Trig Formulas

Co-Functions (Complements)

$\cos(\frac{\pi}{2} - u) = \sin u$ $\quad$ $\tan(\frac{\pi}{2} - u) = \cot u$ $\quad$ $\sec(\frac{\pi}{2} - u) = \csc u$

$\sin(\frac{\pi}{2} - u) = \cos u$ $\quad$ $\cot(\frac{\pi}{2} - u) = \tan u$ $\quad$ $\csc(\frac{\pi}{2} - u) = \sec u$

Addition & Subtraction

$\cos(u + v) = \cos u \cos v - \sin u \sin v$ $\quad$ $\cos(u - v) = \cos u \cos v + \sin u \sin v$

$\sin(u + v) = \sin u \cos v + \cos u \sin v$ $\quad$ $\sin(u - v) = \sin u \cos v - \cos u \sin v$

$\tan(u + v) = \frac{\tan u + \tan v}{1 - \tan u \tan v}$ $\quad$ $\tan(u - v) = \frac{\tan u - \tan v}{1 + \tan u \tan v}$

Double-Angle & Half-Angle

$\sin 2u = 2 \sin u \cos u$

$\cos 2u = \cos^2 u - \sin^2 u$

$= 1 - 2 \sin^2 u$

$= 2 \cos^2 u - 1$

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

$\sin^2 \frac{v}{2} = \frac{1 - \cos v}{2}$

$\cos^2 \frac{v}{2} = \frac{1 + \cos v}{2}$

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

$\tan \frac{v}{2} = \pm \sqrt{\frac{1 - \cos v}{1 + \cos v}}$

$= \frac{1 - \cos v}{\sin v}$

$= \frac{\sin v}{1 + \cos v}$

Sums & Products

$\sin u \cos v = \frac{1}{2} [\sin(u + v) + \sin(u - v)]$ $\quad$ $\sin a + \sin b = 2 \sin \frac{a+b}{2} \cos \frac{a-b}{2}$

$\cos u \sin v = \frac{1}{2} [\sin(u + v) - \sin(u - v)]$ $\quad$ $\sin a - \sin b = 2 \cos \frac{a+b}{2} \sin \frac{a-b}{2}$

$\cos u \cos v = \frac{1}{2} [\cos(u + v) + \cos(u - v)]$ $\quad$ $\cos a + \cos b = 2 \cos \frac{a+b}{2} \cos \frac{a-b}{2}$

$\sin u \sin v = \frac{1}{2} [\cos(u - v) - \cos(u + v)]$ $\quad$ $\cos a - \cos b = -2 \sin \frac{a+b}{2} \sin \frac{a-b}{2}$

Geometric Formulas

length of a circular arc: $s = r\theta$
area of a circular sector: $A = \frac{1}{2} r^2 \theta$
volume of a cone: $V = \frac{1}{3} \pi r^2 h$
surface area of a cone: $S = \pi r \sqrt{r^2 + h^2}$

volume of a sphere: $V = \frac{4}{3} \pi r^3$
surface area of a sphere: $S = 4\pi r^2$
volume of a right circular cylinder: $V = \pi r^2 h$
surface area of a right circular cylinder: $S = 2\pi rh$