APPENDIX B | TABLE OF DERIVATIVES

General Formulas

1. $\frac{d}{dx}(c) = 0$
2. $\frac{d}{dx}(f(x) + g(x)) = f'(x) + g'(x)$
3. $\frac{d}{dx}(f(x)g(x)) = f'(x)g(x) + f(x)g'(x)$
4. $\frac{d}{dx}(x^n) = nx^{n-1}$, for real numbers n
5. $\frac{d}{dx}(cf(x)) = cf'(x)$
6. $\frac{d}{dx}(f(x) - g(x)) = f'(x) - g'(x)$
7. $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{g(x)f'(x) - f(x)g'(x)}{(g(x))^2}$
8. $\frac{d}{dx}[f(g(x))] = f'(g(x)) \cdot g'(x)$

Trigonometric Functions

9. $\frac{d}{dx}(\sin x) = \cos x$
10. $\frac{d}{dx}(\tan x) = \sec^2 x$
11. $\frac{d}{dx}(\sec x) = \sec x \tan x$
12. $\frac{d}{dx}(\cos x) = -\sin x$
13. $\frac{d}{dx}(\cot x) = -\csc^2 x$
14. $\frac{d}{dx}(\csc x) = -\csc x \cot x$

Inverse Trigonometric Functions

15. $\frac{d}{dx}\left(\sin^{-1} x\right) = \frac{1}{\sqrt{1 - x^2}}$
16. $\frac{d}{dx}\left(\tan^{-1} x\right) = \frac{1}{1 + x^2}$
17. $\frac{d}{dx}\left(\sec^{-1} x\right) = \frac{1}{|x|\sqrt{x^2 - 1}}$

18. $\frac{d}{dx}\left(\cos^{-1}x\right) = -\frac{1}{\sqrt{1-x^2}}$

19. $\frac{d}{dx}\left(\cot^{-1}x\right) = -\frac{1}{1+x^2}$

20. $\frac{d}{dx}\left(\csc^{-1}x\right) = -\frac{1}{|x|\sqrt{x^2-1}}$

Exponential and Logarithmic Functions

21. $\frac{d}{dx}(e^x) = e^x$

22. $\frac{d}{dx}(\ln|x|) = \frac{1}{x}$

23. $\frac{d}{dx}(b^x) = b^x \ln b$

24. $\frac{d}{dx}(\log_b x) = \frac{1}{x \ln b}$

Hyperbolic Functions

25. $\frac{d}{dx}(\sinh x) = \cosh x$

26. $\frac{d}{dx}(\tanh x) = \operatorname{sech}^2 x$

27. $\frac{d}{dx}(\operatorname{sech} x) = -\operatorname{sech} x \tanh x$

28. $\frac{d}{dx}(\cosh x) = \sinh x$

29. $\frac{d}{dx}(\coth x) = -\operatorname{csch}^2 x$

30. $\frac{d}{dx}(\operatorname{csch} x) = -\operatorname{csch} x \coth x$

Inverse Hyperbolic Functions

31. $\frac{d}{dx}\left(\sinh^{-1}x\right) = \frac{1}{\sqrt{x^2+1}}$

32. $\frac{d}{dx}\left(\tanh^{-1}x\right) = \frac{1}{1-x^2} (|x| < 1)$

33. $\frac{d}{dx}\left(\operatorname{sech}^{-1}x\right) = -\frac{1}{x\sqrt{1-x^2}} \quad (0 < x < 1)$

34. $\frac{d}{dx}\left(\cosh^{-1}x\right) = \frac{1}{\sqrt{x^2-1}} \quad (x > 1)$

35. $\frac{d}{dx}\left(\coth^{-1}x\right) = \frac{1}{1-x^2} \quad (|x| > 1)$

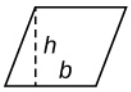
36. $\frac{d}{dx}\left(\operatorname{csch}^{-1}x\right) = -\frac{1}{|x|\sqrt{1+x^2}} (x \neq 0)$

APPENDIX C | REVIEW OF PRE-CALCULUS

Formulas from Geometry

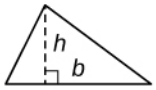
$A =$ area, $V =$ Volume, and $S =$ lateral surface area

Parallelogram



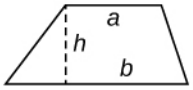
$A = bh$

Triangle



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

Trapezoid

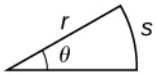


$A = \frac{1}{2}(a + b)h$

Circle

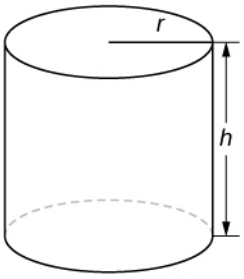
$A = \pi r^2$
$C = 2\pi r$

Sector



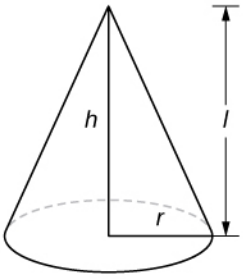
$A = \frac{1}{2}r^2\theta$
$s = r\theta$ (θ in radians)

Cylinder



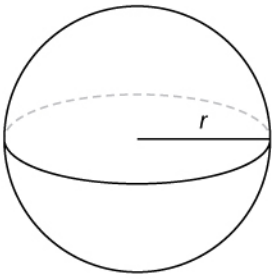
$V = \pi r^2 h$
$S = 2\pi rh$

Cone



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

Sphere



$V = \frac{4}{3}\pi r^3$
$S = 4\pi r^2$

Formulas from Algebra

Laws of Exponents

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

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

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

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

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 $x = \frac{-b \pm \sqrt{b^2 - 4ca}}{2a}$.

Binomial Theorem

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

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

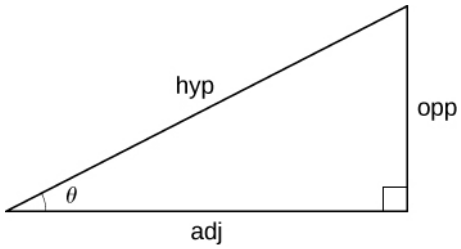
Formulas from Trigonometry

Right-Angle Trigonometry

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

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

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



Trigonometric Functions of Important Angles

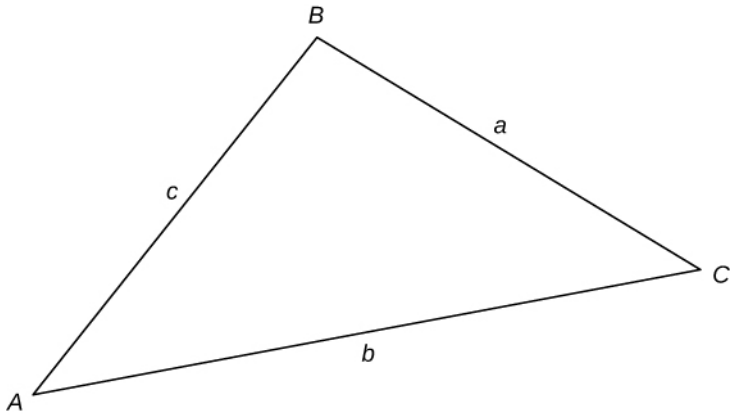
θ	Radians	$\sin\theta$	$\cos\theta$	$\tan\theta$
0°	0	0	1	0
30°	π/6	1/2	$\sqrt{3}/2$	$\sqrt{3}/3$
45°	π/4	$\sqrt{2}/2$	$\sqrt{2}/2$	1
60°	π/3	$\sqrt{3}/2$	1/2	$\sqrt{3}$
90°	π/2	1	0	—

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

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

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