

MAC 1140 Formulas

Conics

Vertical Parabola

$$x^2 = 4py$$

Vertex: (0,0)

Focus: (0, p)

Directrix: $y = -p$

$p > 0$: opens up

$p < 0$: opens down

Focal diameter = $|4p|$

Horizontal Parabola

$$y^2 = 4px$$

Vertex: (0,0)

Focus: (p, 0)

Directrix: $x = -p$

$p > 0$: opens right

$p < 0$: opens left

Focal diameter = $|4p|$

Vertical Ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1; b > a$$

Vertices: (0, $\pm a$)

Major axis: $2b$

Minor axis: $2a$

Focus: (0, $\pm c$)

$$c^2 = b^2 - a^2$$

Horizontal Ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1; a > b$$

Vertices: ($\pm a$, 0)

Major axis: $2a$

Minor axis: $2b$

Focus: ($\pm c$, 0)

$$c^2 = a^2 - b^2$$

Vertical Hyperbola

$$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$$

Vertices: (0, $\pm a$)

Transverse: $2a$

Asymptotes: $y = \pm \frac{a}{b}x$

Focus: (0, $\pm c$)

$$c^2 = a^2 + b^2$$

Horizontal Hyperbola

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

Vertices: ($\pm a$, 0)

Transverse: $2a$

Asymptotes: $y = \pm \frac{b}{a}x$

Focus: ($\pm c$, 0)

$$c^2 = a^2 + b^2$$

Circle (ellipse $a = b$)

$$(x - h)^2 + (y - k)^2 = r^2 \quad \text{Radius: } r, \text{ Center: } (h, k)$$

Sequences

Arithmetic Sequence	Geometric Sequence
n^{th} term $a_n = a_1 + (n - 1)d$	n^{th} term $a_n = a_1 r^{n-1}$
Partial Sum $S_n = \frac{n(a_1 + a_n)}{2}$	Finite sum $S_n = \frac{a(1 - r^n)}{(1 - r)}$
Partial sum $S_n = \frac{[n(2a + (n - 1)d)]}{2}$	Infinite sum $S = \frac{a}{1 - r}; r < 1$

Rational Functions

$$f(x) = \frac{ax^n + \dots}{bx^m + \dots}$$

- x-intercept: set top = 0.
- y-intercept: let x = 0.
- Vertical asymptotes of $f(x)$ are the zeros of the denominator.
- if $n < m$, horizontal asymptote: $y = 0$.
- if $n = m$, horizontal asymptote: $y = a/b$.
- if $n > m$ then no horizontal asymptote.
- if $n = m + 1$, find slant asymptotes by division.

Factorials- Coefficients

$$\binom{n}{r} = \frac{n!}{r!(n - r)!}$$

Exponential Growth & Decay

$M(t) = n_0 e^{rt}$; r negative for decay

$$r = \frac{\ln 2}{h}; h = \text{half-life \& doubling}$$

Partial Fractions Decomposition

$$\frac{1}{(x-a)(x-b)} = \frac{A}{x-a} + \frac{B}{x-b};$$

$$\frac{1}{(x-a)^2(x-b)} = \frac{A}{x-a} + \frac{B}{(x-a)^2} + \frac{C}{x-b};$$

$$\frac{1}{(x^2+a)(x-b)} = \frac{Ax+B}{x^2+a} + \frac{C}{x-b}$$