Math Facts

Symbols

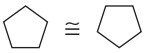
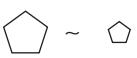
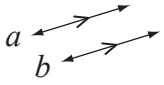
Number

$+$	plus or add
$-$	minus or subtract
$\times$, $\cdot$	multiplied by, times, lots of
$\div$	divided by, into groups of
$=$	equals, is equal to
$\neq$	is not equal to
$\approx$	is approximately equal to
$<$	is less than, $4 < 6$
$>$	is greater than, $8 > 5$
$\leq$	is less than or equal to
$\geq$	is greater than or equal to
( )	brackets, a grouping symbol
%	percent, $12\% = \frac{12}{100}$
.	decimal point as in 7.9
-3	negative 3
6^3	6 raised to the 3rd power, $6 \times 6 \times 6$
$\sqrt{9}$	square root of 9
$\frac{4}{7}$	fraction, $4 \div 7$, four sevenths
$a{:}b$ or $\frac{a}{b}$	ratio of a to b
$2.\overline{4}$ or $2.\overline{13}$	repeating decimal
$\lvert a \rvert$	absolute value of a

Algebra

$3x$	3 times x, 3 lots of x, $3 \cdot x$, $3x$
x^2	x raised to the 2nd power, $x \cdot x$
$-x$	opposite of x
$\frac{1}{x}$	reciprocal of x
(x,y)	coordinates in a cartesian plane
m	slope of a linear graph
b	y-intercept of a linear graph

Geometry

π (pi)	≈ 3.14 or $\frac{22}{7}$
$^\circ$	degree (a right angle measures 90°)
$\cong$	is congruent to, 
$\sim$	is similar to, 
$\parallel$	is parallel to
$\perp$	is perpendicular to
ΔABC	triangle with vertices A, B and C
	right angle
$\overleftrightarrow{AD}$	line AD
$\overline{BC}$	segment BC
$\overset{\frown}{AB}$	arc AB
	parallel lines (line a is parallel to line b)
	congruent segments
	equal angles
	equal side lengths

Set Notation

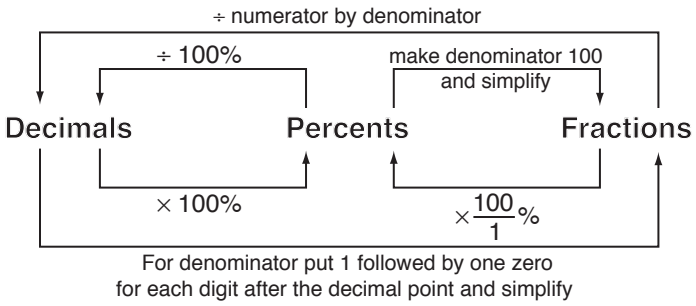
ξ	universal set
$\varnothing$	null set
$\cap$	intersection
$\cup$	union
$'$	complement of a set
$\in$	is an element of
$\notin$	is not an element of
$\subset$	is a subset of
$\not\subset$	is not a subset of

Number Facts

Place value

millions	*hundreds of thousands*	*tens of thousands*	*thousands*	*hundreds*	*tens*	*units*	*decimal point*	*tenths*	*hundredths*	*thousandths*
1,000,000	*100,000*	*10,000*	*1000*	*100*	*10*	*1*		$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$

Decimals / Percents / Fractions



Fraction	Decimal	Percent
$\frac{1}{1}$	1	100%
$\frac{1}{2}$	0.5	50%
$\frac{1}{3}$	$0.\dot{3}$	33.33%
$\frac{2}{3}$	$0.\dot{6}$	66.66%
$\frac{1}{4}$	0.25	25%
$\frac{3}{4}$	0.75	75%
$\frac{1}{5}$	0.2	20%
$\frac{2}{5}$	0.4	40%
$\frac{3}{5}$	0.6	60%
$\frac{4}{5}$	0.8	80%
$\frac{1}{8}$	0.125	12.5%
$\frac{1}{9}$	$0.\dot{1}$	11.11%

