The Need-to-Know List

In order to be able to fully appreciate the calculus that you learn this year, you need to be *completely comfortable* with the following fundamental building blocks.

1. Arithmetic, Algebra, and Fractions

$(a+b)^2 = a^2 + 2ab + b^2$, **NOT** $= a^2 + b^2$

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

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

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

$$(a+b)/c = a/c + b/c$$

$c/(a+b)$ **does NOT simplify!**

$$\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$$

$$\frac{1}{c/d} = \frac{d}{c}, \qquad \frac{a/b}{c/d} = \frac{a}{b}\frac{d}{c} = \frac{ad}{bc}$$

Know how to **factor** and **find roots of** polynomials.

2. Powers

Simplifies	Does Not Simplify
$x^a x^b = x^{a+b}$	$x^a + x^b$
$a^x a^y = a^{x+y}$	$a^x + a^y$
$x^a y^a = (xy)^a$	
$(x^a)^b = x^{ab}$	$x^{(a^b)}$
$x^{-a} = 1/x^a$	
$\sqrt{xy} = \sqrt{x}\sqrt{y}$	$\sqrt{x+y}$
$\sqrt{x^2} = \lvert x \rvert$	

Memorize these special values!

$1^0 = 1 \qquad 0^1 = 0 \qquad 0^0 =$ undefined

3. Areas and Volumes

Area of a rectangle (square):	$A_{\text{rect}} = lw$ $(A_{\text{sq}} = l^2)$
Area of a triangle:	$A_{\text{tri}} = \frac{1}{2}bh$
Area of a circle:	$A_{\text{circ}} = \pi r^2$
Volume of any prism:	$V_{\text{prism}} = Ah$
(rectangular prism):	$(V_{\text{box}} = lwh)$
(cylinder):	$(V_{\text{cyl}} = \pi r^2 h)$
Volume of a sphere:	$V_{\text{sph}} = \frac{4}{3}\pi r^3$

4. Trigonometry and Triangles

$\sin\theta = \frac{\text{Opp}}{\text{Hyp}}, \qquad \cos\theta = \frac{\text{Adj}}{\text{Hyp}}, \qquad \tan\theta = \frac{\text{Opp}}{\text{Adj}}$

$a^2 + b^2 = c^2$ for right triangles with hypotenuse c.

Memorize these special values:

$30^\circ = \pi/6$ radians, $\quad 45^\circ = \pi/4, \quad 90^\circ = \pi/2, \quad 180^\circ = \pi, \quad 360^\circ = 2\pi$

Value	**0**	**1/2**	$\sqrt{\mathbf{2}}/\mathbf{2}$	$\sqrt{\mathbf{3}}/\mathbf{2}$	**1**
Sine	$\sin(0)$	$\sin(\pi/6)$	$\sin(\pi/4)$	$\sin(\pi/3)$	$\sin(\pi/2)$
Cosine	$\cos(\pi/2)$	$\cos(\pi/3)$	$\cos(\pi/4)$	$\cos(\pi/6)$	$\cos(0)$

Key Trig Identities

$$\sin^2 x + \cos^2 x = 1$$

$\sin 2x = 2\sin x \cos x$ double-angle sine formula

$\cos 2x = \cos^2 x - \sin^2 x$ double-angle cosine formula

$\sin^2 x = \frac{1}{2}(1 - \cos 2x)$ half-angle sine formula

$\cos^2 x = \frac{1}{2}(1 + \cos 2x)$ half-angle cosine formula