

Pre-Calculus 12 Formula Sheet

1. Functions & Relations

Transformations of Functions $af(b(x-h))+k$

- Vertical stretch/compression: $af(x)$
- Horizontal stretch/compression: $f(bx)$
- Horizontal shift: $f(x - h)$
- Vertical shift: $f(x) + k$

Even/Odd Functions

- Even: $f(-x) = f(x) \rightarrow$ Flipping the function over the y-axis is the same as the function itself
 - Odd: $f(-x) = -f(x) \rightarrow$ The function flipped over the x-axis is the same as the function flipped over the y-axis
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2. Trigonometry

Primary Ratios

- $\sin(\theta) = \text{opposite} / \text{hypotenuse}$
- $\cos(\theta) = \text{adjacent} / \text{hypotenuse}$
- $\tan(\theta) = \text{opposite} / \text{adjacent}$

Reciprocal Ratios

- $\csc(\theta) = 1/\sin(\theta)$
- $\sec(\theta) = 1/\cos(\theta)$
- $\cot(\theta) = 1/\tan(\theta)$

Trig Graphs Transformation

- $y = a \cdot \sin(bx - c) + d$
 - a: amplitude
 - b: affects period (Period = $2\pi / |b|$)
 - c: phase shift (horizontal shift)
 - d: vertical shift

Special Angles

- Common angles: 0° , 30° , 45° , 60° , 90° and their radian equivalents

Pythagorean Identity

$$\sin^2(\theta) + \cos^2(\theta) = 1$$

Sum and Difference Formulas

- $\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$
- $\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$
- $\tan(A \pm B) = (\tan A \pm \tan B) / (1 \mp \tan A \cdot \tan B)$

Double Angle Formulas

- $\sin(2A) = 2\sin A \cos A$
 - $\cos(2A) = \cos^2 A - \sin^2 A$
 - $\tan(2A) = 2\tan A / (1 - \tan^2 A)$
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3. Polynomial Functions

Standard Form

- $f(x) = a_n x^n + \dots + a_1 x + a_0$

Remainder Theorem

- If $f(a) = 0 \rightarrow (x - a)$ is a factor
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4. Exponential & Logarithmic Functions

Exponential Form

- $f(x) = a \cdot b^x$, where $b > 0$ and $b \neq 1$

Logarithms

- $\log_b(x) = y \rightarrow b^y = x$

Laws of Logarithms

- $\log_b(xy) = \log_b(x) + \log_b(y)$
- $\log_b(x/y) = \log_b(x) - \log_b(y)$
- $\log_b(x^n) = n \cdot \log_b(x)$

Change of Base Formula

- $\log_b(x) = \log_c(x) / \log_c(b)$

Exponential Growth/Decay

- $A(t) = A_0 \cdot e^{(kt)}$
 - Half-life: $A = A_0(1/2)^{(t/h)}$
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5. Sequences & Series

Arithmetic Sequence

- $a_n = a_1 + (n - 1)d$
- $S_n = n/2 [2a_1 + (n - 1)d]$

Geometric Sequence

- $a_n = a_1 \cdot r^{(n - 1)}$
- $S_n = a_1(1 - r^n) / (1 - r)$, where $r \neq 1$
- $S_\infty = a_1 / (1 - r)$, where $|r| < 1$

Sigma Notation

- $\sum$ from $i = a$ to b of $f(i)$ means add all $f(i)$ values from a to b

6. Conics

Parabola (Vertical)

- $(x - h)^2 = 4p(y - k)$
- Focus: $(h, k + p)$
- Directrix: $y = k - p$
- Axis of symmetry: $x = h$

Parabola (Horizontal)

- $(y - k)^2 = 4p(x - h)$
- Focus: $(h + p, k)$
- Directrix: $x = h - p$
- Axis of symmetry: $y = k$

Circle

- $(x - h)^2 + (y - k)^2 = r^2$
- Center: (h, k) , Radius: r

Ellipse (Horizontal Major Axis)

- $(x - h)^2/a^2 + (y - k)^2/b^2 = 1$

- $a > b$
- Foci: $(h \pm c, k)$, $c^2 = a^2 - b^2$

Ellipse (Vertical Major Axis)

- $(x - h)^2/b^2 + (y - k)^2/a^2 = 1$
- $a > b$
- Foci: $(h, k \pm c)$, $c^2 = a^2 - b^2$

Hyperbola (Horizontal Transverse Axis)

- $(x - h)^2/a^2 - (y - k)^2/b^2 = 1$
- Foci: $(h \pm c, k)$, $c^2 = a^2 + b^2$

Hyperbola (Vertical Transverse Axis)

- $(y - k)^2/a^2 - (x - h)^2/b^2 = 1$
- Foci: $(h, k \pm c)$, $c^2 = a^2 + b^2$

Eccentricity (for all conics)

- $e = c / a$