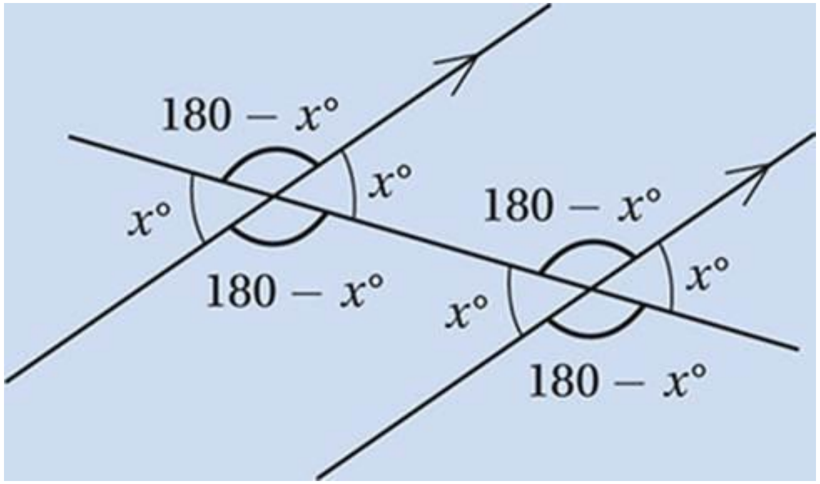
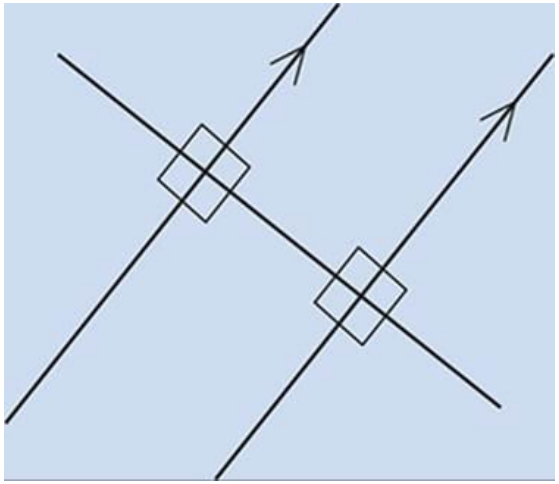
Elements

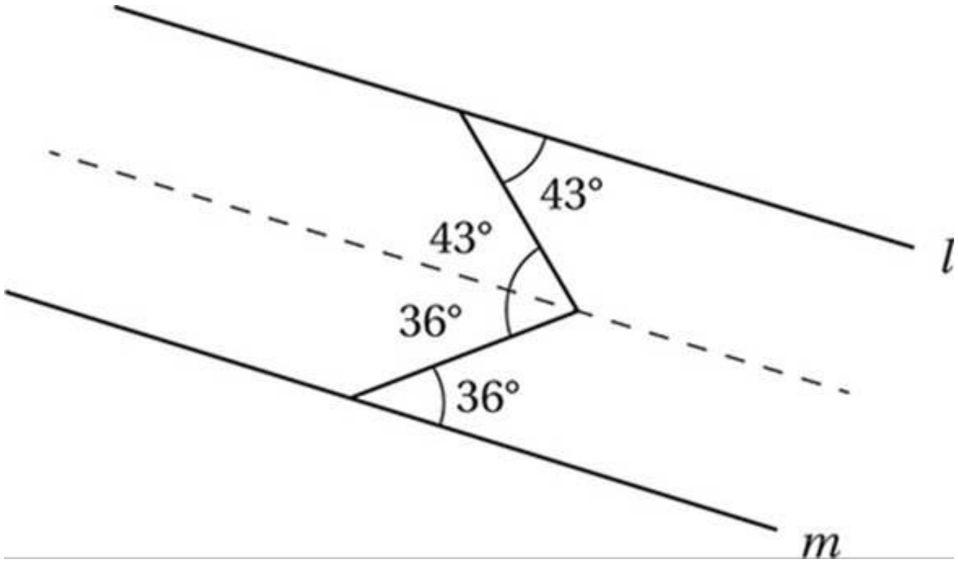
Term	Dimensions	Graphic	Symbol
Point	Zero		• A
Line Segment	One	A B	$\overline{AB}$
Ray	One	A B	$\overrightarrow{AB}$
Line	One		$\overleftrightarrow{AB}$
Plane	Two		Plane M

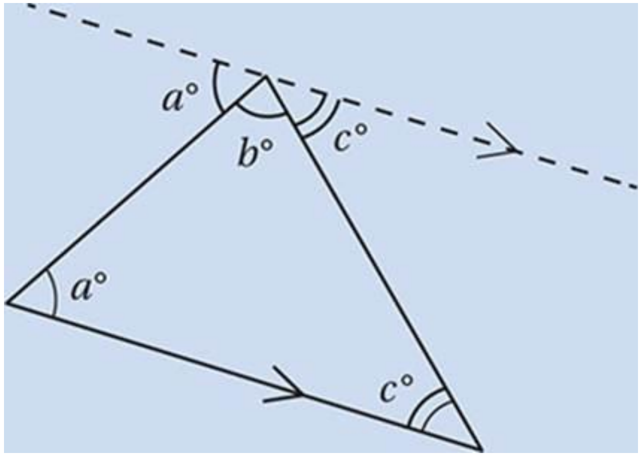
Src: http://geobraniacs.wikispaces.com/file/view/Points-Lines-%26-Planes.gif/90029611/Points-Lines-%26-Planes.gif

