# Formulas

## Unit 1: Analytic Geometry

**Midpoint:** $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

Length $= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

**Slope:** $m = \frac{y_2 - y_1}{x_2 - x_1}$

**Circle:** $x^2 + y^2 = r^2$

## Unit 2: Quadratics

**Standard Form**

$y = ax^2 + bx + c$

**Factored Form**

$y = a(x - r)(x - s)$

**Vertex Form**

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

**Quadratic Formula**

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

**Axis of Symmetry** $x = \frac{-b}{2a}$

## Unit 3: Trigonometry

**Right Triangles**

$\sin \angle = \frac{opposite}{hypotenuse}$

$\cos \angle = \frac{adjacent}{hypotenuse}$

$\tan \angle = \frac{opposite}{adjacent}$

**Sine Law**

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

**Cosine Law (find angle)**

$\text{Cos}(A) = \frac{a^2 - b^2 - c^2}{-2bc}$

$\text{Cos}(B) = \frac{b^2 - a^2 - c^2}{-2ac}$

$\text{Cos}(C) = \frac{c^2 - a^2 - b^2}{-2ab}$

**Cosine Law (find side)**

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

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

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

# Chapter 1/2

## Midpoint and Length and Circles

$$\text{MIDPOINT} = \left( \frac{x_1 + x_2}{2} , \frac{y_1 + y_2}{2} \right)$$

$$\text{Length} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

## Circles

The distance from the origin to any point on a circle (that is centered at the origin) is the length of the radius

**Equation of a Circle:**

$$x^2 + y^2 = r^2$$

## Substitution:

**Method of Substitution:** solving a linear system by substituting for one variable from one equation into the other equation.

**Steps to Substitution**

1. Isolate a variable (choose the easiest one).
2. Substitute this expression into the second equation.
3. Combine like terms (remember order of operations).
4. Solve for the variable.
5. Substitute that value into one of the original equations and solve for the second variable.

## Elimination:

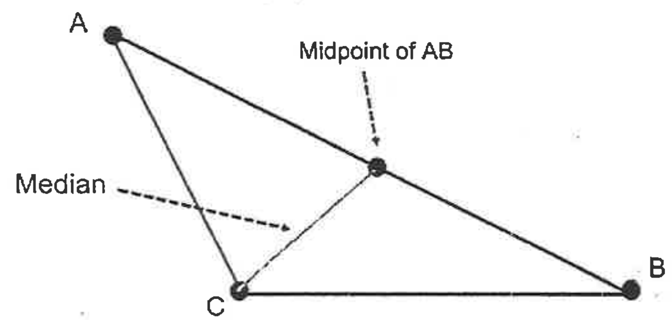
**Elimination:** Solving a linear system by adding or subtracting to eliminate one of the variables

**Steps to Elimination**

1. Get both equations into the form of $x + y = \#$
2. Determine how to get rid of one of the variables.
3. Add OR Subtract like terms in the equation to eliminate the chosen variable.
4. Solve the resulting equation for the remaining variable.
5. Substitute that value into one of the original equations to solve for the second variable.

# Medians

**Median:** Line segment joining a vertex of a triangle to the midpoint of the opposite side

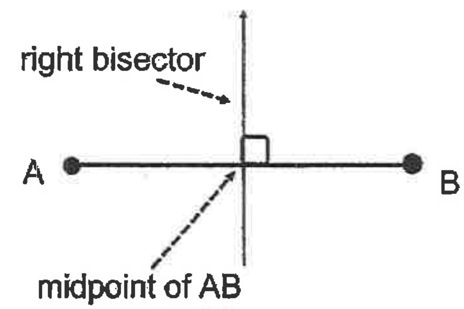



**<u>Steps to Finding the Equation of a Median</u>**

**1)** Determine the coordinates of the midpoint of the side that is opposite the vertex
**2)** Find the <u>slope</u> of the line that connects the vertex to the midpoint of the opposite side
**3)** Using the coordinates of the vertex (or the midpoint of the opposite side) and the slope of the line, solve for the <u>y-intercept</u> of this line.
**4)** Write the <u>equation of the line</u> that connects the vertex to the midpoint of the opposite side in **y=mx+b** format. Plug in your values for 'm' and 'b'.

