-1 \le \sin x \le 1$; $-\infty < \tan x < \infty$

Degrees	0	45	90	135	180	225	270	315	360
Radians	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$	2π

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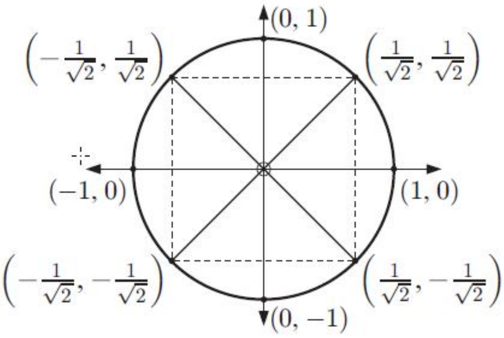
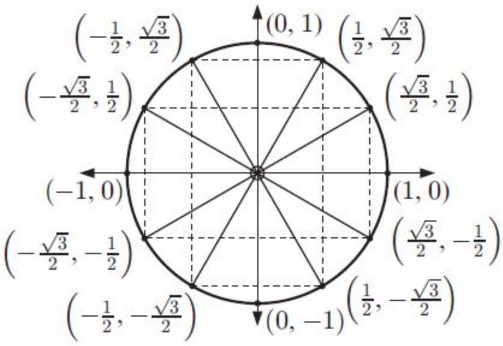
θ (degrees)	0°	90°	180°	270°	360°	450°
θ (radians)	0	$\frac{\pi}{2}$	π	$\frac{3\pi}{2}$	2π	$\frac{5\pi}{2}$
sine	0	1	0	−1	0	1
cosine	1	0	−1	0	1	0
tangent	0	undef	0	undef	0	undef

θ (degrees)	30°	45°	60°	135°	150°	240°	315°
θ (radians)	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{3\pi}{4}$	$\frac{5\pi}{6}$	$\frac{4\pi}{3}$	$\frac{7\pi}{4}$
sine	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	$-\frac{\sqrt{3}}{2}$	$-\frac{1}{\sqrt{2}}$
cosine	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	$-\frac{1}{\sqrt{2}}$	$-\frac{\sqrt{3}}{2}$	$-\frac{1}{2}$	$\frac{1}{\sqrt{2}}$
tangent	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	−1	$-\frac{1}{\sqrt{3}}$	$\sqrt{3}$	−1





$\sin(A+B) = \sin A\cos B + \cos A\sin B$; $\sin(A-B) = \sin A\cos B - \cos A\sin B$

$\cos(A+B) = \cos A\cos B - \sin A\sin B$; $\cos(A-B) = \cos A\cos B + \sin A\sin B$

$\tan(A+B) = \dfrac{\tan A + \tan B}{1-\tan A\tan B}$; $\tan(A-B) = \dfrac{\tan A + \tan B}{1+\tan A\tan B}$

$\sin(A+B)\sin(A-B) = \sin^2 A - \sin^2 B = \cos^2 B - \cos^2 A$

$\cos(A+B)\cos(A-B) = \cos^2 A - \sin^2 B = \cos^2 B - \sin^2 A$

$2\sin A\cos B = \sin(A+B) + \sin(A-B)$; $2\cos A\sin B = \sin(A+B) - \sin(A-B)$

$2\cos A\cos B = \cos(A+B) + \cos(A-B)$; $2\sin A\sin B = \cos(A-B) - \cos(A+B)$

$\sin A + \sin B = 2\sin\left(\dfrac{A+B}{2}\right)\cos\left(\dfrac{A-B}{2}\right)$; $\sin A - \sin B = 2\cos\left(\dfrac{A+B}{2}\right)\sin\left(\dfrac{A-B}{2}\right)$

$\cos A + \cos B = 2\cos\left(\dfrac{A+B}{2}\right)\cos\left(\dfrac{A-B}{2}\right)$; $\cos A - \cos B = -2\sin\left(\dfrac{A+B}{2}\right)\sin\left(\dfrac{A-B}{2}\right)$

$$\sin 2A = 2\sin A\cos A = \frac{2\tan A}{1+\tan^2 A}$$

$$\cos 2A = \cos^2 A - \sin^2 A = 2\cos^2 A - 1 = 1 - 2\sin^2 A = \frac{1-\tan^2 A}{1+\tan^2 A}$$

$$\tan 2A = \frac{2\tan A}{1-\tan^2 A}$$

$$\sin A = \pm\sqrt{\frac{1-\cos 2A}{2}} \quad ; \quad \cos A = \pm\sqrt{\frac{1+\cos 2A}{2}}$$

$$\sin 3A = 3\sin A - 4\sin^3 A \quad ; \quad \cos 3A = 4\cos^3 A - 3\cos A \quad ; \quad \tan 3A = \frac{3\tan A - \tan^3 A}{1 - 3\tan^2 A}$$

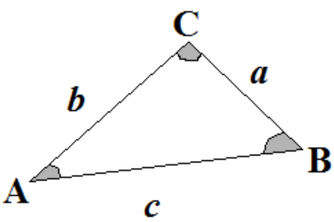
$$\cos A\cos 2A\cos 2^2 A\cos 2^3 A \ldots \cos 2^{n-1} A = \frac{\sin 2^n A}{2^n \sin A}$$