Angles

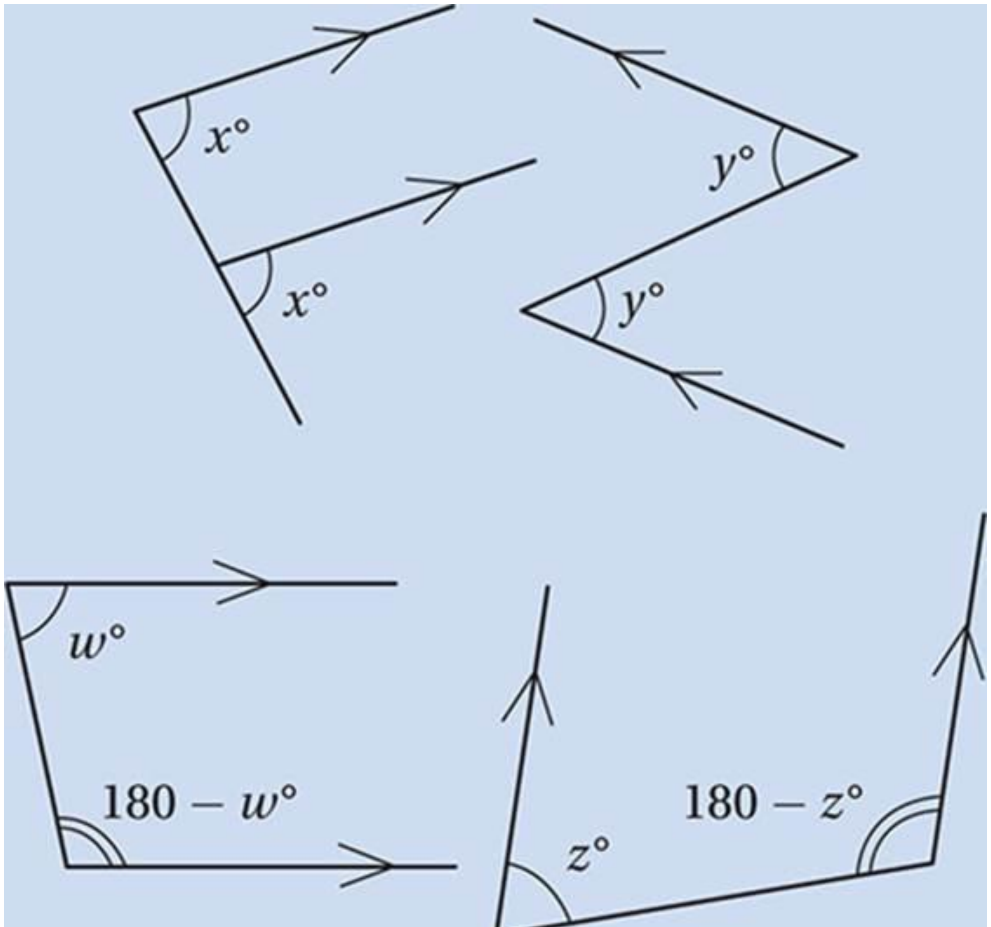


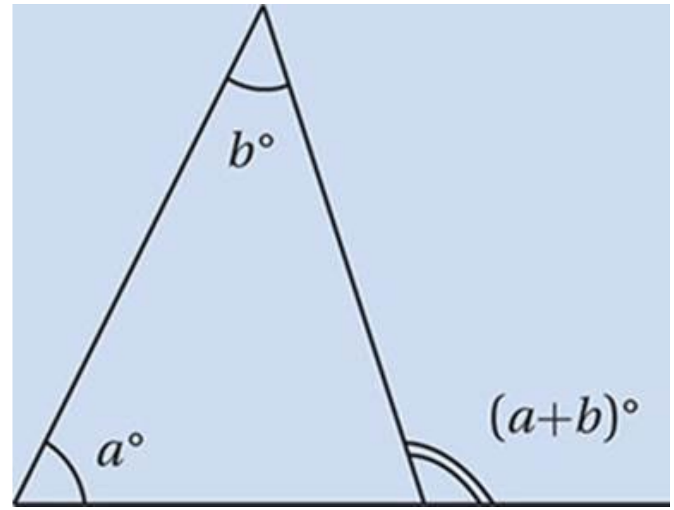


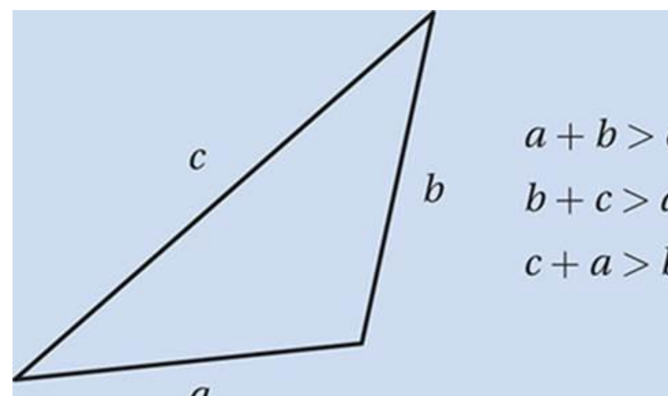




