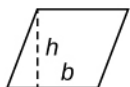


# APPENDIX C | REVIEW OF PRE-CALCULUS

## Formulas from Geometry

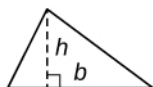
$A$  = area,  $V$  = Volume, and  $S$  = lateral surface area

Parallelogram



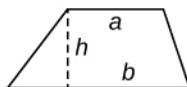
$$A = bh$$

Triangle



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

Trapezoid



$$A = \frac{1}{2}(a + b)h$$

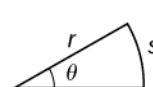
Circle



$$A = \pi r^2$$

$$C = 2\pi r$$

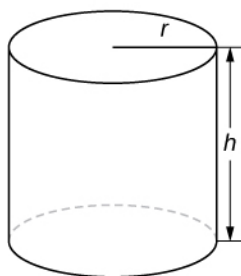
Sector



$$A = \frac{1}{2}r^2\theta$$

$$s = r\theta \text{ (}\theta \text{ in radians)}$$

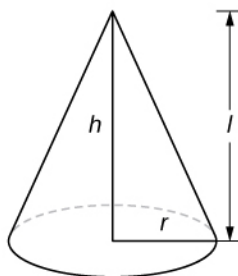
Cylinder



$$V = \pi r^2 h$$

$$S = 2\pi r h$$

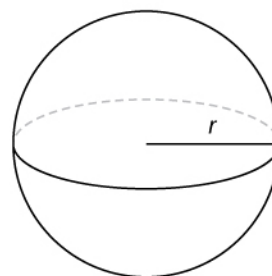
Cone



$$V = \frac{1}{3}\pi r^2 h$$

$$S = \pi r l$$

Sphere



$$V = \frac{4}{3}\pi r^3$$

$$S = 4\pi r^2$$

## Formulas from Algebra

### Laws of Exponents

$$x^m x^n = x^{m+n} \quad \frac{x^m}{x^n} = x^{m-n} \quad (x^m)^n = x^{mn}$$

$$x^{-n} = \frac{1}{x^n} \quad (xy)^n = x^n y^n \quad \left(\frac{x}{y}\right)^n = \frac{x^n}{y^n}$$

$$x^{1/n} = \sqrt[n]{x} \quad \sqrt[n]{xy} = \sqrt[n]{x}\sqrt[n]{y} \quad \sqrt[n]{\frac{x}{y}} = \frac{\sqrt[n]{x}}{\sqrt[n]{y}}$$

$$x^{m/n} = \sqrt[n]{x^m} = (\sqrt[n]{x})^m$$

### Special Factorizations

$$x^2 - y^2 = (x + y)(x - y)$$

$$x^3 + y^3 = (x + y)(x^2 - xy + y^2)$$

$$x^3 - y^3 = (x - y)(x^2 + xy + y^2)$$

### Quadratic Formula

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

## Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \cdots + \binom{n}{n-1}ab^{n-1} + b^n,$$

$$\text{where } \binom{n}{k} = \frac{n(n-1)(n-2) \cdots (n-k+1)}{k(k-1)(k-2) \cdots 3 \cdot 2 \cdot 1} = \frac{n!}{k!(n-k)!}$$

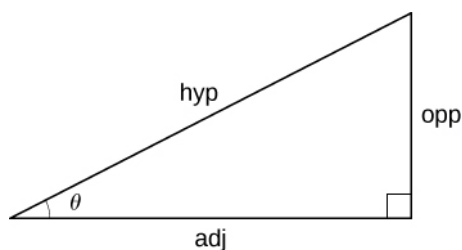
## Formulas from Trigonometry

### Right-Angle Trigonometry

$$\sin \theta = \frac{\text{opp}}{\text{hyp}} \quad \csc \theta = \frac{\text{hyp}}{\text{opp}}$$

$$\cos \theta = \frac{\text{adj}}{\text{hyp}} \quad \sec \theta = \frac{\text{hyp}}{\text{adj}}$$

$$\tan \theta = \frac{\text{opp}}{\text{adj}} \quad \cot \theta = \frac{\text{adj}}{\text{opp}}$$