# Right Bisectors

**Right Bisector:** the line that passes through the midpoint of a line segment and intersects it at a 90 degree angle.




**<u>Steps to finding the equation of a Right Bisector of Line AB</u>**

**1)** Find the slope of AB
**2)** Find the slope of the line perpendicular to AB
**3)** Find the midpoint of AB
**4)** Write the equation of the line that bisects AB and is perpendicular to it.

# Factored Form

## $y=a(x-r)(x-s)$

The x-intercepts of a parabola in factored form are:

**'r' and 's'**

**(r,0) and (s,0)**

## Axis of Symmetry

**Remember:** The axis of symmetry goes through the midpoint of the line connecting the x-intercepts. Find the midpoint of the x-intercepts to find the axis of symmetry. **(add the x-intercepts and divide by 2)**

Axis of symmetry: $x=(r+s)/2$

**How do you find the vertex of a parabola in factored form?**

**Remember:** the axis of symmetry is the x-coordinate of the vertex. Find the axis of symmetry by adding the x-intercepts and then dividing by 2. Use the axis of symmetry to find the y-coordinate of the vertex (plug it into the equation and solve for 'y')

**How to write the equation of a parabola in factored form:**

**1)** Find the x-intercepts: *r* and *s*
**2)** Find another point on the graph (*x*,*y*)
**3)** Plug values for *r,s,x, and y* into $y=a(x-r)(x-s)$
**4)** Solve for *a*
**5)** Write the final equation by plugging in values for *a,r, and s*. Not *x* and *y*.

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

VERTEX FORM

## 'a'

Represents the vertical **STRETCH** or **COMPRESSION**

**If a>1 or <-1 :** vertically stretched by a factor of 'a'

**If -1<a<0 or 0<a<1:** vertically compressed by a factor of 'a'

**If 'a' is positive**, the parabola **opens UP**

**If 'a' is negative**, the parabola **opens DOWN**

## 'h'

Represents the **HORIZONTAL** translation

**If h>0:** The parabola is translated 'h' units to the right

**If h<0:** The parabola is translated 'h' units to the left

## 'k'

Represents the **VERTICAL** translation

**If k>0:** the parabola is translated 'k' units up

**If k<0:** the parabola is translated 'k' units down

## Usefulness of Vertex Form

The **vertex** of a parabola in vertex form is:

**(h,k)**

The **axis of symmetry** of a parabola in vertex form is:

$$x = h$$

# Chapter 6

**Factoring $ax^2+bx+c$ if 'a' is not 1 and can't be factored out**

1. Check for a common factor
2. Multiply '*a*' by '*c*'
3. Find two integers who have a
4. product of this number (*a* x *c*)and a sum of '*b*'
5. Break up the middle term into the integers that satisfy the product and sum
6. Factor by grouping

**Factoring $ax^2+bx+c$ if 'a' is 1 or can be factored out**

1. Check for a common factor
2. Find two integers who have a product of 'c' and a sum of 'b'
3. Put those integers into (x+*r*)(x+*s*) for '*r*' and '*s*'

## Completing the Square:

Going from standard form to vertex form

$y=ax^2+bx+c$ to $y=a(x-h)^2+k$

1) Put brackets around the first two terms
2) Factor out the number in front of the $x^2$ (not the letter)
3) Look at the last term in the brackets, divide it by 2 and then square it.
4) Add and subtract that term behind the last term in the brackets.
5) Move the negative term outside of the brackets by first multiplying it by the 'a' value.
6) Simplify the terms outside of the brackets.
7) Factor the perfect square trinomial $(x + b/2)^2$

**Perfect Square Trinomial:**
$a^2+2ab+b^2 = (a+b)^2$
$a^2-2ab+b^2= (a-b)^2$

**Remember:** the 'c' value of a perfect square trinomial is half of the 'b' value squared : $(b/2)^2$

## Quadratic Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

**Axis of symmtery: -b/2a**

**Use the discriminate to determine the number of roots:**

If $b^2-4ac$ is < 0 → 0 roots
If $b^2-4ac$ is = 0 → 1 root
If $b^2-4ac$ is > 0 → 2 roots

## Solving by Factoring:

1) It must be set to equal 0. Before factoring, it must be in the form $ax^2+bx+c=0$
2) Factor the left side of the equation
3) Set each factor to equal zero and solve for 'x'.