Angles

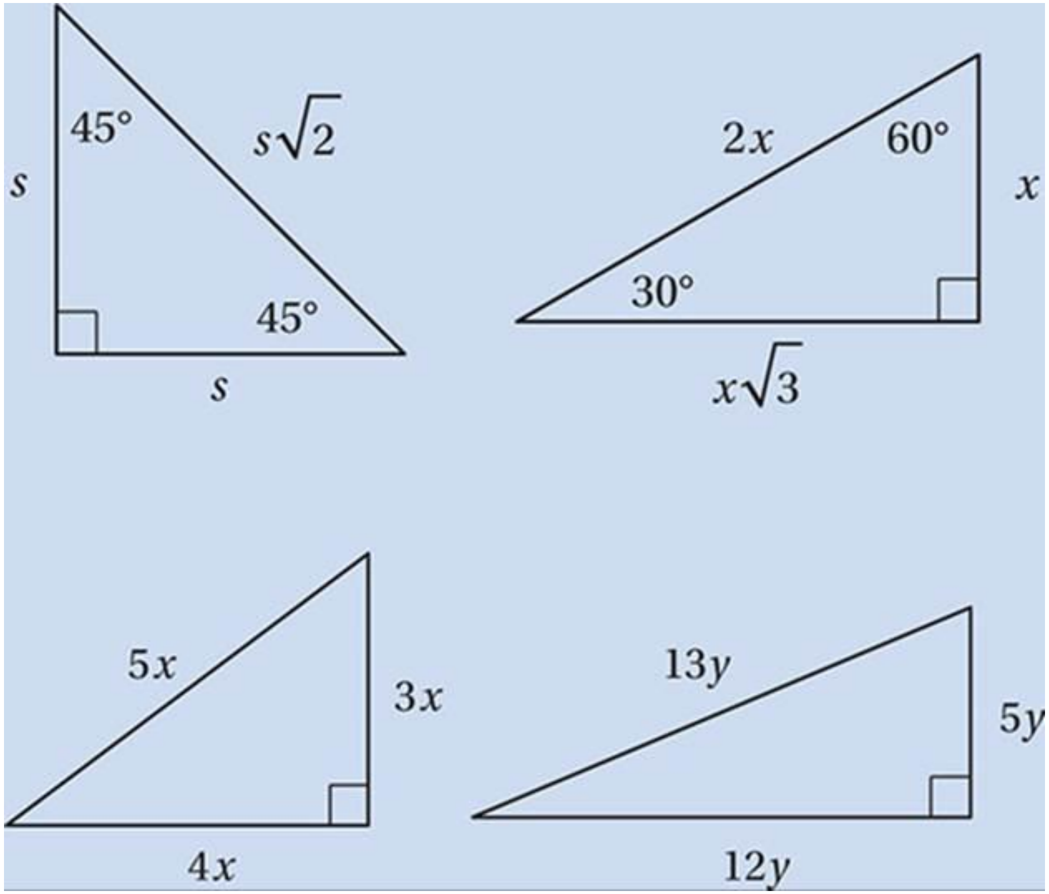






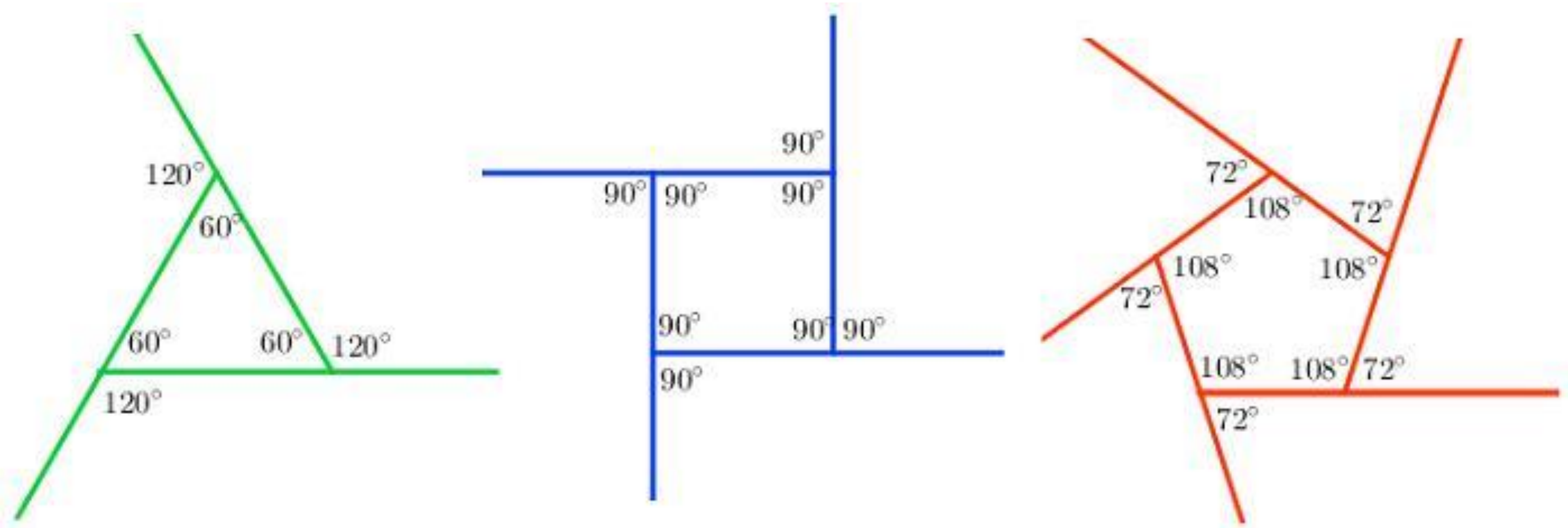
Src: http://schoolbag.info/sat/sat_3/73.html

