

Mathematical Prerequisites

This collection of formulas is not intended to be complete, but it may give you an impression which formulas you should know to be well prepared for this course.

Geometric formulas

Triangle: $A = \frac{1}{2}bh$

Circle: $A = \pi r^2$

Parallelogram: $A = bh$

Sphere: $V = \frac{4}{3}\pi r^3$, $A = 4\pi r^2$

Right circular cylinder: $V = \pi r^2 h$,

lateral surface $A_{lat} = 2\pi r h$ (open ends)

total surface $A_{tot} = 2\pi r h + 2\pi r^2$

Right circular cone: $V = \frac{1}{3}\pi r^2 h$

Basic algebra

Binomial formulas

$$(a + b)^2 = a^2 + 2ab + b^2$$

$$(a - b)^2 = a^2 - 2ab + b^2$$

$$(a + b)(a - b) = a^2 - b^2$$

$$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$$

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$$

Quadratic equations

$$ax^2 + bx + c = 0$$

$$x^2 + px + q = 0$$

$$x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad x_{1,2} = -\frac{p}{2} \pm \sqrt{\left(\frac{p}{2}\right)^2 - q}$$

Exponentials and radicals

$$a^m a^n = a^{m+n} \quad \sqrt[n]{a} \sqrt[n]{b} = \sqrt[n]{ab} \quad a^{-n} = \frac{1}{a^n}$$

$$a^m / a^n = a^{m-n} \quad \sqrt[n]{a} / \sqrt[n]{b} = \sqrt[n]{a/b} \quad a^{1/n} = \sqrt[n]{a}$$

$$a^n b^n = (ab)^n \quad (\sqrt[n]{a})^m = \sqrt[n]{a^m} \quad a^{m/n} = \sqrt[n]{a^m}$$

$$a^n / b^n = (a/b)^n \quad \sqrt[m]{\sqrt[n]{a}} = \sqrt[mn]{a} \quad a^{-m/n} = \frac{1}{\sqrt[n]{a^m}}$$

Finite power series

$$\sum_{k=1}^n k = \frac{1}{2}n(n+1)$$

$$\sum_{k=1}^n k^2 = \frac{1}{6}n(n+1)(2n+1)$$

$$\sum_{k=1}^n k^3 = \frac{1}{4}n^2(n+1)^2 \quad \sum_{k=1}^n k^4 = \frac{1}{30}n(n+1)(2n+1)(3n^2+3n-1)$$

Inequalities and absolute values

$$\begin{aligned} |x| \leq d & \text{ means } -d \leq x \leq d \\ |x| > d & \text{ means } x > d \text{ or } x < -d \end{aligned}$$

Trigonometry

Elementary relations

$$\begin{aligned} \sin^2 \alpha + \cos^2 \alpha &= 1 & \tan \alpha &= \frac{\sin \alpha}{\cos \alpha} & \sec \alpha &= \frac{1}{\cos \alpha} \\ \sec^2 \alpha - \tan^2 \alpha &= 1 & \cot \alpha &= \frac{1}{\tan \alpha} \end{aligned}$$

Decomposition formulas

$$\begin{aligned} \sin(\alpha \pm \beta) &= \sin \alpha \cos \beta \pm \cos \alpha \sin \beta \\ \cos(\alpha \pm \beta) &= \cos \alpha \cos \beta \mp \sin \alpha \sin \beta \\ \tan(\alpha \pm \beta) &= \frac{\tan \alpha \pm \tan \beta}{1 \mp \tan \alpha \tan \beta} \\ \cot(\alpha \pm \beta) &= \frac{\cot \alpha \cot \beta \mp 1}{\cot \beta \pm \cot \alpha} \end{aligned}$$

Double angle formulas

$$\begin{aligned} \sin 2\theta &= 2 \sin \theta \cos \theta \\ \cos 2\theta &= \cos^2 \theta - \sin^2 \theta = 2 \cos^2 \theta - 1 = 1 - 2 \sin^2 \theta \end{aligned}$$

Trig Values

θ	0	$\pi/6$	$\pi/4$	$\pi/3$	$\pi/2$
$\sin \theta$	0	1/2	$1/\sqrt{2}$	$\sqrt{3}/2$	1
$\cos \theta$	1	$\sqrt{3}/2$	$1/\sqrt{2}$	1/2	0
$\tan \theta$	0	$1/\sqrt{3}$	1	$\sqrt{3}$	undef