* The graphs of all polynomial is continuous.

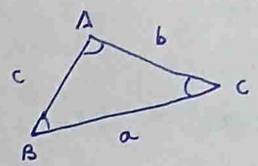
* MULTIPLICITY is the number of times a particular value appears as the root of the polynomial. Sum of multiplicities gives the degree of the polynomial (Fundamental Theorem of Algebra)

* $(a+b)^3 = a^3 + b^3 + 3ab(a+b)$ $\qquad$ $(a-b)^3 = a^3 + b^3 + 3ab(a-b)$

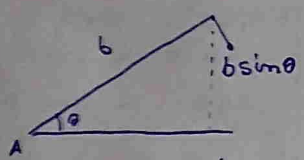
  $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$ $\qquad$ $(a^3 - b^3) = (a-b)(a^2 + ab + b^2)$

* Rational Root Theorem: Roots of a polynomial equation are in form $\frac{p}{q}$ where p is a factor of constant term and q is a factor of higher degree coefficient. After listing the factors, perform division on each combination

Law of the sine: $\frac{\sin a}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$



Law of the cosines: $a^2 = b^2 + c^2 - 2bc\cos A$



A and b given

$a < h \Rightarrow$ No triangle

$a = h \Rightarrow$ one right triangle

$a > h$, $a > b \Rightarrow$ obtuse triangle

$a < b \Rightarrow$ Two possibilities

$\sec^2\theta = 1 + \tan^2\theta$

$\operatorname{cosec}^2\theta = 1 + \cot^2\theta$

* Trigonometric Cofunctions: sin, cos; tan, cot; cosec, sec

  $\text{trig}(\theta) = \text{cotrig}(90° - \theta)$

  $\text{trig}(90° - \theta) = \text{cotrig}(\theta)$

* $f(x) = \frac{p(x)}{q(x)}$ $\qquad$ $p(x) = 0 = q(x)$: Hole in graph

  $p(x) \neq 0 = q(x)$: Asymtotes

Matrix Multiplication: $\begin{bmatrix} 3 & -1 \\ 3 & 5 \\ -2 & 1 \end{bmatrix} \begin{bmatrix} 1 & -2 \\ 5 & -3 \end{bmatrix} = \begin{bmatrix} -2 & -3 \\ 28 & -21 \\ 3 & 1 \end{bmatrix}$

Determinant of $\begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$

Arithmetic series: $S_m = \frac{m}{2}[a_1 + a_m] = \frac{m}{2}[2a + (m-1)d]$

Geometric series: $S_m = \frac{a_1(1 - r^m)}{(1 - r)}$

Statistics

Standard deviation is the average difference between individual data values and the mean

$$s^2 = \frac{\Sigma(x_i - \bar{x})^2}{m-1}$$

$$z = \frac{x - \bar{x}}{s}$$

Higher $|z|$, less common the data value is

Resultant of $\vec{U}(u_1, u_2)$ and $\vec{V}(v_1, v_2) = \overrightarrow{U+V} = (u_1 + v_1, u_2 + v_2)$

$\frac{\vec{U}}{|U|}$ = norm · unit vector

point-line distance: (x_1, y_1), $(Ax + By + c = 0)$ $\qquad$ $d = \frac{|Ax_1 + By_1 + C|}{\sqrt{A^2 + B^2}}$

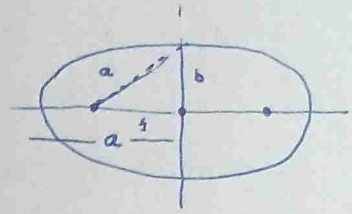
Ellipse

$$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$$

Horizontal radius : a

Vertical radius : b

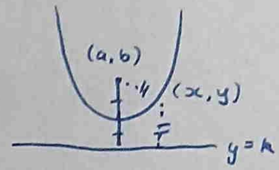
let $a > b$ or a be the major radius



$$f^2 = a^2 - b^2$$

Ellipse eccentricity $= \frac{a^2 - b^2}{a} < 1$

Parabola Focus and Directrix



$$\sqrt{(y-k)^2} = \sqrt{(x-a)^2 + (y-b)^2}$$

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

$$y^2 + k^2 - 2yk = (x-a)^2 + y^2 + b^2 - 2yb$$

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

$$y = \frac{(x-a)^2}{2(b-k)} + \frac{(b+k)}{2}$$

(a, b) is Vertex

y = k is directrix

Probability

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

either A or B occuring

$P(A|B)$: A occuring given B occured

$P(A \cap B)$: A and B occuring

$$P(A|B) = \frac{P(A \cap B)}{P(A|B)}$$

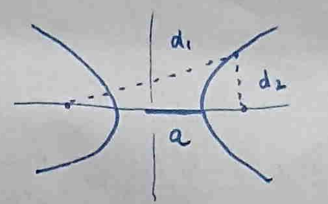
Hyperbola:

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

↓

Asymtotes : $\pm \frac{b}{a} x$

* Vertices at $(\pm a, 0)$ or at $(0, \pm b)$



$|d_1 - d_2|$ is constant $= 2a$

Focus : $f^2 = a^2 + b^2$ Eccentricity $= \frac{c}{a} > 1$

Notes : * The inverse of a function is not necessarily a function
* Range of a function can be found by the domain of inverse

* A relation is even if $(-x, y)$ is in the relation whenever (x, y) is in it
  Relations can be both even and odd. (like the circle!)

* Sum of even functions is even, sum of odds is odd.
  Product of two evens or two odds is even, while the product of even and odd is odd

* In quadratic equations, sum of zeros $= \frac{-b}{a}$ while the product is $\frac{c}{a}$.