

Precalculus Cheat Sheet

§5.1 Polynomial Functions and Models (review)

Steps to Analyze Graph of Polynomial

1. y-intercept: $f(0)$
2. x-intercept: $f(x) = 0$
3. f crosses / touches axis @ x-intercepts
4. End behavior: like leading term
5. Find max/min turning pts of f ($n-1$)
6. Behavior near zeros for each x-intercept
7. May need few extra pts to draw f .

§5.2 Rational Functions

Finding Horizontal/Oblique Asymptotes of R

where degree of numer. = n and degree of denom. = m

1. If $n < m$, horizontal asymptote: $y = 0$ (the x-axis).
2. If $n = m$, line $y = \frac{a_n}{a_m}$ is a horizontal asymptote.
3. If $n = (m + 1)$, quotient from long div is $ax + b$ and line $y = ax + b$ is oblique asymptote.
4. If $n > (m + 1)$, R has no asymptote.

§7.6 Graphing Sinusoids

Graphing $y = A \sin(\omega x)$ & $y = A \cos(\omega x)$

$|A|$ = amplitude (stretch/shrink vertically)

$|A| < 1$ shrink $|A| > 1$ stretch $A < 0$ reflect

Distance from min to max = $2A$

ω = frequency (stretch/shrink horizontally)

$|\omega| < 1$ stretch $|\omega| > 1$ shrink $\omega < 0$ reflect

period = $T = \frac{2\pi}{|\omega|}$

§7.8 Phase Shift = $\frac{\pi}{\omega}$

$$y = A \sin(\omega x - \phi) + B$$

$$y = A \cos(\omega x - \phi) + B$$



§8.1 Inverse Sin, Cos, Tan Fns

$$y = \sin^{-1}(x) \quad \text{Restrict range to } [-\pi/2, \pi/2]$$

$$y = \cos^{-1}(x) \quad \text{Restrict range to } [0, \pi]$$

$$y = \tan^{-1}(x) \quad \text{Restrict range to } (-\pi/2, \pi/2)$$

§8.2 Inverse Trig Fns (com't)

$$y = \sec^{-1} x \quad \text{where } |x| \geq 1 \text{ and } 0 \leq y \leq \pi, \quad y \neq \frac{\pi}{2}$$

$$y = \csc^{-1} x \quad \text{where } |x| \geq 1 \text{ and } -\frac{\pi}{2} \leq y \leq \frac{\pi}{2}, \quad y \neq 0$$

$$y = \cot^{-1} x \quad \text{where } -\infty < x < \infty \text{ and } 0 < y < \pi$$

§8.3 Trig Identities

$$\tan \theta = \frac{\sin \theta}{\cos \theta} \quad \cot \theta = \frac{\cos \theta}{\sin \theta}$$

$$\csc \theta = \frac{1}{\sin \theta} \quad \sec \theta = \frac{1}{\cos \theta} \quad \cot \theta = \frac{1}{\tan \theta}$$

$$\text{Pythagorean: } \sin^2 \theta + \cos^2 \theta = 1$$

$$\tan^2 \theta + 1 = \sec^2 \theta \quad \cot^2 \theta + 1 = \csc^2 \theta$$

§8.4 Sum & Difference Formulae

$$\cos(\alpha \pm \beta) = \cos \alpha \cos \beta \mp \sin \alpha \sin \beta$$

$$\sin(\alpha \pm \beta) = \sin \alpha \cos \beta \pm \cos \alpha \sin \beta$$

$$\tan(\alpha \pm \beta) = \frac{\tan \alpha \pm \tan \beta}{1 \mp \tan \alpha \tan \beta}$$

