The Parabola Formulas

The standard formula of a parabola

|  |  |
| --- | --- |
|  | *y*2=2*px* |

Parametric equations of the parabola:

|  |  |
| --- | --- |
|  | *xy*=2*pt*2=2*pt* |

Tangent line in a point *D*(*x*0,*y*0) of a parabola *y*2=2*px* is :

|  |  |
| --- | --- |
|  | *y*0*y*=*p*(*x*+*x*0) |

Tangent line with a given slope *m*:

|  |  |
| --- | --- |
|  | *y*=*mx*+*p*2*m* |

**Tangent lines from a given point**

Take a fixed point *P*(*x*0,*y*0). The equations of the tangent lines are:

|  |  |
| --- | --- |
|  | *y*−*y*0*y*−*y*0*m*1*m*2=*m*1(*x*−*x*0)=*m*2(*x*−*x*0)=*y*0+*y*20−2*px*0−−−−−−−−√2*x*0=*y*0−*y*20−2*px*0−−−−−−−−√2*x*0 |

The Ellipse Formulas

The set of all points in the plane, the sum of whose distances from two fixed points, called the foci, is a constant.

**The standard formula of a ellipse:**

|  |  |
| --- | --- |
|  | *x*2*a*2+*y*2*b*2=1 |

**Parametric equations of the ellipse:**

|  |  |
| --- | --- |
|  | *xy*=*a*cos*t*=*b*sin*t* |

**Tangent line in a point***D*(*x*0,*y*0)**of a ellipse:**

|  |  |
| --- | --- |
|  | *x*0*xa*2+*y*0*yb*2=1 |

**Eccentricity of the ellipse:**

|  |  |
| --- | --- |
|  | *e*=*a*2−*b*2−−−−−−√*a* |

**Foci of the ellipse:**

|  |  |
| --- | --- |
|  | if *a*≥*b*⟹*F*1(−*a*2−*b*2−−−−−−√,0)  *F*2(*a*2−*b*2−−−−−−√,0)if *a*<*b*⟹*F*1(0,−*b*2−*a*2−−−−−−√)  *F*2(0,*b*2−*a*2−−−−−−√) |

**Area of the ellipse:**

|  |  |
| --- | --- |
|  | *A*=*π*⋅*a*⋅*b* |

The Hyperbola Formulas

The set of all points in the plane, the difference of whose distances from two fixed points, called the foci, remains constant.

**The standard formula of a hyperbola:**

|  |  |
| --- | --- |
|  | *x*2*a*2−*y*2*b*2=1 |

**Parametric equations of the Hyperbola:**

|  |  |
| --- | --- |
|  | *xy*=*a*sin*t*=*b*sin*t*cos*t* |

**Tangent line in a point***D*(*x*0,*y*0)**of a Hyperbola:**

|  |  |
| --- | --- |
|  | *x*0*xa*2−*y*0*yb*2=1 |

**Foci:**

|  |  |
| --- | --- |
|  | if *a*≥*b*⟹*F*1(−*a*2+*b*2−−−−−−√,0)  *F*2(*a*2+*b*2−−−−−−√,0)if *a*<*b*⟹*F*1(0,−*a*2+*b*2−−−−−−√)  *F*2(0,*a*2+*b*2−−−−−−√) |

**Asymptotes:**

|  |  |
| --- | --- |
|  | if *a*≥*b*⟹*y*=*bax* and *y*=−*bax*if *a*<*b*⟹*y*=*abx* and *y*=−*abx* |

**Sets of numbers**

Definitions:

N : Natural numbers

N0 : Whole numbers

Z : Integers

Z+ : Positive integers

Z− : Negative integers

Q : Rational numbers

C : Complex numbers

Formulas:

**Natural numbers** (counting numbers )

|  |  |
| --- | --- |
|  | N={1,2,3,…} |

**Whole numbers** ( counting numbers with zero )

|  |  |
| --- | --- |
|  | N0={0,1,2,3,…} |

**Integers** ( whole numbers and their opposites and zero )

|  |  |
| --- | --- |
|  | Z={…,−2,−1,0,1,2,…} |

|  |  |
| --- | --- |
|  | Z+=N={1,2,…} |

|  |  |
| --- | --- |
|  | Z−={…,−3,−2,−1} |

|  |  |
| --- | --- |
|  | Z=Z−∪0∪Z |

**Irrational numbers:** Non repeating and nonterminating integers

**Real numbers:** Union of rational and irrational numbers

**Complex numbers:**

|  |  |
| --- | --- |
|  | C={*x*+*iy* | *x*∈R  *and*  *y*∈R} |

|  |  |
| --- | --- |
|  | N⊂N0⊂Z⊂Q⊂R⊂C |