Angles



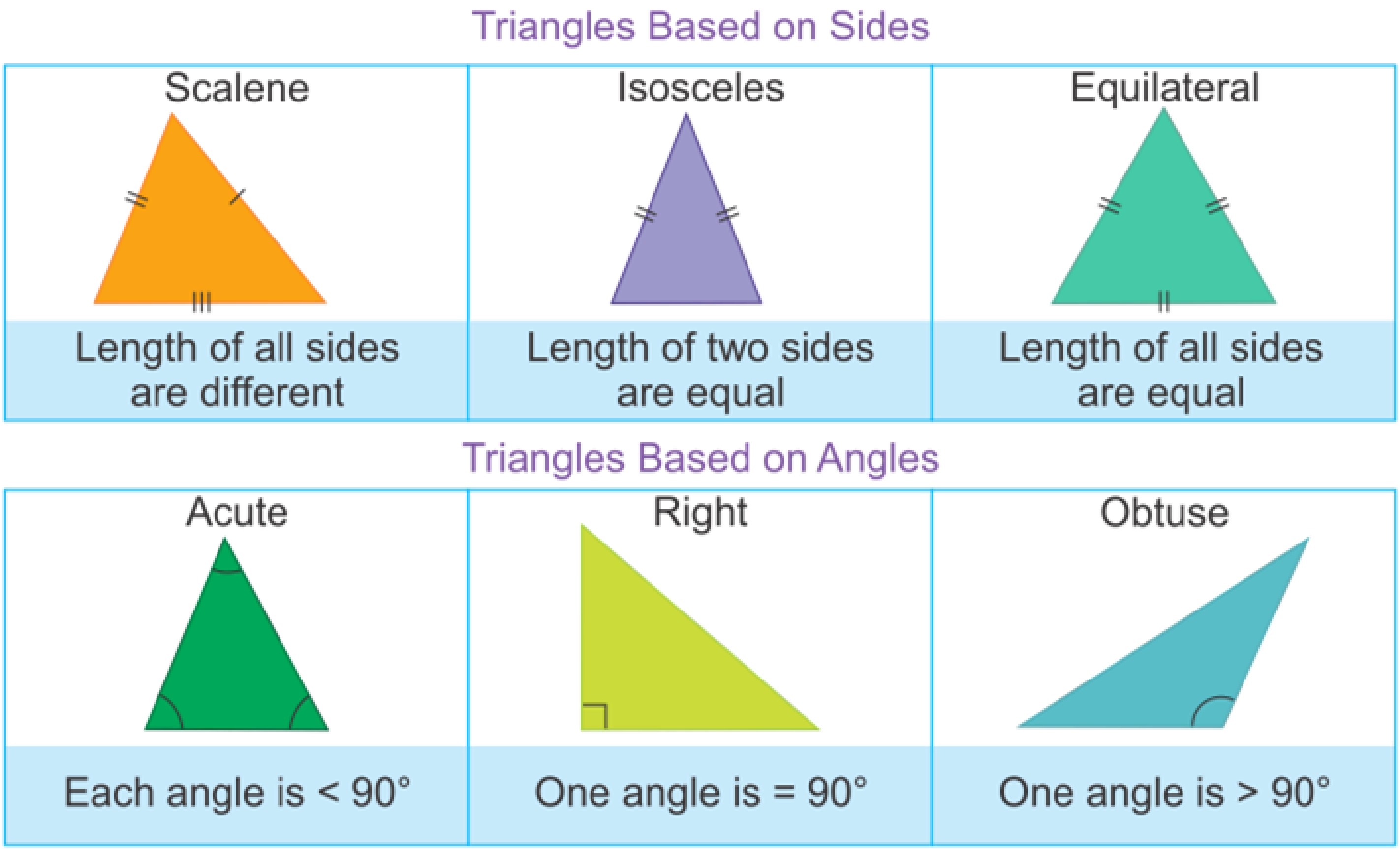
Angles

360 / # sides if all equal



Src: http://www.debate.org/photos/albums/1/6/5244/257096-5244-a4bzy-a.jpg

Triangles Types

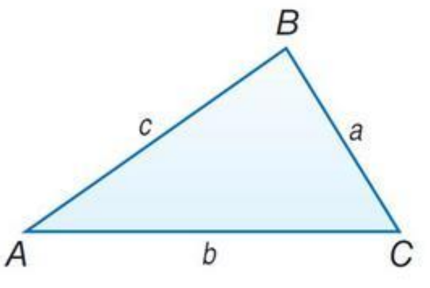


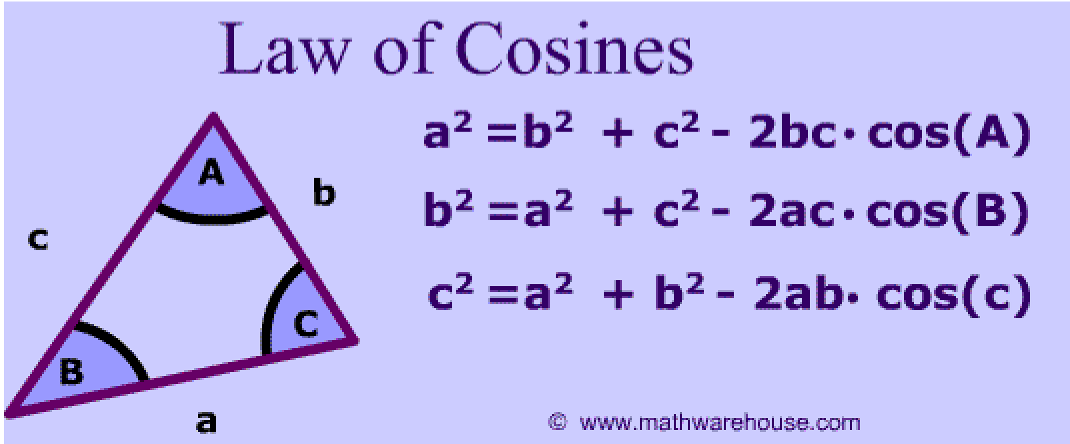
Src: https://s3-ap-southeast-1.amazonaws.com/learnhive/lcards/Types-of-Triangles-521dd275368b9.png

Triangle Laws

Law of Sines

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





Src: http://www.mathwarehouse.com/trigonometry/images/law-of-cosines/law-of-cosines-formula-and-picture2.png

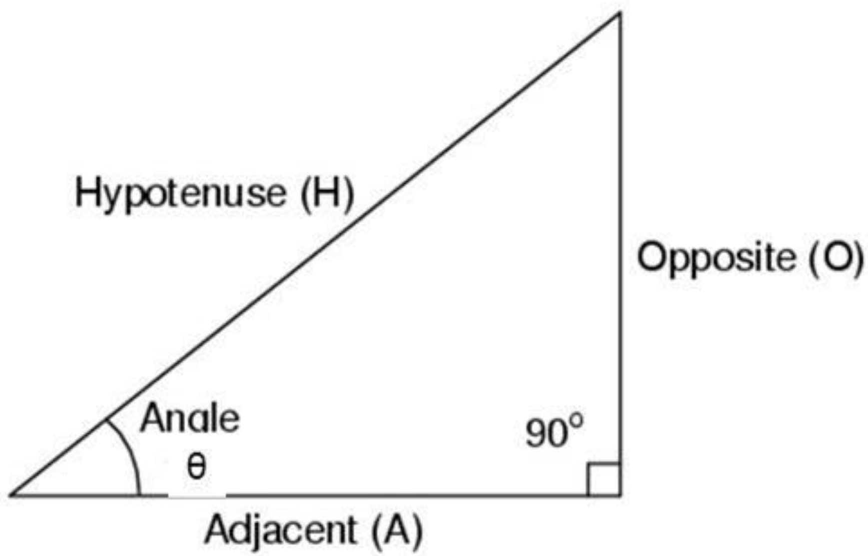
Trigonometric functions

- Sin θ = opposite/hypotenuse — Soh
- Cos θ = adjacent/hypotenuse — Cah
- Tan θ = opposite/adjacent — Toa