0

Subtraction $a - 0 = a$

Multiplication $a \cdot 0 = 0$ and $0 \cdot a = 0$

Division $0 \div a = 0$

1

Multiplication $a \cdot 1 = a$ and $1 \cdot a = a$

Division $a \div 1 = a$

Prime numbers < 100

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89 and 97

Perfect squares of numbers 0 to 30

0, 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 124, 169, 196, 225, 256, 289, 324, 361, 400, 441, 484, 529, 576, 625, 676, 729, 784, 841 and 900

Number Facts

Real Numbers $\mathbb{R}$

IRRATIONAL
π, φ, e, $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$,
2.6293045632....
cos 30°

$\mathbb{Q}$
RATIONAL
$-2\frac{3}{7}$, 3.010101...,
$\frac{4}{10}$, 0.56, $\sqrt{\frac{4}{9}}$

$\mathbb{Z}$
Integers
..., –3, –2, –1, 0, 1, 2, 3, ...

$\mathbb{N}$
Natural (Whole Numbers)
0, 1, 2, 3, 4, 5, 6, ...

Rational Approximations

$\sqrt{2} = 1.4142$ $\sqrt{3} = 1.7321$ $\sqrt{5} = 2.2361$ $\sqrt{6} = 2.4495$ $\sqrt{7} = 2.6458$ $\sqrt{10} = 3.1623$ $\sqrt{15} = 3.8730$

Operation terminology

Addition: sum, all together, in total, more than
Subtraction: difference, less than, change
Multiplication: product, times, lots of
Division: a fraction (half, third, quarter) of, quotient

Order of operations

1) Simplify inside all brackets first.
2) Evaluate powers and square roots.
3) Do all multiplications or divisions in order from left to right.
4) Do all additions or subtractions in order from left to right.

Sign Rules

$+ + = +$
$- - = +$
$+ - = -$
$- + = -$

Ratios and Proportions

$$a:b = \frac{a}{b}$$
$$a:b = c:d$$
$$\frac{a}{b} \times \frac{c}{d}$$
$$a \times d = b \times c$$
$$ad = bc$$

Applied number - money

$$\text{Percent} = \text{Fraction} \times \frac{100}{1}\,\%$$
$$\frac{P}{100} = P\%$$

$$\text{Commission} = \% \times \text{Selling price}$$

$$\text{Simple Interest} = \text{principal} \times \text{rate} \times \text{time}$$
$$I = prt$$

$$\text{Percent change} = \frac{\text{amount of change}}{\text{original amount}} \times \frac{100}{1}\,\%$$

Applied number - distance

Distance (d) = rate of speed (r) × time taken (t)

$$d = rt$$
$$r = \frac{d}{t}$$
$$t = \frac{d}{r}$$

Applied number - rates

$$\text{Rate } (r) = \frac{\text{amount } (a)}{\text{time } (t)}$$
$$r = \frac{a}{t}$$
$$a = rt$$
$$t = \frac{a}{r}$$