**zero product rule:** if two factors have a product of zero; one or both of the factors must equal zero.

**Remember:** the axis of symmetry is the x-coordinate of the vertex. Find the axis of symmetry by adding the x-intercepts and then dividing by 2. Use the axis of symmetry to find the y-coordinate of the vertex

# Chapter 5

## Factoring $ax^2+bx+c$ if 'a' is not 1 and can't be factored out

1. Check for a common factor
2. Multiply *'a'* by *'c'*
3. Find two integers who have a product of this number (*a* x *c*)and a sum of *'b'*
4. Break up the middle term into the integers that satisfy the product and sum
5. Factor by grouping

## Factoring $ax^2+bx+c$ if 'a' is 1 or can be factored out

1. Check for a common factor
2. Find two integers who have a product of 'c' and a sum of 'b'
3. Put those integers into (x+*r*)(x+*s*) for *'r'* and *'s'*

## Common Factoring

1. Determine the greatest common factor of all terms in the polynomial
2. Take out the greatest common factor as the first factor
3. Divide each term in the polynomial by the greatest common factor to get the second factor.

## Multiplying Polynomials

**FOIL METHOD:** You can find the product of two binomials by multiplying each term in the first binomial by each term in the second binomial. Then simplify by collecting like terms

First Outside Inside Last

## Special Products

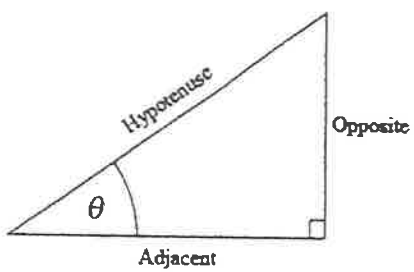
**Difference of Squares:**
$a^2-b^2 = (a-b)(a+b)$

**Perfect Square Trinomial:**
$a^2+2ab+b^2 = (a+b)^2$
$a^2-2ab+b^2 = (a-b)^2$

# Trigonometry

## Trigonometry of Right Triangles

$$S\ \frac{O}{H} \quad C\ \frac{A}{H} \quad T\ \frac{O}{A}$$




$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

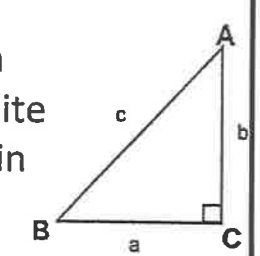
$$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

**Note:** To find an unknown <u>angle</u>, you must use the inverse trig ratios :

**$\sin^{-1}$, $\cos^{-1}$, and $\tan^{-1}$**

**Note:** Angles are labeled with a capital letter. Label sides opposite the angle with the same letter in lower case




## Trigonometry of Acute Triangles

## Sine Law

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

**The Sine Law can be used to find:**

**1.** An unknown side when two angles and a side are known

**2.** An unknown angle if two sides and the angle opposite one of the known sides are known

## Cosine Law:

**1)** You can use the cosine law to find a missing side of an acute triangle if the other two sides and their contained angle are known

$$a^2 = b^2 + c^2 - 2bc\cos(A)$$
$$b^2 = a^2 + c^2 - 2ac\cos(B)$$
$$c^2 = a^2 + b^2 - 2ab\cos(C)$$

**2)** find an unknown angle if you know three side lengths of an acute triangle

$$\cos(A) = \frac{a^2 - b^2 - c^2}{-2bc}$$
$$\cos(B) = \frac{b^2 - a^2 - c^2}{-2ac}$$
$$\cos(C) = \frac{c^2 - a^2 - b^2}{-2ab}$$