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

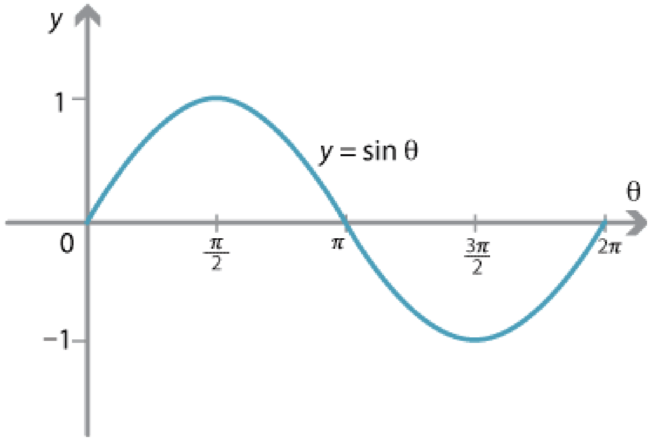
$\sin^{-1}$, $\cos^{-1}$, and $\tan^{-1}$ functions give θ

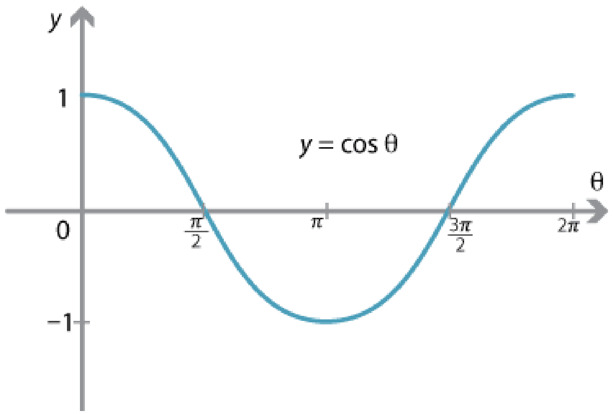
With any 2 values, you can find all sides and all angles

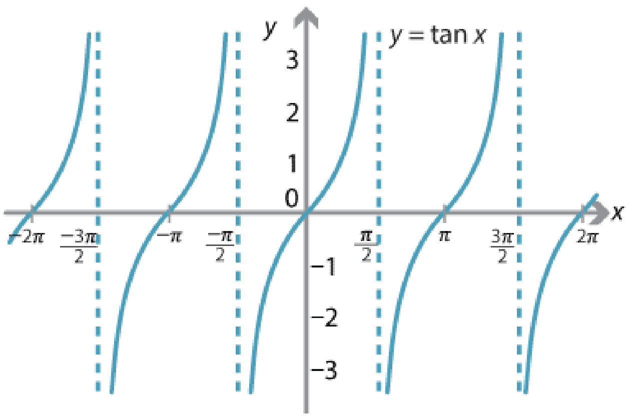


Src: http://images.slideplayer.com/30/9560908/slides/slide_12.jpg

Trigonometric functions







$$\sin\left(\frac{\pi}{2}-\theta\right)=+\cos\theta$$
$$\cos\left(\frac{\pi}{2}-\theta\right)=+\sin\theta$$
$$\tan\left(\frac{\pi}{2}-\theta\right)=+\cot\theta$$
$$\csc\left(\frac{\pi}{2}-\theta\right)=+\sec\theta$$
$$\sec\left(\frac{\pi}{2}-\theta\right)=+\csc\theta$$
$$\cot\left(\frac{\pi}{2}-\theta\right)=+\tan\theta$$

Src: http://amsi.org.au/ESA_Senior_Years/SeniorTopic2/2d/2d_2content_6.html

Trigonometric formula

$$\sin(A + B) = \sin A \cos B + \sin B \cos A$$

$$\sin(A - B) = \sin A \cos B - \sin B \cos A$$

$$\cos(A + B) = \cos A \cos B - \sin A \sin B$$

$$\cos(A - B) = \cos A \cos B + \sin A \sin B$$

$$tan(A+B) = \frac{tan\,A + tan\,B}{1 - tan\,A\,tan\,B}$$

$$\tan\ (a-b) = \frac{\tan a - \tan b}{1 + \tan a \cdot \tan b}$$

Src: http://images.slideplayer.com/2/1035617/slides/slide_1.jpg

Trigonometric functions in C++

- In cmath header .. all in **radians**
  - Revise input/output ranges...vary much

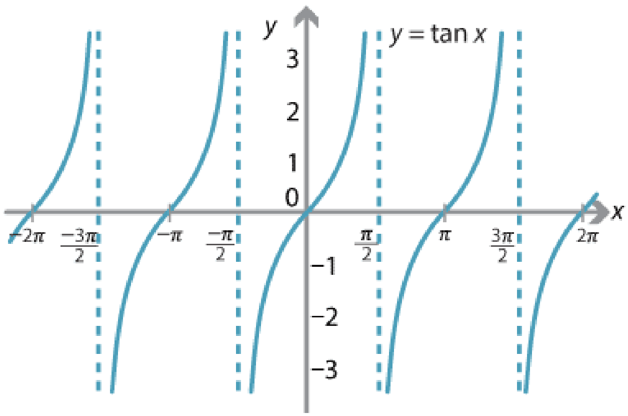
Trigonometric functions

cos	Compute cosine (function)
sin	Compute sine (function)
tan	Compute tangent (function)
acos	Compute arc cosine (function)
asin	Compute arc sine (function)
atan	Compute arc tangent (function)
atan2	Compute arc tangent with two parameters (function)