Algebra Facts

Identity Properties

Additive identity $a + 0 = 0 + a = a$

Multiplicative identity $a \cdot 1 = 1 \cdot a = a$

Associative Properties

Addition $(a + b) + c = a + (b + c)$

Multiplication $(a \cdot b) \cdot c = a \cdot (b \cdot c)$

Commutative Properties

Addition $a + b = b + a$

Multiplication $a \cdot b = b \cdot a$

Distributive Properties

$a(b + c) = ab + ac$

$a(b - c) = ab - ac$

Perfect squares rules

$(a + b)^2 = a^2 + 2ab + b^2$

$(a - b)^2 = a^2 - 2ab + b^2$

Difference of two squares rule

$(a + b)(a - b) = a^2 - b^2$

Inverse properties

Addition $a + (-a) = -a + a = 0$

Multiplication $a \cdot \frac{1}{a} = \frac{1}{a} \cdot a = 1, a \neq 0$

Exponential Properties

$a^0 = 1$ Zero exponent

$a^{-n} = \frac{1}{a^n}$ Negative exponent

$a^m \times a^n = a^{m+n}$ Product of powers

$\frac{a^m}{a^n} = a^{m-n}$ Quotient of powers

$(a^m)^n = a^{mn}$ Power to power

$(ab)^n = a^n b^n$ Product to power

$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$ Quotient to power

Operations with radicals

$\sqrt{a} \times \sqrt{b} = \sqrt{a \times b}$

$\sqrt{a} \times \sqrt{a} = \sqrt{a \times a} = a$

$\frac{\sqrt{a}}{\sqrt{b}} = \sqrt{\frac{a}{b}}$

$\frac{\sqrt{a}}{\sqrt{a}} = \sqrt{\frac{a}{a}} = 1$

Properties of Equality

Addition $a = b \Rightarrow a - c = b - c$

Subtraction $a = b \Rightarrow a + c = b + c$

Multiplication $a = b \Rightarrow a \cdot c = b \cdot c$

Division $a = b \Rightarrow \frac{a}{c} = \frac{b}{c}, c \neq 0$

Inverse operation rules

Operation +	Inverse Operation −	Operation +	Inverse Operation −	Operation ×	Inverse Operation ÷	Operation ÷	Inverse Operation ×
$x + 3 = 6$		$x - 3 = 6$		$3x = 6$		$\frac{x}{3} = 6$	
$x + 3 - 3 = 6 - 3$		$x - 3 + 3 = 6 + 3$		$\frac{3x}{3} = \frac{6}{3}$		$\frac{x}{3} \times 3 = 6 \times 3$	
$x = 3$		$x = 9$		$x = 2$		$x = 18$	

Measures - Conversions

Customary

Length

12 inches (in.) = 1 foot (ft)

3 ft =] 1 yard (yd)
36 in. =]

5280 ft =] 1 mile (mi)
1760 yd =]

Mass

16 ounces (oz) = 1 pound (lb)

2000 lb = 1 ton

Liquid Capacity

8 fluid ounces (fl oz) = 1 cup (c)

2 c = 1 pint (pt)

2 pt = 1 quart (qt)

4 qt = 1 gallon (gal)

Temperature - degrees Fahrenheit (°F)

32°F = freezing point of water

98.6°F = human body temperature

212°F = boiling point of water

Area

144 square inch ($in.^2$) = 1 square feet (ft^2)

9 ft^2 = 1square yard (yd^2)

Metric

Length

10 millimeters (mm) = 1 centimeter (cm)

100 cm =] 1 meter (m)
1000 mm =]

1000 m = 1 kilometer (km)

Mass

1000 milligrams (mg) = 1 gram (g)

1000 g = 1 kilogram (kg)

1000 kg = 1 tonne (t)

Liquid Capacity

1000 milliliters (mL) =] 1 liter (L)
1000 cm^3 =]

1000 L = 1 kiloliter (kL)

Temperature - degrees Celsius (°C)

0°C = freezing point of water

37°C = human body temperature

100°C = boiling point of water

Area

100 square mm (mm^2) = 1 square cm (cm^2)

10,000 cm^2 = 1 square meter (m^2)

1,000,000 m^2 = 1 square km (km^2)

Volume

1000 cubic mm (mm^3) = 1 cubic cm (cm^3)

1,000,000 cm^3 = 1 cubic meter (m^3)

Measures - Conversions

Time

60 seconds (s) = 1 minute (min)

60 minutes (min) = 1 hour (h)