### Trigonometric Functions of Important Angles

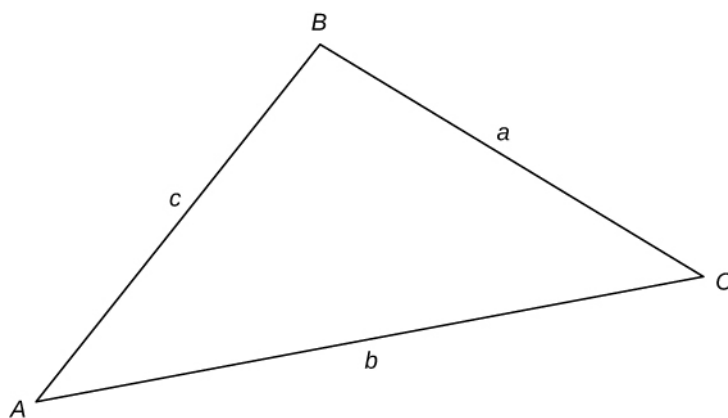
| $\theta$   | Radians | $\sin \theta$ | $\cos \theta$ | $\tan \theta$ |
|------------|---------|---------------|---------------|---------------|
| $0^\circ$  | 0       | 0             | 1             | 0             |
| $30^\circ$ | $\pi/6$ | $1/2$         | $\sqrt{3}/2$  | $\sqrt{3}/3$  |
| $45^\circ$ | $\pi/4$ | $\sqrt{2}/2$  | $\sqrt{2}/2$  | 1             |
| $60^\circ$ | $\pi/3$ | $\sqrt{3}/2$  | $1/2$         | $\sqrt{3}$    |
| $90^\circ$ | $\pi/2$ | 1             | 0             | —             |

## Fundamental Identities

$$\begin{aligned}
 \sin^2 \theta + \cos^2 \theta &= 1 & \sin(-\theta) &= -\sin \theta \\
 1 + \tan^2 \theta &= \sec^2 \theta & \cos(-\theta) &= \cos \theta \\
 1 + \cot^2 \theta &= \csc^2 \theta & \tan(-\theta) &= -\tan \theta \\
 \sin\left(\frac{\pi}{2} - \theta\right) &= \cos \theta & \sin(\theta + 2\pi) &= \sin \theta \\
 \cos\left(\frac{\pi}{2} - \theta\right) &= \sin \theta & \cos(\theta + 2\pi) &= \cos \theta \\
 \tan\left(\frac{\pi}{2} - \theta\right) &= \cot \theta & \tan(\theta + \pi) &= \tan \theta
 \end{aligned}$$

## Law of Sines

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$



## Law of Cosines

$$\begin{aligned}
 a^2 &= b^2 + c^2 - 2bc \cos A \\
 b^2 &= a^2 + c^2 - 2ac \cos B \\
 c^2 &= a^2 + b^2 - 2ab \cos C
 \end{aligned}$$

## Addition and Subtraction Formulas

$$\begin{aligned}
 \sin(x + y) &= \sin x \cos y + \cos x \sin y \\
 \sin(x - y) &= \sin x \cos y - \cos x \sin y \\
 \cos(x + y) &= \cos x \cos y - \sin x \sin y \\
 \cos(x - y) &= \cos x \cos y + \sin x \sin y \\
 \tan(x + y) &= \frac{\tan x + \tan y}{1 - \tan x \tan y} \\
 \tan(x - y) &= \frac{\tan x - \tan y}{1 + \tan x \tan y}
 \end{aligned}$$

## Double-Angle Formulas

$$\begin{aligned}
 \sin 2x &= 2 \sin x \cos x \\
 \cos 2x &= \cos^2 x - \sin^2 x = 2 \cos^2 x - 1 = 1 - 2 \sin^2 x \\
 \tan 2x &= \frac{2 \tan x}{1 - \tan^2 x}
 \end{aligned}$$

## Half-Angle Formulas

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

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