Hyperbolic functions

cosh	Compute hyperbolic cosine (function)
sinh	Compute hyperbolic sine (function)
tanh	Compute hyperbolic tangent (function)
acosh C++11	Compute area hyperbolic cosine (function)
asinh C++11	Compute area hyperbolic sine (function)
atanh C++11	Compute area hyperbolic tangent (function)

Atan vs Atan 2



Quadrant	Angle	sin	cos	tan
I	0 < α < π/2	> 0	> 0	> 0
II	π/2 < α < π	> 0	< 0	< 0
III	π < α < 3π/2	< 0	< 0	> 0
IV	3π/2 < α < 2π	< 0	> 0	< 0

Atan range is [-PI/2 , PI/2]
Tan of either angles 45 or 135 => positive values?!
How to know the quadrant! We need to use sin/cos too

atan2(y, x) do that for us and return range [-PI, PI]

Src: http://stackoverflow.com/questions/283406/what-is-the-difference-between-atan-and-atan2-in-c

Atan vs Atan 2

$$\operatorname{atan2}(y, x) = \begin{cases} \arctan(\frac{y}{x}) & x > 0 \\ \arctan(\frac{y}{x}) + \pi & y \geq 0\,,\ x < 0 \\ \arctan(\frac{y}{x}) - \pi & y < 0\,,\ x < 0 \\ \frac{\pi}{2} & y > 0\,,\ x = 0 \\ -\frac{\pi}{2} & y < 0\,,\ x = 0 \\ \text{undefined} & y = 0\,,\ x = 0 \end{cases}$$

```
(+1,+1) cartesian is (1.41421,0.785398) polar
(+1,-1) cartesian is (1.41421,2.35619) polar
(-1,-1) cartesian is (1.41421,-2.35619) polar
(-1,1) cartesian is (1.41421,-0.785398) polar
atan2(0, 0) = 0 atan2(0,-0) = 3.14159
atan2(7, 0) = 1.5708 atan2(7,-0) = 1.5708
```

Degree = Radian

----

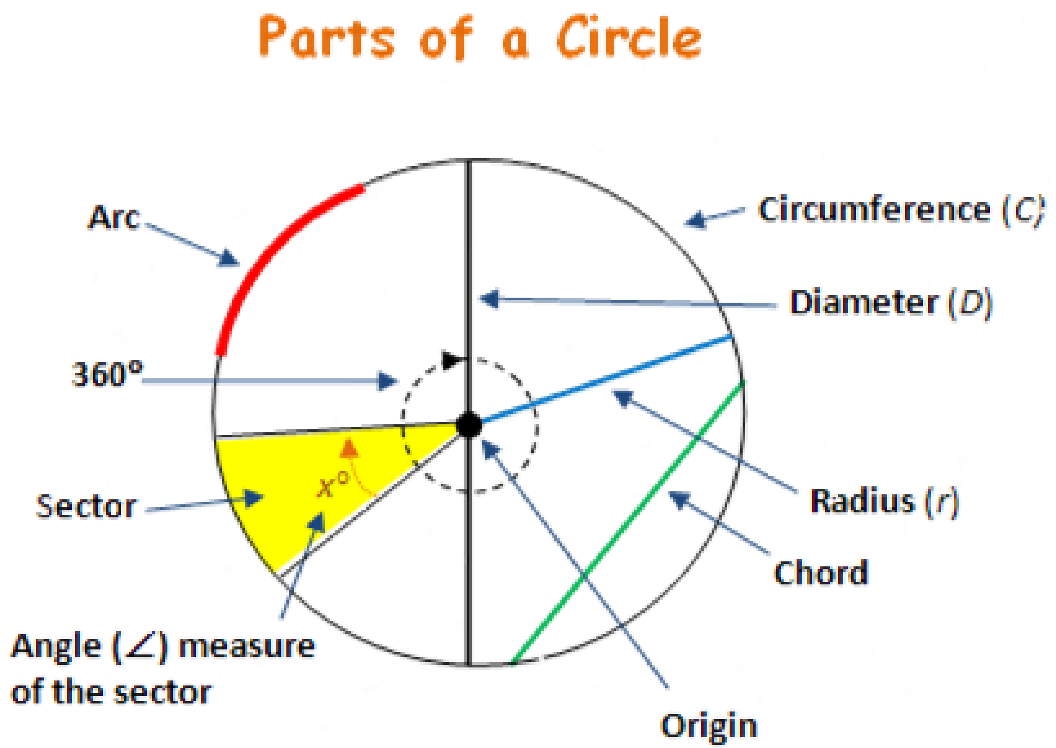
0 = 0
90 = 1.5708
180 = 3.14159
270 = 4.71239
360 = 6.28319

45 = 0.785398
135 = 2.35619
225 = 3.92699
315 = 5.49779

1.4 = sqrt(2)

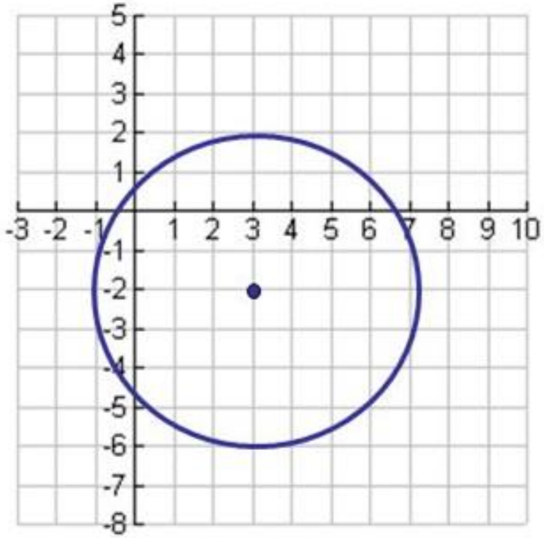
Src: http://stackoverflow.com/questions/283406/what-is-the-difference-between-atan-and-atan2-in-c