24 hours = 1 day

7 days = 1 week

4 weeks (approx.) = 1 month

365 or 366 days =
52 weeks (approx.) = } 1 year
12 months =

10 years = 1 decade

100 years = 1 century

Conversion factors: metric ⇔ customary

Length

1 inch ≈ 2.54 centimeters

1 kilometer ≈ 0.62 miles

Mass

1 ounce ≈ 28 grams

1 kilogram ≈ 2.2 pounds

Liquid Capacity

1 liter ≈ 1.06 quarts

Conversion factors: capacity ⇔ volume

1 milliliter (mL) = 1 cubic centimeter (cm^3)

1000 liter (L) = 1 cubic meter (m^3)

Metric prefixes

giga (G) = 1 billion = 1,000,000,000

mega (M) = 1 million = 1,000,000

kilo (k) = 1 thousand = 1000

hecto (h) = 1 hundred = 100

deca (da) = 1 ten = 10

micro (μ) = 1 millionth = $\frac{1}{1{,}000{,}000}$

milli (m) = 1 thousandth = $\frac{1}{1000}$

centi (c) = 1 hundredth = $\frac{1}{100}$

deci (d) = 1 tenth = $\frac{1}{10}$

Measurement Facts

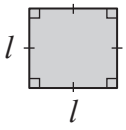
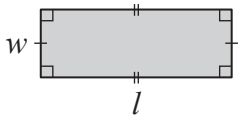
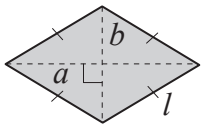
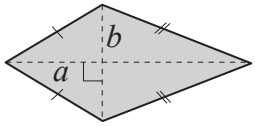
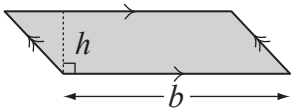
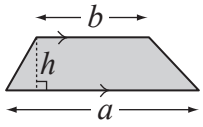
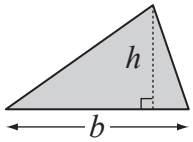
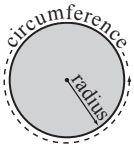
Prefixes

poly	- many	**mono**	- one
equi	- equal	**bi** or **di**	- two
hedra	- face	**tri**	- three
gon	- angle	**quad** or **tetra**	- four
lateral	- side	**penta**	- five
		hexa	- six
		hepta	- seven
		octa	- eight
		nona	- nine
		deca	- ten

Abbreviations

l	length
w	width
h	height
b	base length
P	perimeter
r	radius
C	circumference
A	area

2D shapes

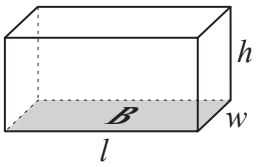
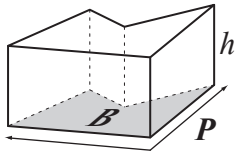
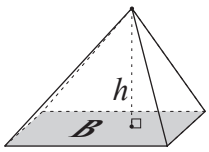
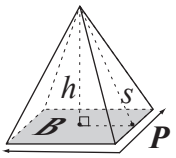
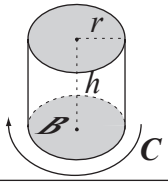
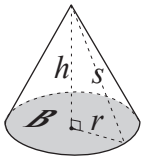
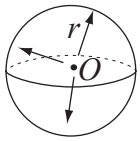
Name	Shape	Perimeter	Area
Square		$P = 4 \times l$ $= 4l$	$A = l \times l$ $= l^2$
Rectangle		$P = 2l + 2w$ $= 2(l + w)$	$A = l \times w$ $= lw$
Rhombus		$P = 4 \times l$ $= 4l$	$A = \frac{a \times b}{2}$ $= \frac{1}{2}ab$
Kite		$P =$ Sum of all sides	$A = \frac{a \times b}{2}$ $= \frac{1}{2}ab$
Parallelogram		$P =$ Sum of all sides	$A = b \times h$ $= bh$
Trapezoid		$P =$ Sum of all sides	$A = \frac{1}{2}(a + b)h$
Triangle		$P =$ Sum of all sides	$A = \frac{b \times h}{2}$ $= \frac{1}{2}bh$
Circle		$C = 2\pi r$	$A = \pi r^2$ where $\pi \approx 3.14$ or $\frac{22}{7}$