§8.5 Double-Angle & Half-Angle Formulae

$$\sin(2\alpha) = 2 \sin \alpha \cos \alpha \quad \cos(2\alpha) = \cos^2 \alpha - \sin^2 \alpha$$

$$\cos(2\alpha) = 1 - 2 \sin^2 \alpha = 2 \cos^2 \alpha - 1$$

$$\tan(2\alpha) = \frac{2 \tan \alpha}{1 - \tan^2 \alpha}$$

$$\sin\left(\frac{\alpha}{2}\right) = \pm \sqrt{\frac{1 - \cos \alpha}{2}} \quad \cos\left(\frac{\alpha}{2}\right) = \pm \sqrt{\frac{1 + \cos \alpha}{2}}$$

$$\tan\left(\frac{\alpha}{2}\right) = \pm \sqrt{\frac{1 - \cos \alpha}{1 + \cos \alpha}} = \frac{1 - \cos \alpha}{\sin \alpha} = \frac{\sin \alpha}{1 + \cos \alpha}$$

§9.2 Law of Sines

§9.3 Law of Cosines

$$c^2 = a^2 + b^2 - 2ab \cos C$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$b^2 = a^2 + c^2 - 2ac \cos B$$

§9.4 Area of Triangle

$$K = \frac{1}{2} bc \sin A = \frac{1}{2} ac \sin B = \frac{1}{2} ab \sin C$$

Heron's Formula

$$s = \frac{1}{2}(a + b + c)$$

$$K = \sqrt{s(s-a)(s-b)(s-c)}$$

§9.5 Simple & Damped Harmonic Motion

Simple Harmonic Motion

$$d = a \cos(\omega t) \quad \text{or} \quad d = a \sin(\omega t)$$

Damped Harmonic Motion

$$d(t) = ae^{-(b/2m)t} \cos\left(\sqrt{\omega^2 - \frac{b^2}{4m^2}} t\right)$$

where a, b, m constants:

b = damping factor (damping coefficient)

m = mass of oscillating object

a = displacement at $t = 0$

$\frac{2\pi}{\omega}$ = period if no damping.

§10.1 Polar Coordinates

Convert Polar to Rectangular Coordinates

$$x = r \cos \theta \quad y = r \sin \theta$$

Convert Rectangular to Polar Coordinates

If $x = y = 0$ then $r = 0$, θ can have any value

$$\text{else } r = \sqrt{x^2 + y^2}$$

$$\theta = \begin{cases} \tan^{-1}\left(\frac{y}{x}\right) & Q_1 \text{ or } Q_4 \\ \tan^{-1}\left(\frac{y}{x}\right) + \pi & Q_2 \text{ or } Q_3 \\ \pi/2 & x = 0, y > 0 \\ -\pi/2 & x = 0, y < 0 \end{cases}$$

§10.3 Complex Plane & De Moivre's Theorem

Conjugate of $z = x + yi$ is $\bar{z} = x - yi$

Modulus of z : $|z| = \sqrt{x^2 + y^2} = \sqrt{z\bar{z}}$

Products & Quotients of Complex Nbs (Polar)

$$z_1 = r_1 (\cos \theta_1 + i \sin \theta_1) \quad z_2 = r_2 (\cos \theta_2 + i \sin \theta_2)$$

$$z_1 z_2 = r_1 r_2 [\cos(\theta_1 + \theta_2) + i \sin(\theta_1 + \theta_2)]$$

$$\frac{z_1}{z_2} = \frac{r_1}{r_2} [\cos(\theta_1 - \theta_2) + i \sin(\theta_1 - \theta_2)] \quad z_2 \neq 0$$

De Moivre's Theorem $z = r (\cos \theta + i \sin \theta)$

$$z^n = r^n [\cos(n\theta) + i \sin(n\theta)] \quad n \geq 1$$

Complex Roots $n \geq 2, k = 0, 1, 2, \dots, (n-1)$

$$z_k = \sqrt[n]{r} \left[\cos\left(\frac{\theta}{n} + \frac{2k\pi}{n}\right) + i \sin\left(\frac{\theta}{n} + \frac{2k\pi}{n}\right) \right]$$

where $k = 0, 1, 2, \dots, (n-1)$

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