Circles



Src: http://ssepkowitz.pbworks.com/f/1241790691/SAT_Geometry_Circles1.png

Circles



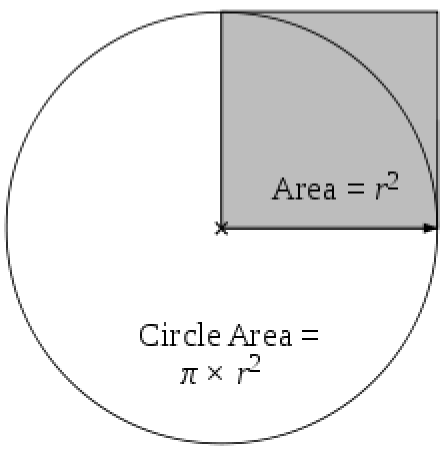
$$(x-h)^2+(y-k)^2=r^2$$

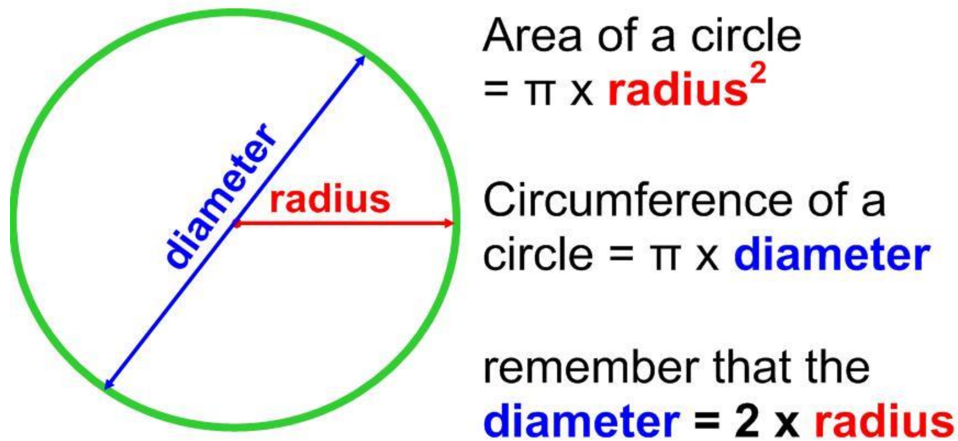
$$(x-3)^2 \; + \; (y-(-2))^2 = 4^2$$

$$\boxed{(x-3)^2 \; + \; (y+2)^2 = 16}$$

Src: http://images.slideplayer.com/18/6070989/slides/slide_4.jpg

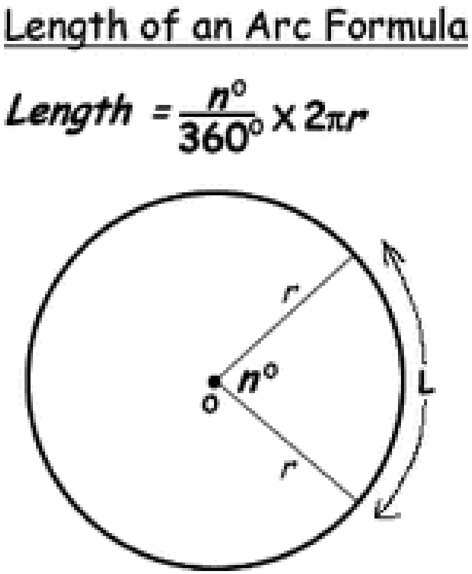
Circles

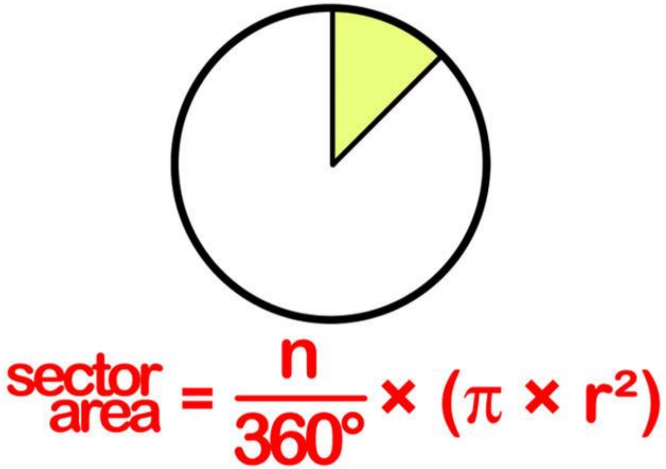


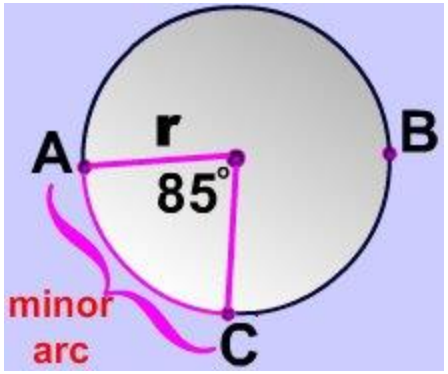


Src: http://img1.wikia.nocookie.net/__cb20140723160517/central/images/4/4d/Circle-formuasl-.jpg https://upload.wikimedia.org/wikipedia/commons/thumb/c/ce/Circle_Area.svg/220px-Circle_Area.svg.png

Circles





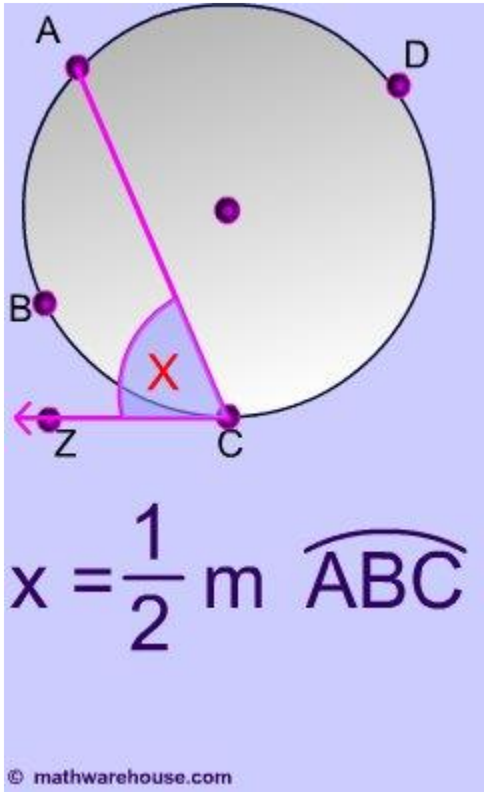


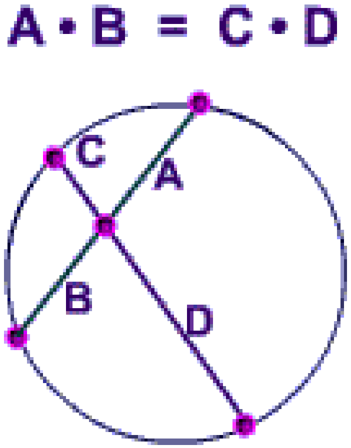
$\overset{\frown}{ABC}$ is the major arc