Measurement Facts

Abbreviations

l	length
w	width
h	height
b	base length
P	perimeter
r	radius
C	circumference
A	area
$L.A.$	lateral area
$S.A.$	surface area
V	volume
B	base area
P	perimeter of base
s	slant height

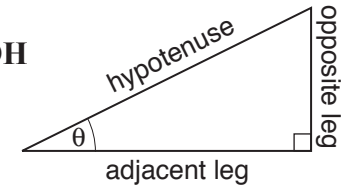
3D shapes

Name	Shape	Surface Area	Volume
Rectangular Prism		$S.A. = 2lw \times 2wh \times 2lh$ $= 2(lw \times wh \times lh)$	$V = lwh$ or $= Bh$
Prism - (All)		$S.A. = P \times h + 2B$ $= Ph + 2B$	$V = Bh$
Pyramid		$S.A.$ = Sum of areas of all faces	$V = \frac{1}{3}Bh$
Regular Pyramid		$S.A. = \frac{P \times s}{2} + B$ $= \frac{Ps}{2} + B$	$V = \frac{1}{3}Bh$
Cylinder		$L.A. = 2\pi rh$ $S.A. = 2\pi r^2 + 2\pi rh$ $= 2\pi r(r + h)$	$V = B \times h$ $= \pi r^2 h$
Cone		$L.A. = \pi rs$ $S.A. = \pi r^2 + \pi rs$ $= \pi r(r + s)$	$V = \frac{1}{3}B \times h$ $= \frac{1}{3}\pi r^2 h$
Sphere		$S.A. = 4\pi r^2$	$V = \frac{4}{3}\pi r^3$

Trigonometry Facts

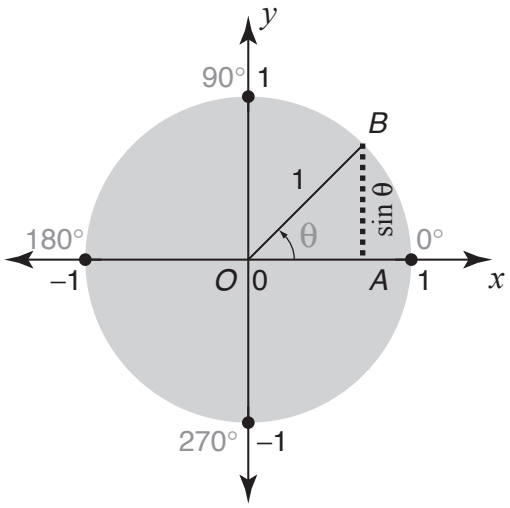
Sine

$\sin\theta = \dfrac{\text{opposite leg}}{\text{hypotenuse}}$ **SOH**



$\sin\theta = \dfrac{AB}{OB} = \dfrac{AB}{1} = AB$

angle	0°	30°	45°	60°	90°	180°
sine	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1	0

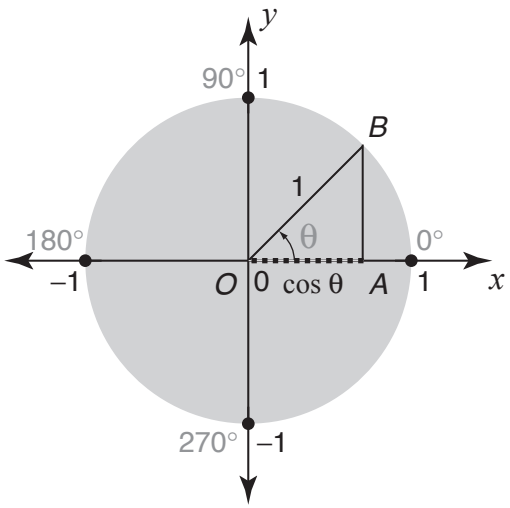


Cosine

$\cos\theta = \dfrac{\text{adjacent leg}}{\text{hypotenuse}}$ **CAH**

$\cos\theta = \dfrac{OA}{OB} = \dfrac{OA}{1} = OA$

angle	0°	30°	45°	60°	90°	180°
cosine	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0	–1