Sine Rule

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = k \quad \text{or} \quad \frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c} = k$$

Cosine Rule

$$\cos A = \frac{b^2+c^2-a^2}{2bc} \quad ; \quad \cos B = \frac{a^2+c^2-b^2}{2ac} \quad ; \quad \cos C = \frac{a^2+b^2-c^2}{2ab}$$



Area of triangle formula:

$$= \frac{1}{2}\text{ab}\,\sin\text{C} = \frac{1}{2}\text{bc}\,\sin\text{A} = \frac{1}{2}\text{ac}\,\sin\text{B}$$

Maximum and minimum values of $a\cos\theta + b\sin\theta$ are $\sqrt{a^2+b^2}$ and $-\sqrt{a^2+b^2}$ respectively.

Trigonometric Equation		General Solution
(i)	$\sin\theta = 0$	$\theta = n\pi \; , n\in Z$
(ii)	$\cos\theta = 0$	$\theta = (2n+1)\frac{\pi}{2} \; , n\in Z$
(iii)	$\tan\theta = 0$	$\theta = n\pi \; , n\in Z$
(iv)	$\sin\theta = \sin\alpha$	$\theta = n\pi + (-1)^n\alpha \; , n\in Z$
(v)	$\cos\theta = \cos\alpha$	$\theta = 2n\pi \pm \alpha \; , n\in Z$
(vi)	$\tan\theta = \tan\alpha$	$\theta = n\pi + \alpha \; , n\in Z$
(vii)	$\left.\begin{array}{l}\sin^2\theta = \sin^2\alpha \\ \cos^2\theta = \cos^2\alpha \\ \tan^2\theta = \tan^2\alpha\end{array}\right\}$	$\theta = n\pi \pm \alpha \; , n\in Z$

$$\sin n\pi = 0 \quad ; \quad \cos n\pi = (-1)^n \quad ; \quad \tan n\pi = 0$$

Complex Numbers

Multiplicative Inverse of $z = a + ib$ is $\dfrac{\overline{z}}{|z|^2}$.

Conjugate of $z = a + ib$ is $\overline{z} = a - ib$.

Modulus of $z = a + ib$ is $|z| = \sqrt{a^2 + b^2}$

For three complex numbers z_1, z_2, z_3:

$(i)\ \left(\overline{\overline{z}}\right) = z$ $\quad (ii)\ z + \overline{z} = 2\,\mathrm{Re}(z)$ $\quad (iii)\ z - \overline{z} = 2\,\mathrm{Im}(z)$ $\quad (iv)\ z\,\overline{z} = |z|^2$

$(v)\ \overline{z_1 \pm z_2} = \overline{z}_1 \pm \overline{z}_2$ $\quad (v)\ \overline{z_1 z_2} = \overline{z}_1 \overline{z}_2$ $\quad (vi)\ \overline{\left(\dfrac{z_1}{z_2}\right)} = \dfrac{\overline{z}_1}{\overline{z}_2}\ ;\ z_2 \neq 0$

Square root of a complex number:

Use $\left(a^2 + b^2\right)^2 = \left(a^2 - b^2\right)^2 + 4a^2b^2$

$$\sqrt{z} = \pm\left\{\sqrt{\frac{|z| + \mathrm{Re}(z)}{2}} + i\sqrt{\frac{|z| - \mathrm{Re}(z)}{2}}\right\};\ \text{if } \mathrm{Im}(z) > 0$$

$$\sqrt{z} = \pm\left\{\sqrt{\frac{|z| + \mathrm{Re}(z)}{2}} - i\sqrt{\frac{|z| - \mathrm{Re}(z)}{2}}\right\};\ \text{if } \mathrm{Im}(z) < 0$$

Polar Form: $z = r(\cos\theta + i\sin\theta)$

Algorithm:

Step 1: Find $\alpha = \tan^{-1}\left|\dfrac{y}{x}\right|$, lying between 0 and $\dfrac{\pi}{2}$.

Step 2: Determine in which quadrant the point $P(x, y)$ belongs.

If I quad then $\theta = \alpha$, If II quad then $\theta = \pi - \alpha$

If III quad then $\theta = \pi + \alpha$, If II quad then $\theta = 2\pi - \alpha$

Quadratic Formula

If $ax^2 + bx + c = 0,$ then $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Linear In equations

$(i)\ x^2 \le a^2 \Leftrightarrow |x| \le a \Leftrightarrow -a \le x \le a$ $\quad (ii)\ x^2 \ge a^2 \Leftrightarrow |x| \ge a \Leftrightarrow x \le -a$ or $x \ge a$

$(iii)\ x^2 < a^2 \Leftrightarrow |x| < a \Leftrightarrow -a < x < a$ $\quad (iv)\ x^2 > a^2 \Leftrightarrow |x| > a \Leftrightarrow x > -a$ or $x > a$

$(v)\ |x - a| < b \Leftrightarrow a - b < x < a + b$ $\quad (vi)\ |x - a| > b \Leftrightarrow x > a + b$ or $x < a - b$