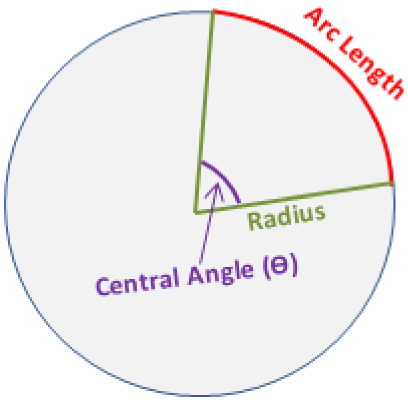
$\overset{\frown}{AC}$ is the minor arc

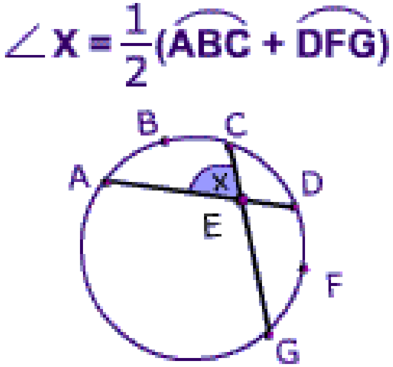
Src: http://thearclengthofacircle.weebly.com/uploads/1/2/3/3/12338358/3055696.gif?160

Circles

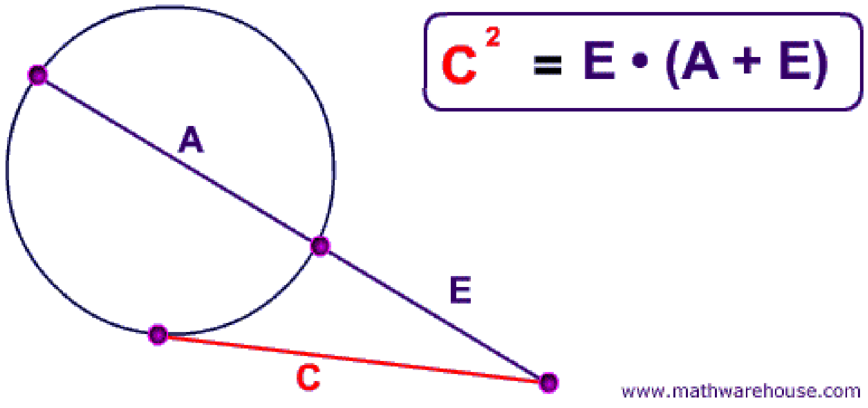

A
D
B
X
Z
C
$x = \frac{1}{2} m \overset{\frown}{ABC}$
© mathwarehouse.com

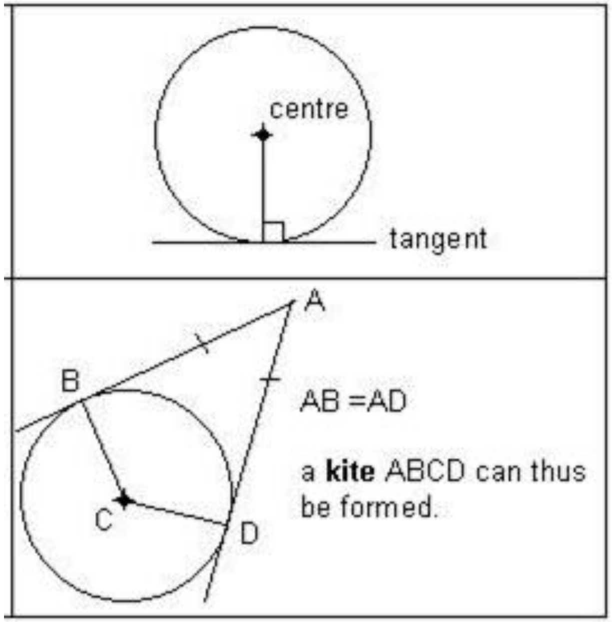

A • B = C • D
C
A
B
D

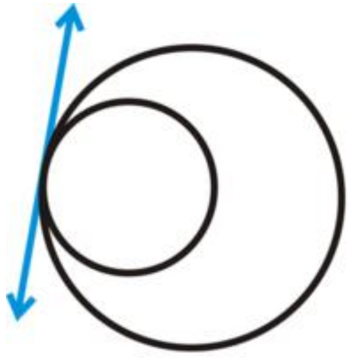

Arc Length
Radius
Central Angle (θ)

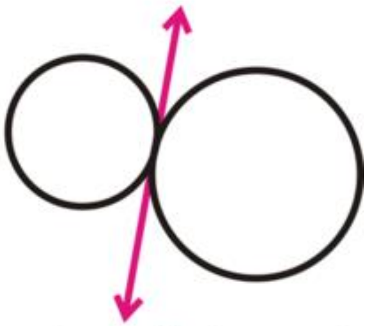

$\angle X = \frac{1}{2}(\overset{\frown}{ABC} + \overset{\frown}{DFG})$
B
C
A
X
D
E
F
G

Circles









Src: http://www.funmaths.com/math_tutorials/images/tutorial_geometry6_clip_image002.jpg http://www.mathwarehouse.com/geometry/circle/images/secant-tangent-sides/secant-tangent-side-picture.gif