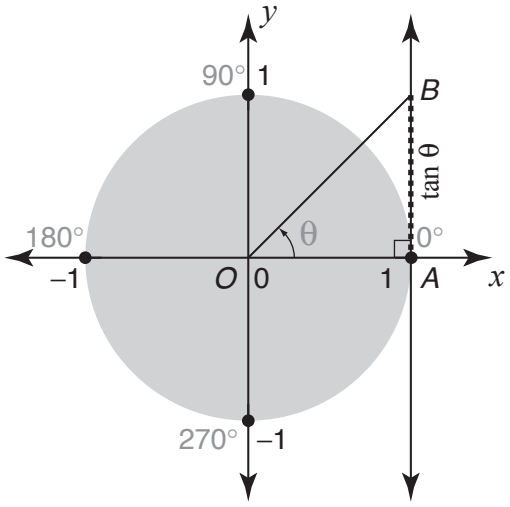


Tangent

$\tan\theta = \dfrac{\text{opposite leg}}{\text{adjacent leg}}$ **TOA**

$\tan\theta = \dfrac{AB}{OA} = \dfrac{AB}{1} = AB$

angle	0°	30°	45°	60°	90°	180°
tangent	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$		0



Trigonometry hint: SOH - CAH - TOA

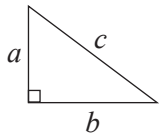
Geometry Facts

Euler's formula

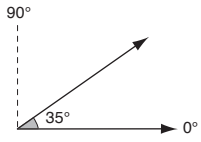
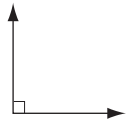
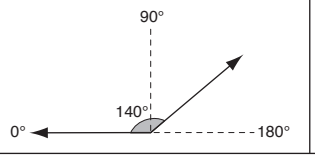
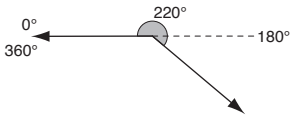
For any polyhedra: **E** = **V** + **F** − 2
Edges = Vertices + Faces − 2

Pythagorean theorem

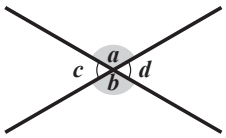
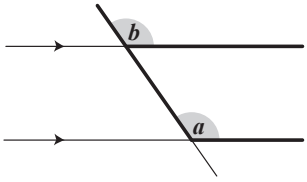
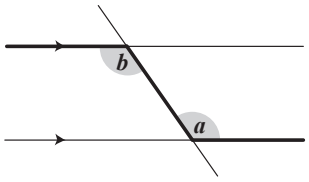
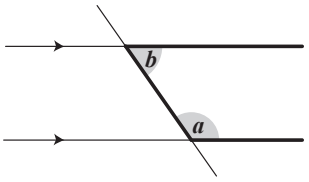
$a^2 + b^2 = c^2$



Angle types

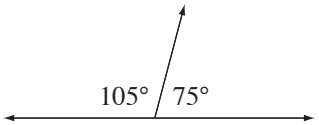
Acute	Right	Obtuse	Straight	Reflex	Revolution
< 90°	90°	more than 90° less than 180°	180°	more than 180° less than 360°	360°
					

