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# 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)

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

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## 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 $S = \frac{a}{1-r}$; $\lvert r \rvert < 1$ |

## Rational Functions

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

1. x –intercept: set top = 0.
2. y –intercept: let x = 0.
3. Vertical asymptotes of $f(x)$ are the zeros of the denominator.
4. if n < m, horizontal asymptote: y = 0.
5. if n = m, horizontal asymptote: y = $a/b$.
6. if n > m then no horizontal asymptote.
7. 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 = half-life & doubling

## Partial Fractions Decomposition

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

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

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