Properties of angles

Vertical	Corresponding	Alternate Interior	Same-side Interior
			
m∠*a* = m∠*b*, m∠*c* = m∠*d*	m∠*a* = m∠*b*	m∠*a* = m∠*b*	m∠*a* + m∠*b* = 180°

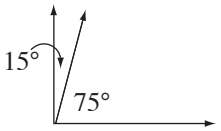
Supplementary Angles

Add to 180°



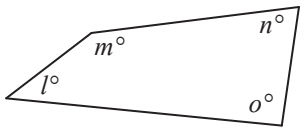
Complementary Angles

Add to 90°



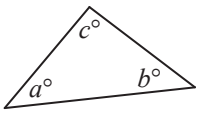
Properties of angles in a quadrilateral

The sum of interior angles of a quadrilateral is 360°.
$l° + m° + n° + o° = 360°$

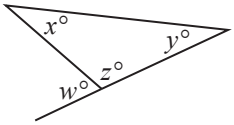


Properties of angles in a triangle

The sum of interior angles of a triangle is 180°.
$a° + b° + c° = 180°$



An exterior angle of a triangle is equal to the sum of the two opposite interior angles of the triangle.
$w° = x° + y°$

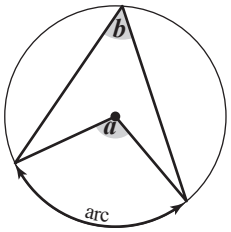


Sides and angles	Triangle type
no equal sides/angles	**scalene**
two equal sides/angles	**isosceles**
three equal sides/angles	**equilateral**
all acute angles	**acute**
one right angle	**right**
one obtuse angle	**obtuse**

Geometry Facts

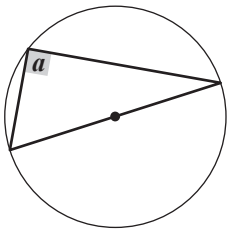
Properties of angles in a circle

Property 1
The central arc of a circle is twice the size of the inscribed angle which intercepts the same arc of the circle.



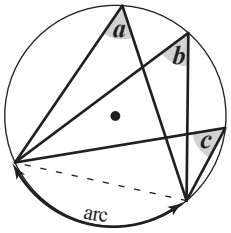
$m\angle a = 2 \times m\angle b$

Property 2
An angle inscribed in a semicircle is a right angle.



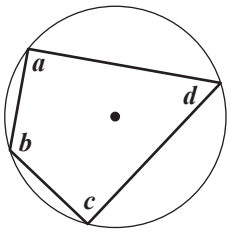
$m\angle a = 90°$

Property 3
All inscribed angles that intercept the same arc of the circle are equal.



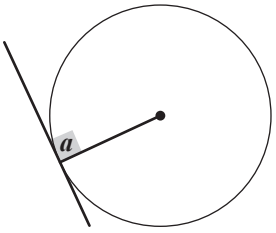
$m\angle a = m\angle b = m\angle c$

Property 4
The opposite angles in a quadrilateral inscribed in a circle add up to 180° (are supplementary).



$m\angle a + m\angle c = 180°$
$m\angle b + m\angle d = 180°$

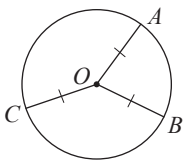
Property 5
If a line is tangent to a circle, then the line is perpendicular to the radius drawn to the point of tangency.



$m\angle a = 90°$

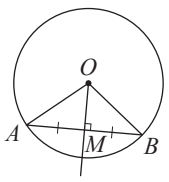
Properties of lines related to a circle

Property 1
The radii in a circle are the same length.



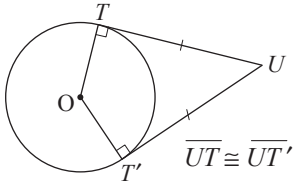
$\overline{OA} \cong \overline{OB} \cong \overline{OC}$

Property 2
In a circle, a diameter that is perpendicular to a chord bisects the chord.



$\overline{AM} \cong \overline{MB}$

Property 3
The two segments tangent to a circle from a point outside the circle are congruent.



$\overline{UT} \cong \overline{UT'}$